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ENCYCLOPÆDIA BRITANNICA

A

DICTIONARY

OF

ARTS, SCIENCES, AND GENERAL LITERATURE

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PRINCIPAL CONTENTS.

ENCYCLOPÆDIA BRITANNICA.

ANAXAGORAS

ANAXAGORAS, according to the most probable calculations, was born about the year 500 B.C. At his native town of Clazomenæ, in Asia Minor, he had, it appears, some amount of property and prospects of political influence, both of which he surrendered, from a fear that they would interfere with his search after the knowledge of nature. In early manhood he went to Athens, which was rapidly becoming the headquarters of Greek culture; and in that city he is said to have continued for thirty years. Here Pericles learnt to love and admire him; and the poet Euripides derived from him an enthusiasm for science and humanity. His influence was due partly to his astronomical and mathematical eminence, but still more to the ascetic dignity of his nature, and his superiority to ordinary weaknesses—traits which legend has embalmed. His observations of the celestial bodies led him to form new theories of the universal order, and brought him into collision with the popular faith which found the objects of its worship in the heavens. Anaxagoras had tried to reduce eclipses to the operation of known causes: he had removed the halo of deity from the sun, and profanely turned Apollo into a mass of blazing metal, larger than Peloponnesus; and he was even reported to have brought the phenomena of meteoric stones within the limits of predictable events. The dominant polytheism, and the ignorance of the multitude, could not tolerate such explanation; and the enemies of Pericles used the superstitions of their countrymen as a means of attacking the ideas of that statesman in the person of his friend. Anaxagoras was arrested on a charge of contravening the established dogmas of religion; and it required all the eloquence of Pericles to rescue him from the persecutors. Even then Athens could no longer be the sphere of his activity. He was forced to retire to Lampsacus, where he died about 428 B.C.

It is difficult to present the cosmical theory of Anaxagoras in an intelligible scheme. All things have existed in a sort of way from the beginning. But originally they existed in infinitesimally small fragments of themselves, endless in their number, inextricably mixed throughout the spaces of the world. All things were in that mass, but in the obscurity of indistinguishableness. There were the seeds or miniatures of corn, and flesh, and gold, in the primitive mixture; but these parts, of like nature with their wholes (the ὁμοιομερῆ of Aristotle), had to be eliminated from the complex mass before they could receive a definite name and character. The existing species of things having thus been transferred, with all their specialities, to the prehistoric stage, they were multiplied endlessly in number, by reducing their size through continued subdivision, at the same time that each one thing is so indissolubly connected with every other that the keenest analysis can never completely sever them. The work of arrangement, the segregation of like from unlike, and the summation of the ὁμοιομερῆ into totals of the same name, was the work of Mind or Reason. This peculiar thing, called Mind (νοῦς), was no less illimitable than the chaotic mass, but it stood pure and independent, a thing of finer texture, alike in all its manifestations, and everywhere the same. This subtle agent, possessed of all knowledge and power, is especially seen ruling in all the forms of life. Its first appearance, and the only manifestation of it which Anaxagoras describes, is Motion. Reason originated a rotatory movement in the mass (a movement far exceeding the most rapid in this present scene), which, arising in one corner or point, gradually extended till it gave distinctness and reality to the aggregates of like parts. But even after it has done its best, the original intermixture of things is not wholly overcome. No one thing in the world is ever abruptly separated, as by the blow of an axe, from the rest of things. The name given to it merely signifies that in that congeries of fragments the particular seed is preponderant. Every *a* of this present universe is only *a* by a majority, and is also in lesser number *b*, *c*, *d*.

Anaxagoras proceeded to give some account of the stages in the process from original chaos to present arrangements. The division into cold mist and warm ether first broke the spell of confusion. With increasing cold, the former gave rise to water, earth, and stones. The seeds of life which continued floating in the air were carried down with the rains, and produced vegetation. Animals, including man, sprang from the warm and moist clay. If these things be so, then the evidence of the senses must be held in slight esteem. *We* seem to see things coming into being and passing from it; but reflection tells us that decease and growth only mean a new aggregation and disruption. Thus Anaxagoras distrusted the senses, and gave the preference to the conclusions of reflection. People even said that he maintained snow to be really black; for was it not produced from the dark water?

Anaxagoras marks a turning-point in the history of philosophy. With him speculation passed from the colonies of Greece to settle at Athens. By the theory of minute constituents of things, and his emphasis on mechanical processes in the formation of order, he paved the way for the Atomic theory. By his enunciation of the order that comes from Reason, on the other hand, he suggested the theory that nature is the work of Design. But the features of this Reason he described in a vague and analogical way. Aristotle and Plato have blamed him for basing his explanations on natural, not on final causes. These charges are scarcely fair. Anaxagoras seems to have held that the order was the work of Mind; but he needed not on that account to assume what the order was, and then employ the conception to explain why things were so and so. The order is rather the general postulate which the details have to prove, instead of themselves resting upon it. The conception of Reason in the world passed from him to Aristotle, to whom it seemed the dawn of sober thought after a night of distempered dreams. From Aristotle it descended to his commentators, and under the influence of Averroes became the engrossing topic of speculation. The fragments of Anaxagoras have been collected by Schaubach (Leipsic, 1827), and Schorn (Bonn, 1829). See also Mullach, *Fragmenta Philos. Græc.* i. 243–252. (W. W.)

ANAXARCHUS, a Grecian philosopher of the Eleatic school, was born in Abdera, and flourished about 340 B.C. He was the companion of Alexander in his expedition into Asia, and seems, from anecdotes that have been preserved, to have enjoyed his intimate friendship. He checked the vainglory of Alexander, when, elated with pride, he aspired to the honours of divinity, by pointing to his wounded finger, saying, "See the blood of a mortal, not of a god." When Alexander was tortured with remorse at having slain his friend Clitus, Anaxarchus endeavoured to soothe him by saying, that "kings, like the gods, could do no wrong." It is said that Nicocreon, tyrant of Cyprus, commanded him to be pounded in a mortar, and that he endured this torture with the greatest patience; but the story is doubtful, having no earlier authority than Cicero. Regarding his philosophical doctrines we have no information. Some have inferred from the epithet εὐδαιμονικός ("The Fortunate"), usually applied to him, that he held the end of life to be Εὐδαιμονία.

ANAXILAUS of Larissa, a physician and Pythagorean philosopher, was banished from Rome by Augustus, B.C. 28, on the charge of practising the magic art. This accusation appears to have originated in his superior skill in natural philosophy, by which he produced effects that the ignorant attributed to magic. (Euseb., *Chron. ad Olymp.* clxxxviii.; St Iren. i. 13; Plin. xix. 4, xxv. 95, xxviii. 49, xxxii. 52, xxxv. 50.)

ANAXIMANDER, the second of the physical philosophers of Ionia, belonged, like his predecessor Thales, to the city of Miletus. His biography is a blank. The computations of Apollodorus have fixed the year of his birth at 611, and of his death a short while after 547 B.C. Tradition, probably correct in its general estimate, represents him as a successful student of astronomy and geography, and as one of the pioneers of exact science among the Greeks. But it is not to his delineations of the divisions of the globe, or to his dialling, or to his enlarged acquaintance with the celestial phenomena, especially of the obliquity of the ecliptic, that we can attribute the preservation of his name to the present day. That honour he owes to the broad views of the origin of things which his glimpses of natural knowledge suggested, and which he propounded in a treatise on nature or growth (φύσις). Of that work only a few words are left. The beginning or first principle (ἀρχή, a word which, it is said, he was the first to use) was an endless, unlimited mass (ἄπειρον), subject neither to old age nor decay, and perpetually yielding fresh materials for the series of beings which issued from it. It embraced everything, and directed the movement of things, by which there grew up a host of shapes and differences. Out of the vague and limitless body there sprung a central mass,—this earth of ours, cylindrical in shape, poised equidistant from surrounding orbs of fire, which had originally clung to it like the bark round a tree, until their continuity was severed, and they parted into several wheel-shaped and fire-filled bubbles of air. Man himself and the animals had come into being by like transmutations. Mankind was supposed by Anaximander to have sprung from some other species of animals, probably aquatic. But as the measureless and endless had been the prime cause of the motion into separate existences and individual forms, so also, according to the just award of destiny, these forms would at an appointed season suffer the vengeance due to their earlier act of separation, and return into the vague immensity whence they had issued. Thus the world, and all definite existences contained in it, would lose their independence and disappear. The "indeterminate" alone is perennial and godlike, all-embracing and all-guiding. The blazing orbs, which have drawn off from the cold earth and water, are the temporary gods of the world, clustering round the earth, which, to the ancient thinker, is the central figure. (See Ritter et Preller, *Historia Phil.* §§ 17–22; Mullach, *Fragmenta Phil. Græc.* i. 237–240.) (W. W.)

ANAXIMENES of Miletus may have been a younger contemporary of Anaximander, whose pupil or friend the ordinary tradition represents him to have been. To him it seemed that the air, with all its variety of contents, its universal presence, and all the vagueness which it has for the popular fancy as the apparent source of life and growth, was what maintained the universe, even as breath, which is our life and soul, sustains us. This vital air, boundless in its kind, is the source of the world's life. Everything is air at a different degree of density. Eternal movement pervades it; and under the influence of heat, which expands, and of cold, which contracts its volume, it gives rise to the several phases of existence. The process is a gradual one, and takes place in two directions, as heat or cold predominates. In this way was formed a broad disk of earth, which floats like a leaf on the circumambient air. Similar condensations produced the sun and stars; and the flaming state of these bodies is due solely to the extreme velocity of their motions. (See Ritter et Preller, *Historia Phil.* §§ 23–27; Mullach, *Fragmenta Phil. Græc.* i. 241–243). (W. W.)

ANAXIMENES, a Greek historian and rhetorician, was born at Lampsacus, in Asia Minor, in the 4th century B.C. He accompanied Alexander, whom he is said to have instructed in rhetoric, on his expedition against Persia. He wrote a history of Philip and of Alexander, and likewise twelve books on the early history of Greece, but only a very few fragments of these exist. The treatise Ῥητορικὴ πρὸς Ἀλέξανδρον, usually included among the works of Aristotle, has been ascribed by many critics to Anaximenes, on grounds that are generally admitted to be conclusive.

ANCELOT, Jacques Arsène François Polycarpe, a French dramatist and *littérateur*, was born at Havre, 9th Feb. 1794, and died 7th Sept. 1854. He completed his studies at Paris, where he made his literary début in 1819, with *Louis IX.*, a five-act tragedy, of which three editions were speedily exhausted. It had a run of fifty representations, and brought him a pension of 2000 francs from the king, Louis XVIII. His next work *The Mayor of the*

Palace, was played in 1823 with less success; but for it he received the cross of the Legion of Honour. Five years to a day after his *Louis IX.*, he produced *Fiesque*, a clever adaptation of Schiller's *Fiesco*. In 1828 appeared *Olga, or the Russian Orphan*, the plot of which had been inspired by a voyage he made to Russia in 1826, of which he also published an account in prose. About the same period he produced in succession *Mary of Brabant*, a poem in six cantos; *The Man of the World*, a novel in four volumes, afterwards dramatised with success; and in 1829 *Elizabeth of England*, which became very popular. By the revolution of July 1830 he lost at once his royal pension and his office as librarian at Meudon; and, obliged by the cares of a wife and family to resign a life of art for one of industry, he was chiefly employed during the next ten years in writing vaudevilles and light dramas and comedies, working, as he happily remarked, *pro fame* instead of *pro famâ*. A well-conceived tragedy, *Maria Padilla*, gained him admission to the French Academy, who chose him to succeed Bonald in 1841. Ancelot was sent by the French Government in 1849 to Turin, Florence, Brussels, and other capitals, to negotiate on the subject of international copyright; and the treaties on this question, which were concluded soon after, were the result, in a great measure, of his tact and intelligence.

ANCHISES (Ἀγχίσης), in *Greek Legend*, son of Capys and grandson of Assaracus, his mother being Themis, a daughter of Ilus, the founder of Ilium or Troy, to the ruling family of which, at the time of the Trojan war, he was also, on the paternal side, related, since Assaracus had been a brother of Ilus (*Iliad*, xx. 231–239). From the Assyrian character of the name Assaracus, from the intercourse between the Phœnicians and the early inhabitants of the Troad, and from the connection of Venus, the protecting goddess of the Phœnicians, with Anchises, it has been inferred that the family of the latter had originally come from somewhere near the centre of Assyrian influence. Venus met Anchises on Mount Ida, and, enamoured of his beauty, bore him Æneas (*Iliad*, ii. 820, v. 247). He was not to mention the mother of the child on pain of being killed by a thunderbolt from Jupiter. He did mention it, however, and, by one account, was slain as foretold; but according to others, was only wounded and blinded. In the more recent legend, adopted by Virgil, he was conveyed out of Troy on the shoulders of his son Æneas, whose wanderings he followed, it is differently stated, as far only as Sicily, where he was buried on Mount Eryx, or as far as Italy. On the other hand, there was a grave on Mount Ida at Troy pointed out as his. At Segesta in Sicily he had a sanctuary He was said by some to have had prophetic power. The scenes of his life represented in works of art are his being carried on the shoulders of Æneas, which frequently occurs on engraved gems of the Roman period; and his visits from Venus, which is rendered in a beautiful bronze relief, engraved in Millingen's *Unedited Monuments*, pl. 12.

ANCHOR, in *Navigation*, from the Greek ἄγκυρα, which Vossius thinks is from ὄγκη, a crook or hook, an instrument of iron or other heavy material used for holding ships in any situation in which they may be required to lie, and preventing them from drifting by the winds or tides, by the currents of rivers, or any other cause. This is done by the anchor, after it is let down from the ship by means of the cable, fixing itself into the ground, and there holding the vessel fast. The anchor is thus obviously an implement of the first importance in navigation, and one on which too much attention cannot be bestowed in its manufacture and proper construction, seeing that on it depends the safety of the vessel in storms. The invention of so necessary an instrument is to be referred, as may be supposed, to the remotest antiquity. The most ancient anchors consisted merely of large stones, baskets full of stones, sacks filled with sand, or logs of wood loaded with lead. Of this kind were the anchors of the ancient Greeks, which, according to Apollonius Rhodius and Stephen of Byzantium, were formed of stone; and Athenæus states that they were sometimes made of wood. These sorts of anchors retained the vessel merely by their inertia, and by the friction along the bottom. Iron was afterwards introduced for the construction of anchors, and also the grand improvement of forming them with teeth or flukes to fasten themselves into the bottom; whence the words ὀδόντες and *dentes* are frequently taken for anchors in the Greek and Latin poets. The invention of the teeth is ascribed by Pliny to the Tuscans; but Pausanias gives the merit to Midas, king of Phrygia. Originally there was only one fluke or tooth, whence anchors were called ἑτερόστομοι; but shortly afterwards the second was added, according to Pliny, by Eupalamus, or, according to Strabo, by Anacharsis, the Scythian philosopher. The anchors with two teeth were called ἀμφίβολοι or ἀμφίστομοι, and from ancient monuments appear to have been much the same with those used in our days, except that the stock is wanting in them all. Every ship had several anchors, the largest of which, corresponding to our sheet-anchor, was never used but in extreme danger, and was hence peculiarly termed ἱερά or *sacra*; whence the proverb *sacram anchoram solvere*, as flying to the last refuge.

Antiquity of anchors

Modern anchors

Up to the commencement of the present century what was termed the "old plan long-shanked" anchor seems to have been generally used. It was made of wrought iron, but the appliances of the anchor smith were so crude that little dependence could be placed upon it. About this time public attention was drawn to the importance of the anchor by a clerk of Plymouth yard named Pering, who published a book, and argued, from the number of broken anchors which came to the yard for repair, that there "must be something wrong in the workmanship—undue proportion or the manner of combining the parts." Mr Pering altered the sectional form, made the arms curved instead of straight, used iron of better quality, and introduced improvements in the process of manufacture. Since 1820 about 130 patents have been taken out for anchors; and the attention thus given to the subject, with the introduction of steam hammers and furnaces, the substitution of the fan blast for the old bellows, and the better knowledge obtained of the forgeman's art, have rendered the anchor of the present day so far superior to that of fifty years ago, that we rarely hear of one being broken, the ground in which it is embedded generally giving way before the anchor.

1. 2. 3.

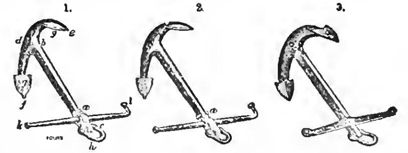


Fig. 1.—Common Anchor. Fig. 2.—Admiralty's. Fig. 3.—Rodger's

Common anchor.

Fig. 1 represents the "common" anchor. The various parts are known by the following terms:—The *shank* is the straight part, *ab*; the *square*, *ac*, is that part of the shank to which the stock and the shackle are attached; *d* is the *crown*; *de* and *df* the *arms*; *gg* the *palms* or *flukes*; the *pee* the *bill*, or the *point* is the extreme end of the arm beyond the palm; the *blade* is the part of the arm at the back of the palm; *h* is the *shackle* or *ring* to which the cable is attached, *kl* is the *stock*, placed at right angles

1.—*Chains and Anchors for Steam Vessels required by Lloyd's Register of British and Foreign Shipping* (1874).

Minimum Weights of Anchors ex. Stock; Sizes and Length of Chain Cables, and the Proof Strain to which they are to be tested; also Sizes and Length of Hawsers and Warps,—the Anchors and the Links of the Chains to be of unexceptionable form and proportions.

Numbers for Iron Vessels.[1]	Ship's Tonnage.	Anchors. Number. Bower.	Stream.	Kedge.	Anchors. Weight. Bowers.[2] Ex. Stock.	Admiralty Test.	Collective Weights.	Including Stock. Stream.	Kedge.	2d Kedge.	Stud-Chain Cables. Minimum size.	Proved to Admiralty Test.	Length.	Hawsers and Warps (90 fathoms of each). Stream. Chain.	Rope.	Hawser.	Warp.
					Cwts.	Tons.	Cwts.	Cwts.	Cwts.	Cwts.	Inch.	Tons.	Fath.	Inch.	Inch.	Inch.	Inch.
2,750	75	2	1	1	$3\frac{1}{2}$	$5\frac{18}{20}$	7	1	$\frac{1}{2}$	...	$\frac{11}{16}$	$8\frac{10}{20}$	120	$\frac{8}{16}$	$5\frac{1}{2}$	3	..
3,750	112	2	1	1	$4\frac{1}{4}$	$6\frac{12}{20}$	$8\frac{1}{2}$	$1\frac{1}{2}$	$\frac{3}{4}$	...	$\frac{12}{16}$	$10\frac{2}{20}$	120	$\frac{8}{16}$	6	4	...
4,670	150	2	1	1	5	$7\frac{7}{20}$	10	$1\frac{3}{4}$	1	...	$\frac{13}{16}$	$11\frac{13}{20}$	135	$\frac{9}{16}$	6	4	...
5,420	188	2	1	1	$5\frac{3}{4}$	8	$11\frac{1}{2}$	2	1	...	$\frac{14}{16}$	$13\frac{15}{20}$	165	$\frac{10}{16}$	$6\frac{1}{2}$	4	...
6,170	225	2	1	1	$6\frac{1}{2}$	$8\frac{15}{20}$	13	$2\frac{1}{2}$	$1\frac{1}{4}$	...	$\frac{15}{16}$	$15\frac{15}{20}$	165	$\frac{10}{16}$	7	5	...
6,840	262	2	1	1	$7\frac{1}{4}$	$9\frac{9}{20}$	$14\frac{1}{2}$	$2\frac{3}{4}$	$1\frac{1}{4}$	...	1	18	165	$\frac{11}{16}$	$7\frac{1}{2}$	$5\frac{1}{2}$	...
7,500	300	3	1	1	$8\frac{1}{4}$	$10\frac{7}{20}$	$23\frac{1}{2}$	3	$1\frac{1}{2}$	...	$1\frac{1}{16}$	$20\frac{8}{20}$	165	$\frac{11}{16}$	$7\frac{1}{2}$	6	...
8,750	375	3	1	2	10	12	$28\frac{1}{2}$	$4\frac{3}{4}$	$2\frac{1}{4}$	1	$1\frac{2}{16}$	$22\frac{15}{20}$	195	$\frac{12}{16}$	$8\frac{1}{2}$	$6\frac{1}{2}$	...
9,800	450	3	1	2	12	$13\frac{17}{20}$	$34\frac{1}{4}$	5	$2\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{3}{16}$	$25\frac{7}{20}$	195	$\frac{13}{16}$	9	7	...
10,800	525	3	1	2	$13\frac{1}{2}$	$15\frac{3}{20}$	$38\frac{1}{2}$	6	3	$1\frac{1}{2}$	$1\frac{4}{16}$	$28\frac{2}{20}$	210	$\frac{13}{16}$	$9\frac{1}{2}$	7	4
11,830	600	3	1	2	$15\frac{1}{4}$	$16\frac{14}{20}$	$43\frac{1}{2}$	$6\frac{1}{2}$	$3\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{5}{16}$	31	210	$\frac{14}{16}$	10	8	6
12,750	675	3	1	2	$16\frac{3}{4}$	18	$47\frac{3}{4}$	7	$3\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{6}{16}$	34	240	$\frac{14}{16}$	10	8	5
13,670	750	3	1	2	18	19	$51\frac{1}{4}$	8	4	2	$1\frac{7}{16}$	$37\frac{3}{20}$	240	$\frac{15}{16}$	10	9	$5\frac{1}{2}$
15,400	900	3	1	2	21	$21\frac{13}{20}$	60	9	$4\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{8}{16}$	$40\frac{10}{20}$	240	$\frac{15}{16}$	10	9	$5\frac{1}{2}$
17,000	1050	3	1	2	$23\frac{1}{4}$	$23\frac{19}{20}$	67	10	5	$2\frac{1}{2}$	$1\frac{9}{16}$	$43\frac{13}{20}$	270	1	10	$9\frac{1}{2}$	6
18,580	1200	3	1	2	$25\frac{1}{2}$	$25\frac{3}{20}$	$72\frac{3}{4}$	$10\frac{1}{2}$	$5\frac{1}{4}$	$2\frac{3}{4}$	$1\frac{10}{16}$	$47\frac{10}{20}$	270	1	10	10	6
20,160	1350	3	1	2	$27\frac{3}{4}$	$26\frac{19}{20}$	79	11	$5\frac{1}{2}$	$2\frac{3}{4}$	$1\frac{11}{16}$	$51\frac{6}{20}$	270	$1\frac{1}{16}$	11	$10\frac{1}{2}$	$6\frac{1}{2}$
21,660	1500	3	1	2	30	$28\frac{12}{20}$	$85\frac{1}{2}$	12	6	3	$1\frac{12}{16}$	$55\frac{2}{20}$	270	$1\frac{1}{16}$	11	11	7
24,580	1800	3	1	2	32	$30\frac{2}{20}$	$91\frac{1}{4}$	13	$6\frac{1}{2}$	$3\frac{1}{4}$	$1\frac{13}{16}$	$59\frac{2}{20}$	270	$1\frac{2}{16}$	11	11	7
27,500	2100	3	1	2	34	$31\frac{12}{20}$	97	$13\frac{1}{2}$	$6\frac{3}{4}$	$3\frac{1}{4}$	$1\frac{14}{16}$	$63\frac{5}{20}$	270	$1\frac{2}{16}$	11	11	$7\frac{1}{2}$
30,330	2400	3	1	2	$36\frac{1}{2}$	$33\frac{8}{20}$	104	14	7	$3\frac{1}{2}$	$1\frac{15}{16}$	$67\frac{11}{20}$	300	$1\frac{2}{16}$	12	12	8
33,100	2700	3	1	2	38	$34\frac{10}{20}$	$108\frac{1}{4}$	$14\frac{1}{2}$	$7\frac{1}{4}$	$3\frac{1}{2}$	2	72	300	$1\frac{3}{16}$	12	12	8
35,750	3000	3	1	2	40	$35\frac{16}{20}$	114	15	$7\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{1}{16}$	$76\frac{11}{20}$	300	$1\frac{3}{16}$	12	12	8
41,000	3750	4	1	2	42	$37\frac{2}{20}$	$161\frac{3}{4}$	17	$8\frac{1}{2}$	$4\frac{1}{4}$	$2\frac{2}{16}$	$81\frac{5}{20}$	300	$1\frac{4}{16}$	12	12	8
45,100	4500 to 5250	4	1	2	45	$39\frac{5}{20}$	$173\frac{1}{4}$	19	$9\frac{1}{2}$	$4\frac{3}{4}$	$2\frac{4}{16}$	$91\frac{2}{20}$	300	$1\frac{4}{16}$	12	12	9

2.—*Chains and Anchors for Sailing Vessels required by Lloyd's Register of British and Foreign Shipping* (1874).

Numbers for Iron Vessels.[1]	Ship's tonnage.	Anchors. Number. Bower.	Stream.	Kedge.	Anchors. Weight. Bowers.[2] Ex. Stock.	Admiralty Test.	Collective Weights.	Including Stock. Stream.	Kedge.	2d Kedge.	Stud-Chain Cables. Minimum size.	Proved to Admiralty Test.	Length.	Hawsers and Warps (90 fathoms of each). Stream. Chain.	Rope.	Hawser.	Warp.
					Cwts.	Tons.	Cwts.	Cwts.	Cwts.	Cwts.	Inch.	Tons.	Fath.	Inch.	Inch.	Inch.	Inch.
2600	50	2	1	1	$3\frac{1}{2}$	$5\frac{18}{20}$	7	1	$\frac{1}{2}$	...	$\frac{11}{16}$	$8\frac{10}{20}$	120	$\frac{7}{16}$	5	3	....
3200	75	2	1	1	$4\frac{1}{4}$	$6\frac{12}{20}$	$8\frac{1}{2}$	$1\frac{1}{2}$	$\frac{3}{4}$	...	$\frac{12}{16}$	$10\frac{2}{20}$	120	$\frac{8}{16}$	5	3	...
3400	100	2	1	1	5	$7\frac{7}{20}$	10	$1\frac{3}{4}$	1	...	$\frac{13}{16}$	$11\frac{13}{20}$	135	$\frac{8}{16}$	$5\frac{1}{2}$	3	...
3810	125	2	1	1	$5\frac{3}{4}$	8	$11\frac{1}{2}$	2	1	...	$\frac{14}{16}$	$13\frac{15}{20}$	165	$\frac{9}{16}$	$5\frac{1}{2}$	$3\frac{1}{2}$	...
4140	150	2	1	1	$6\frac{1}{2}$	$8\frac{15}{20}$	13	$2\frac{1}{2}$	$1\frac{1}{4}$	...	$\frac{15}{16}$	$15\frac{15}{20}$	165	$\frac{9}{16}$	6	4	...
4610	175	2	1	1	$7\frac{1}{4}$	$9\frac{9}{20}$	$14\frac{1}{2}$	$2\frac{3}{4}$	$1\frac{1}{4}$	...	1	18	165	$\frac{9}{16}$	6	4	...
6020	200	3	1	1	$8\frac{1}{4}$	$10\frac{7}{20}$	$23\frac{1}{2}$	3	$1\frac{1}{2}$	...	$1\frac{1}{16}$	$20\frac{8}{20}$	165	$\frac{10}{16}$	$6\frac{1}{2}$	4	...
6070	250	3	1	2	10	12	$28\frac{1}{2}$	$4\frac{3}{4}$	$2\frac{1}{4}$	1	$1\frac{2}{16}$	$22\frac{15}{20}$	195	$\frac{10}{16}$	7	5	...
6920	300	3	1	2	12	$13\frac{17}{20}$	$34\frac{1}{4}$	5	$2\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{3}{16}$	$25\frac{7}{20}$	195	$\frac{11}{16}$	$7\frac{1}{2}$	$5\frac{1}{2}$	...
7880	350	3	1	2	$13\frac{1}{2}$	$15\frac{3}{20}$	$38\frac{1}{2}$	6	3	$1\frac{1}{2}$	$1\frac{4}{16}$	$28\frac{2}{20}$	210	$\frac{11}{16}$	$7\frac{1}{2}$	$5\frac{1}{2}$	...
8600	400	3	1	2	$15\frac{1}{4}$	$16\frac{14}{20}$	$43\frac{1}{2}$	$6\frac{1}{2}$	$3\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{5}{16}$	31	210	$\frac{12}{16}$	8	6	...
9420	450	3	1	2	$16\frac{3}{4}$	18	$47\frac{3}{4}$	7	$3\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{6}{16}$	34	240	$\frac{12}{16}$	$8\frac{1}{2}$	$6\frac{1}{2}$	...
10,030	500	3	1	2	18	19	$51\frac{1}{4}$	8	4	2	$1\frac{7}{16}$	$37\frac{3}{20}$	240	$\frac{13}{16}$	9	7	.
11,300	600	3	1	2	21	$21\frac{13}{20}$	60	9	$4\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{8}{16}$	$40\frac{10}{20}$	240	$\frac{13}{16}$	$9\frac{1}{2}$	7	4
12,500	700	3	1	2	$23\frac{1}{4}$	$23\frac{19}{20}$	67	10	5	$2\frac{1}{2}$	$1\frac{9}{16}$	$43\frac{13}{20}$	270	$\frac{14}{16}$	10	8	
13,580	800	3	1	2	$25\frac{1}{2}$	$25\frac{3}{20}$	$72\frac{3}{4}$	$10\frac{1}{2}$	$5\frac{1}{4}$	$2\frac{3}{4}$	$1\frac{10}{16}$	$47\frac{10}{20}$	270	$\frac{14}{16}$	10	8	5
14,620	900	3	1	2	$27\frac{3}{4}$	$26\frac{19}{20}$	79	11	$5\frac{1}{2}$	$2\frac{3}{4}$	$1\frac{11}{16}$	$51\frac{6}{20}$	270	$\frac{15}{16}$	10	9	$5\frac{1}{2}$
16,600	1000	8	1	2	30	$28\frac{13}{20}$	$85\frac{1}{2}$	12	6	3	$1\frac{12}{16}$	$55\frac{2}{20}$	270	$\frac{15}{16}$	10	9	$5\frac{1}{2}$
17,500	1200	3	1	2	32	$30\frac{2}{20}$	$91\frac{1}{4}$	13	$6\frac{1}{2}$	$3\frac{1}{4}$	$1\frac{13}{16}$	$59\frac{2}{20}$	270	1	10	$9\frac{1}{2}$	6
19,320	1400	8	1	2	34	$31\frac{12}{20}$	97	$13\frac{1}{2}$	$6\frac{3}{4}$	$3\frac{1}{4}$	$1\frac{14}{16}$	$63\frac{5}{20}$	270	1	10	10	6
21,100	1600	3	1	2	$36\frac{1}{2}$	$33\frac{8}{20}$	104	14	7	$3\frac{1}{2}$	$1\frac{15}{16}$	$67\frac{11}{20}$	270	$1\frac{1}{16}$	11	$10\frac{1}{2}$	$6\frac{1}{2}$
22,720	1800	3	1	2	38	$34\frac{10}{20}$	$108\frac{1}{4}$	$14\frac{1}{2}$	$7\frac{1}{4}$	$3\frac{1}{2}$	2	72	270	$1\frac{1}{16}$	11	11	7
24,400	2000	3	1	2	40	$35\frac{16}{20}$	114	15	$7\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{1}{16}$	$76\frac{11}{20}$	270	$1\frac{2}{16}$	11	11	7
28,300	2500	3	1	2	42	$37\frac{2}{20}$	$119\frac{3}{4}$	17	$8\frac{1}{2}$	$4\frac{1}{4}$	$2\frac{2}{16}$	$81\frac{5}{20}$	300	$1\frac{2}{16}$	12	12	8
32,100	3000	3	1	2	45	$39\frac{5}{20}$	$128\frac{1}{4}$	19	$9\frac{1}{2}$	$4\frac{3}{4}$	$2\frac{4}{16}$	$91\frac{2}{20}$	300	$1\frac{2}{16}$	12	12	8

[1] The rules for the building and classification of iron ships provide that "their equipment is to be regulated by the *number* produced by the sum of the measurements of the half moulded breadth of the vessel amidships, her depth from the upper part of keel to the top of the upper deck beams, and the girth of her half midship section to the same height, multiplied by the vessel's length, for a one, two, and three decked vessel, and for a spar-decked steam vessel."

[2] Two of the bower anchors must not be less than the weight set forth above; in the third a reduction of 15 per cent. will be allowed.

3.—*Weights of Anchors and Sizes of Cables and Messengers for all classes of Screw Ships and Vessels of H.M. Navy. (The weight given for Anchors is exclusive of the Stock.)*

	Line-of-Battle Ships.					Frigates.				Corvettes.						Despatch Vessels.			Gunboats.	
	Large Armour-clads.	Above 3500 tons.	Above 2700 and under 3500 tons.	2000 to 2700 tons.	Under 2000 tons.	Above 3500 tons.	2700 to 3500 tons.	2000 to 2700 tons.	Under 2000 tons.	Above 1600 tons.	1100 to 1600 tons.	900 to 1100 tons.	700 to 960 tons.	500 to 700 tons.	Under 500 tons.	Above 800 tons.	600 to 800 tons.	Under 600 tons.	Above 250 tons.	Under 250 tons.
Anchors.																				
Bower.................cwt.	100	100	95	90	75	85	75	70	60	50	45	40	30	25	20	25	20	14	9	7
No. of do.	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	2	2	2
Stream............... cwt.	30	30	25	25	20	25	20	20	18	14	12	10	9	7	6	7	6	6	5	3
Stern .... ,,	40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Large kedge .... ,,	15	15	15	12	9	12	9	9	8	7	6	5	5	5	4	5	4	3	2	2
Small do............ ,,	9	9	8	7	5	7	5	5	4	4	4	3	3	3	2	...	...	...	...	...
Cables—Chain.																				
Bower...............inches	2 3/8	2 3/8	2 1/4	2 1/4	2 1/8	2 1/4	2 1/8	2	1 7/8	1 7/8	1 3/4	1 5/8	1 1/2	1 1/4	1 1/4	1 3/8	1 1/4	1 1/8	1	7/8
Stream.............. ,,	1 1/2	1 1/2	1 3/8	1 3/8	1 1/4	1 3/8	1 1/4	1 1/4	1 1/4	1 1/8	1 1/8	1	1	7/8	7/8	7/8	7/8	7/8	3/4	...
Stern .... ,,	1 3/4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Messenger.......... ,,	...	1 9/10	1 9/10	1 1/2	1 1/2	1 9/10	1 1/2	1 3/8	1 3/8	1 1/4	1 1/4	1 1/4	1 1/4	1	1	1	7/8	7/8	...	...
Cables—Hempen.																				
Bower .... ,,	18	19	18 1/2	18	17	17 1/2	17	16 1/2	15 1/2	14 1/2	14	13 1/2	12	...	...	...	...	...	...	...
Stream............. ,,	14 1/2	15 1/2	14 1/2	14 1/2	13 1/2	14 1/2	13 1/2	13 1/2	13	12	11	10 1/2	...	...	...	...	...	...	...	...

Weight of Anchors supplied to Boats.—42 ft. Launch, 120 lb; 32 ft. Pinnace, 56 lb; 30 ft. Cutter, 40 lb; Jollyboats or Gigs, 30 lb.

to the plane of the arms and shank. The use of the stock is to "cant" the anchor. If it falls with the arms on the ground, the other end resting on the end of the stock, the pull of the cable will turn it over, so that the stock will lie upon the ground, and the weight of the crown and arms then resting upon the sharp point, will cause it to enter the soil and take fast hold.

The stock is made of iron in anchors of 60 cwt. and under, and of wood for anchors above that weight. A wooden stock (fig. 8) is made of English oak in two pieces; they are scored over the square so as to leave a space of about 2 in. clear between them at the shank and to touch at the extremities. It is made parallel for about 1/8th of its length at the centre, tapering from thence to the extremities, the side next the shackle being kept straight and the remaining three sides tapered. The section at any part is square, the dimensions being 1/10th of the length at the centre and half of this at the ends. The two pieces are fastened together by four iron bolts near the shank, six or eight treenails, and six iron hoops at the ends. The hoops are driven on tightly while hot, so that the contraction of the iron in cooling may draw the parts closely together. A projection, termed a *nut*, shown by the dotted lines at *a*, *a*, in fig. 8, is left on the square to prevent any lateral motion of the stock. An iron stock is made in one forging, so as to pass through a hole *a*, punched in the square. The stock has a shoulder *b*, which fits against the side of the shank when it is in the position for action as in fig. 1, and it is secured by a key driven tightly on the other side of the shank. The advantage of this is, that the stock can be unshipped and laid along the shank for convenience of stowing, as shown in fig. 4.

Fig. 4.—Iron stock unshipped for stowing.

The weight of the stock, whether of wood or iron, is about 1/4th that of the anchor.

The shank and each arm are forged under the steam-hammer in three pieces, and are then welded together at *m* and *n*, fig. 8. The welding is done by the "Hercules," which is a heavy iron ram placed over an anvil, so that it can be raised by steam power to a height of some 9 or 10 feet, and then let fall, being guided in its descent by three men, who hold rods attached to it. It is needless to say that the welding must be carefully done, as the whole strength of the anchor depends upon it.

Testing.

To ensure safety, every anchor should be tested at a public testing-house to 1/3d of its breaking strain. The anchor is held by a chain attached to the shackle, and the strain is applied to each arm separately at 1/3d of its length from the point. The proof of the anchor is that it must show no sign of fracture, and that if any deflection is caused by the strain, it must return very nearly to its original shape. A good anchor, after being deflected half an inch, will return to its former shape, leaving no permanent set.

Size of anchors.

The size of anchors for various ships has been determined by practice, but is based upon the theory that as the anchor is required to withstand the force brought upon the ship by the wind and tide, which would otherwise cause her to drift, its strength must be nearly proportional to her resistance. A result which will accord with sound practice may be obtained by calculating the resistance of a given ship at a speed of twelve knots, and taking this for the working load of the anchor. The working load should be half the testing strain, and consequently 1/6th of the breaking strength.

A large ironclad carries 8 anchors,—2 bower, 2 sheet, 1 stream, 1 stern, and 2 kedge. The bower anchors (fig. 7) are stowed at the bow, and are for ordinary use in a roadstead; if there is any difference in weight, the heavier is stowed on the starboard side, and is termed the best bower. The sheet anchors (fig. 8) are stowed as far forward as is convenient in the waist of the ship, and are sometimes called the waist anchors; they are only used in cases of emergency, or in the event of any accident befalling the bowers. The stream anchor is for use in a river or sheltered place, where a small anchor is sufficient to hold the ship. The stern anchor is used when it is required to moor at both head and stern, as is the case when there is not room for the ship to swing with the tide. The kedge anchors are generally of different sizes, one large and one small; they are used to warp the ship along a narrow channel, the kedge being carried out in a boat with the hempen cable attached to it, and dropped; the ship can then be hauled to the anchor. Kedge anchors are still supplied in the Royal Navy, but are very rarely used, the service for which they are intended being generally performed by the aid of a steam-tug vessel.

The tables on pp. 4 and 5 give the sizes and number of anchors and cables carried by ships of the Royal Navy, and those required by Lloyd's rules to be carried in merchant ships. The sheet and bower anchors are of the same size, and are given in the tables under the heading "Bower."

Committee of 1852. Public attention having been directed to the subject of anchors by the specimens which were exhibited at the Exhibition of 1851, a committee was appointed by the Admiralty in the succeeding year to consider and report upon the qualifications of the various kinds. The committee determined the qualities it was desirable for an anchor to possess, and assigned numerical values to each. The following tables give the result of their labours, showing the number of marks obtained by each anchor under trial :—

Table showing the relative order in which the several Anchors stand with regard to each of the properties essential to a good Anchor—the names arranged alphabetically.

ANCHORS	Strength computed from first crack.	Holding long and short scope.	Facility of stowing.	Quick holding.	Quick tripping.	Exemption from fouling.	Facility of sweeping.	Facility of transport in boats.	Fishing in a heavy seaway.	Canting.
Admiralty, ...	4	5	1	2	1	4	1	2	2	2
Aylen's, ...	7	4	1	2	3	4	1	2	2	5
Honiball's (or Porter's),	2	2	3	4	2	1	4	3	5	3
Isaac's, ...	1	6	4	5	1	1	4	4	5	1
Lenox's, ...	6	3	2	1	2	3	2	1	3	2
Mitcheson's, . . .	Refused this trial.	1	3	1	3	2	3	2	4	4
Rodger's, ...	5	2	1	1	2	4	2	1	1	2
Trotman's, ...	3	1	3	3	4	1	4	3	5	5

Table showing the estimated numerical values of the several Anchors in regard to the properties considered essential to a good Anchor.

ANCHORS.	Strength computed from the first crack.	Holding long and short scope.	Facility of stowing.	Quick holding.	Quick tripping.	Exemption from fouling.	Facility of sweeping.	Facility of transport in boats.	Fishing in a heavy seaway with present fish-hook.	Canting.	Total values.
Proportionate values of the qualities, .	15	80	10	15	5	10	5	5	10	5	160
Admiralty, .	2·07	6·42	1·82	2·01	·89	·65	·95	·65	1·98	·73	18·17
Aylen's, . . .	1·89	9·10	1·82	2·01	·45	·65	·95	·65	1·98	·44	19·94
Honiball's (Porter's),	2·33	10·69	·91	1·58	·67	1·85	·29	·52	·55	·60	19·94
Isaac's, . . .	2·63	5·	45	·59	·89	1·85	·29	·26	·55	·81	13·32
Lenox's, . . .	1·92	9·56	1·36	2·86	·67	1·11	·71	·87	1·32	·73	20·61
Mitcheson's, .	Refused this trial.	14·10	·91	2·36	·45	1·39	·57	·65	·88	·52	21·83
Rodger's, . .	1·94	10·69	1·82	2·36	·67	·64	·95	·87	2·19	·73	22·86
Trotman's, . .	2·22	14·44	·91	1·77	·31	1·85	·29	·52	·55	·44	23·30
Totals, . .	15·00	80·00	10·00	14·99	5·00	9·99	5·00	4·99	10·00	5·00	159·97

Note.—This Table only professes to show approximate values, and has no pretensions to mathematical accuracy or precision.

The following is a recapitulation of the order in which the anchors were ranked by the committee, together with their relative percentage of inferiority or superiority to the Admiralty anchor the value of which, as given in the foregoing table (18·17), was taken as the standard or unit :—

Trotman's, . . .	1·28,	or 28 per cent. superior to Admiralty.			
Rodger's, . . .	1·26,	or 26	do.	do.	do.
Mitcheson's, . . .	1·20,	or 20	do.	do.	do.
Lenox's, ...	1·13,	or 13	do.	do.	do.
Honiball's, . . .	1·09,	or 9	do.	do.	do.
Aylen's, ...	1·09,	or 9	do.	do.	do.
Admiralty, . . .	1·	the standard.			
Isaac's, ...	·73,	or 27 per cent. inferior to Admiralty.			

The decisions of the committee have been much questioned, one of the objections being that the qualities of strength and holding on, neither of which is of any use without the other, were assigned such different values as 15 and 80; it has also been stated that the Admiralty anchor was treated unfairly, as one was taken promiscuously out of store for the trial, whereas the other competing anchors were made specially for it.

The Admiralty anchor (fig. 2) differs only from the ordinary anchor in having a *nut*, *a*, worked on the square, so that a wooden stock may be fitted temporarily if the iron stock is damaged, and that its proportions and form have been carefully considered and definitely fixed. Lenox's and Aylen's were modifications of the Admiralty anchor. Mitcheson's was of a difficult section to forge, and consequently expensive, and was withdrawn from the test of strength. Isaac's was of a peculiar construction, and may be passed over as more curious than useful.

Rodger's anchor, placed second on the list, was one of Captain Rodger's, R.N., who for the last forty years has devoted considerable pains to the improvement of anchors. Among his earlier inventions is an anchor with a *hollow shank*, to obtain greater strength with a given weight of iron; then an anchor without a palm, which he termed a "*pickaxe anchor;*" afterwards a "*small-palmed*" anchor; and by a patent taken in 1863, an "*indented small palmed anchor*" (figs. 3 and 7). The stock is of iron in large as well as small anchors, and is made with a mortice, to fit over the shank instead of passing through it. It is somewhat heavier than the stocks of other anchors; the arms are shorter than usual in proportion to the length of the shank, and are of a wedge shape, varying in sharpness from the throat to the head of the palms; the back part of the arms is parallel from palm to palm; the palm is double concave on the front, and has a small border at the edge for confining the soil through which it is dragged; it also has a large indentation on the back for the same purpose and to save weight; the shank is rectangular at its junction with the arms, and square close to the collar for the stock; the crown is made longer than usual, and has a large countersunk hole in its centre to save weight. It is claimed for this anchor that the peculiar form of the palms and arms, with the hole in the crown, give it great holding power, and that it will bury itself in the soil until the upper palm is beneath the surface, and consequently is not liable to be fouled by the cable. Rodger's anchor.

Trotman's anchor (fig. 5), which obtained the highest place in the committee's estimation, was an improved Honiball's (Porter's). The stock is of iron, similar to the Admiralty anchor; the shank is of rectangular section, somewhat larger at the centre than at the ends, and is made fork-shaped at one end to receive the arms; the arms are in one piece, and are connected to the shank by a bolt passing through their centre. The peculiarity of the anchor is that the arms pivot about this bolt, so that when it takes hold the upper fluke is brought in contact with the shank, thus reducing the height above ground, and rendering it almost impossible for the cable to get entangled round it, or, in other words, for the anchor to become foul. Trotman's anchor.

FIG. 5.—Trotman's.

Of the anchors tested by the committee, Trotman's

Rodger's, and the Admiralty find the most favour at the present time. Trotman's and the Admiralty have undergone no alteration, but Captain Rodgers has taken out two patents for improvements in his anchor since the committee reported.

Martin's anchor.

We now come to an anchor of entirely different shape from the preceding, patented by a Frenchman named Martin. The anchor is represented in fig. 6 in the position in which it lies on the ground just before taking hold. The shank is made in one forging, is of rectangular section, having a shoulder for the stock to fit against, and is increased both in thickness and area at the crown; the arms with the palms are forged in one piece, and then bent to the required shape; one of the arms is passed through a hole in the crown and is kept in position by a bolt screwed through the end of the crown, so that its point reaches a little way into an indent made for it in the round part at the back of the arms. Until very recently this securing bolt was placed in the shank in a vertical position (supposing the anchor to be lying with the palms horizontal), so as to cut into the hollow part at the front of the bent arm. A very strong shoulder is worked on the arms, so as to fit in a groove on one side of the shank, in such a manner that the arms will revolve through an angle of 30° either way. The stock is fitted over the shank as shown, and secured by a key, which fixes it tightly against the shoulder left on the shank. The advantages of Martin's anchor are as follows:—It is *self-canting;* it must fall in the position shown in the figure, and the weight of the arms, together with the pull of the cable, presses their sharp points into the soil, so that it takes hold immediately; it is impossible to foul it; it stows much more neatly than any other anchor; its holding power is very great, as both arms are in the soil at the same time, and the stock, which is flat and broad, adds materially to this quality; the strength is also very great. At an experiment made at Portsmouth dockyard in March 1867, two of the anchors were subjected to a strain of 50 per cent. over the Admiralty proof; the arms were deflected but three-tenths of an inch by this great strain, and when it was removed they regained their former shape. The anchor is made in three separate forgings without a weld. Unmasted turret ships, which have an all-round fire, are, almost without exception, fitted with Martin's anchor on account of the neatness with which it can be stowed, as the stock of any other anchor, if not unshipped, would obstruct the fire of the guns. The Admiralty allow a reduction of 25 per cent. in weight for Martin's anchor, using an 80 cwt. Martin where a 90 cwt. Admiralty or Rodger's anchor, weighing with its stock from 108 to 112 cwt., would be fitted, the weight given for Martin's anchor including the stock.

FIG. 6.—Martin's.

Stockless anchor.

Smith's patent stockless anchor has been highly spoken of. It is a modification of Martin's anchor, but without the stock.

Stowing bower anchor.

A bower anchor is stowed in H.M. service as shown in fig. 7. A, is the *cathead;* B, the *fish davit;* C, and E, *bollards;* D, the *bill-board.* The anchor is held in place by two chains, *a* and *b*, termed the *cat-stopper* and *shank painter* respectively, each of which is fitted with a long link at one end. A bolt *b*, about 5 or 6 inches long, is fixed on the side of the cathead, on a hinge at its lower end; it is held in the upright position by another bolt *c*, which passes through the cathead, and is worked by a lever *d; d* is provided with a hole at the end for a lanyard, so that two or three men can pull it. This whole arrangement is termed a *slip-stopper.* A somewhat similar combination of bolts and levers is fitted close to the bill-board D, *e* being a short bolt secured at its lower end with a hinge to the ship's side; and *f* a hooked lever which holds it in its upright position; *f* has a socket at its inboard end, to which a shifting arm, provided with a lanyard like the lever *d*, is fitted. The cat-stopper is rove through the shackle of the anchor, and the long link placed over the bolt *b;* it is then passed over a cleat *g*, on the side of the cathead, and belayed at the bollards C. The end of the shank painter is passed under the crown and over the shank; its long link is placed over the bolt *e*, and it is belayed at the bollards E. When it is desired to let go the anchor, the arm is shipped at *f*, and the lanyards at *f* and *d* are manned; then, at the word of command (given, if the ship is rolling, when she lurches towards the side on which the anchor is stowed), the men pull the lanyards, and *b* and *e* are released simultaneously, the links of the cat-stopper and shank painter drop off, and the anchor falls clear of the ship. In merchant ships it is not usual to fit the second slip-stopper, *b* and *e;* in this case it is necessary, before letting go, to "cock-bill" the anchor,—that is, to ease away the shank painter, so that the anchor hangs by the cathead alone. The next thing is to "weigh" the anchor. It is hove up by the capstan, and when it appears at the bows, the operations of "catting" and "fishing" have to be performed. A chain called the "cat pendant" is rove over the sheave *h* in the cathead, and shackled to a short piece of a similar chain attached to the anchor at one end, and stoppered to the cable at the other; the inboard end of the cat pendant is taken to a leading block on the opposite side of the ship, and a purchase tackle attached to it, so as to give the men a run right aft. When all is ready, the word is given, and the men run away with the purchase until the anchor hangs from the cathead instead of the hawse-pipe; it is then said to be "catted." A chain rove through the block at the head of the fish davit, and having a large hook at the end, is then hooked to the inner arm of the anchor, which is then raised and swung inboard (the fish davit being made to revolve), so that the fluke rests upon the bill-board D, and the anchor is "fished." The cat-stopper and shank painter are then rove, and all made ready to let go again at a moment's notice.

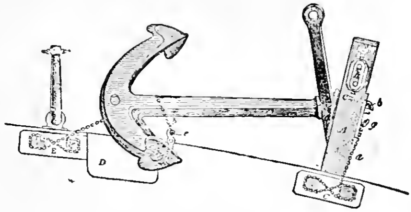


FIG. 7.—Bower Anchor, and manner of stowing.

The cathead shown in the figure is made of plates and angle irons, and is similar in shape to the old wooden catheads; it is fitted with a single sheave *h*, made to swivel so as to give a fair lead for the chain when the anchor is at the hawse-pipe. Catheads are frequently made of solid forgings, with a block hanging from the head for the cat pendant or fall. In ships designed for ramming, the cathead is made to revolve like the fish davit B, so that it can be turned inboard, and there will be no projection on the bow to foul the enemy's rigging.

Stowing sheet anchor.

Fig. 8 shows a sheet anchor as stowed in a man-of-war. The anchor rests upon stout iron rods, *a*, *a*, called tumblers; they are connected to the ship's side at the lower ends, so that they will fall outwards. *b*, *b*, are short bolts to keep the anchor in its proper position, with the tumblers slightly inclining outboard. Both *a*, *a*, and *b*, *b*, are fitted to the shank of the anchor, and so arranged that rope lashings

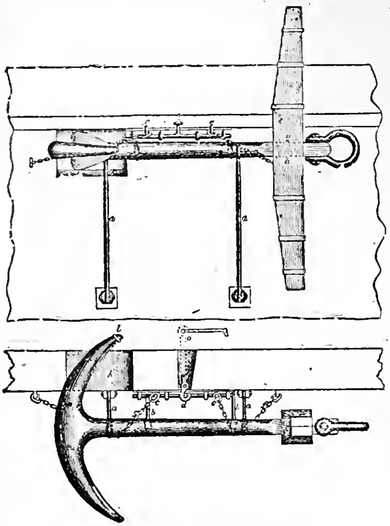


Fig. 8.—Stowing a Sheet Anchor.

passing round the shank can be secured to them. A strong bolt, fitted with three lugs, *c*, *d*, and *e*, is secured to the ship's side by eye-bolts, which allow it to revolve. Chains, *f* and *g*, fastened to the ship's side at one end, are passed round the shank of the anchor, and held by the lugs *c* and *e* at the other. A slip-stopper, *h*, clasps the lug *d*, and keeps the bolt in the position shown; the inner fluke of the anchor rests on the *bill-board k*, the point is held down by a securing chain fitted with a slip at *l*, and the upper end of the stock is secured in a similar way. When it is desired to "let go," the rope lashings on *a*, *a*, and *b*, *b*, are cut, the slips at the point and stock are knocked away, and then the stopper *h* is the only thing which holds the anchor. A shifting lever, shown by dotted lines, is fitted to a socket in *h*; when a strain is brought upon this, the lug *d* is released from the grip of the stopper *h*, and the anchor let go, the tumblers, *a*, *a*, throwing it clear of the ship.

It should be observed that whenever a slip-stopper is fitted, care must be taken, by placing a pin at the back of it, or otherwise, to prevent the anchor being let go by accident.

Stern and stream anchors are stowed at the stern of the ship in the way described for sheet anchors.

The kedge anchors are generally stowed in the main-chains.

Sheet, stream, and stern anchors being very rarely used, have to be re-stowed by the aid of the yard-arm, without any special appliances being fitted.

Mooring anchors.

Mooring anchors are those which are placed in harbours, &c., for the convenience of vessels frequenting them. A large *buoy* is attached to the end of the mooring cable, and the ship is made fast to a ring-bolt fitted on the buoy. Mooring anchors are not limited by considerations of weight, &c., as other anchors are, the only requirements being that they have sufficient holding power, and do not project above the ground, as any projection in the shallow waters in which they are usually placed would render ships liable to injury from grounding on them, and be dangerous to fishing-nets, &c. Mooring anchors may therefore be of stone, as shown in fig. 9; or of cast-iron, as in fig. 10. Mushroom anchors (fig. 11), first proposed for ships, are now only used for moorings. An old anchor which has one arm damaged is frequently used as a mooring anchor, the damaged arm being bent down close to the shank; the anchor is sunk with the bent arm uppermost, and there is no projection above the ground. In harbours where there is not much room it is usual to place two anchors, connected by a cable, in a line at right angles to the direction of the tide; a swivel is fitted at the centre of this cable, and the *buoy* chain is made fast to the swivel. With this arrangement the ship does not sweep such a large circle in swinging.

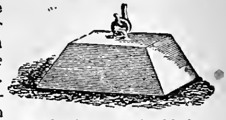


Fig. 9.—Buoy Mooring Block.

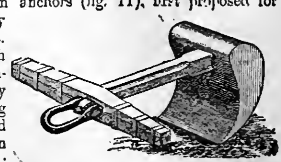


Fig. 10.—Cast-iron Mooring Anchor.

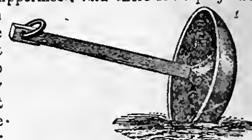


Fig. 11.—Mushroom Anchor.

The best mooring anchor which has yet been devised is shown in fig. 12. Its shank is a round bar of wrought iron, *a*, about 7 feet in length and 6 inches in diameter; it is increased at *b* to 9 inches diameter for about 1 foot of its length, and terminated at *f* similarly to the point of a gimlet; holes are made in the stout part *b*, and a screw flange of $3\frac{1}{2}$ feet diameter is cast around it; the molten metal gets into the holes and makes a good connection with the wrought-iron shank. A swivel *c*, to which a large shackle *d*, is attached, is fitted on as shown, and secured by a strong nut; the end of the shank *e* is made square. To place this anchor in about 8 fathoms of water, four iron bars, each about 17 feet in length, and provided with a socket at one end and a square head at the other, are used. As the anchor is lowered the socket of the first bar is fitted on at *e*, and the socket of the second bar in its turn fitted to the square end of the first, and so on till the anchor reaches the bottom. A drumhead, similar to a capstan, is then fitted on the last bar, and capstan bars shipped in it; by these means the anchor is turned round, and so screwed into the ground. It must be sunk through the soft mud or sand into the harder soil beneath it, and when this is done the holding power of the anchor is enormous. An anchor of the dimensions given weighs about 14 cwt., and will hold far more than a cast-iron mooring anchor of 7 tons. The only objections to it seem to be the difficulty of removing it if the moorings are required to be taken up, and that special appliances are required for putting it down.

Fig. 12.—Mooring Anchor.

Anchorage

A good anchorage is where there are from 10 to 20 fathoms of water, and the ground is not rocky or loose sand. Where there are more than about 20 fathoms the cable bears too nearly perpendicular, and is liable to trip the anchor. For anchoring in ordinary weather the length of cable veered out is about three times the depth of water. (T. M.)

ANCHOVY (*Engraulis*, Cuv.), a family of small fishes akin to the shad and the sprat, all three being of the *Clupeidæ*, or Herring tribe. There are six or seven species of anchovy found in the seas of Europe, of tropical America, and of India. Of these the most important and the largest is the common anchovy, *Engraulis encrasicholus*, so called from the bitter taste of its head, and the ancient belief that its bile was in that part. From the days of the Greeks and Romans it has been esteemed for its delicate and unique flavour; anchovy sauce is referred to under the name *garum* in *Horace*, Sat. ii. 8, 46. The common anchovy is from five to seven inches long, and resembles the sprat and sardine. Its distinguishing peculiarities are a short anal fin, the dorsal fin right over the ventral, a long sharp head with projecting upper jaw and mouth cleft behind the eyes, the colour rich bluish green on the back and silvery white on the belly, and large loose silvery scales. Anchovies are abundant on the coasts of Britain, but the markets are supplied chiefly from the Mediterranean fisheries, the best qualities coming from Gorgona, a small island near Leghorn. They leave the Atlantic depths, and come in shoals to the coasts of Spain, Portugal, France, and Italy, to deposit their spawn during the months of May, June, and July. Like herring they are caught with nets at night, being allured round the fishing-boats by fires kept burning at the stern. They are "headed," "gutted," pick'ed, and packed for exportation in barrels of five to twenty pounds, being repacked when brought to this country, and bottled up for use. Some relish them raw from the brine in which they are pickled; but they are commonly used in the shape of *sauce* or *paste*—a little vinegar, which dissolves the whole fish, including the bones, being used to produce the necessary consistence.

ANCHYLOSIS, or ANKYLOSIS (from ἀγκύλος, bent, crooked), stiffness of a joint, the result of injury or disease. The rigidity may be complete or only partial, and may be due to disease of the tendinous or muscular structures outside the joint, or to disease of the joint itself. When the structures outside the joint are affected, the term "false" anchylosis has been used in contradistinction to "true" anchylosis, in which the disease is within the joint. Anchylosis is also used as an anatomical term, bones being said to anchylose (or ankylose) when, from being originally distinct, they coalesce, or become so joined together that no motion can take place between them. The form *ankylosis* agrees best with the etymology.

ANCILLON, CHARLES, son of David Ancillon, and one of a distinguished family of French Protestants, was born 28th July 1659, at Metz, and died, 5th July 1715, at Berlin. He studied law at Marburg, Geneva, and Paris, where he was called to the bar. At the request of the Huguenots of his native place, he pleaded its cause at the court of Louis XIV., urging that it should be excepted in the revocation of the Edict of Nantes; but his efforts were so unsuccessful that he quitted the country and joined his father, who was already in Berlin. Through the influence of his father with the elector of Brandenburg, he was appointed at first judge and director of French refugees, and ultimately embassy counsel, historian to the king, and superintendent of the French school. He is known chiefly by his writings, several of which relate to the revocation of the Edict of Nantes, and other events of his time. He also wrote *Miscellaneous Literary Criticisms*, a *Life of Soliman II.*, and a *Treatise on Eunuchs*, the last of which he published under the name of *Ollincan*, an anagram of Ancillon.

ANCILLON, DAVID, an eminent French Protestant divine, father of the preceding, was born, 17th March 1617, at Metz, and died, 3d September 1692, at Berlin. At the age of sixteen he went to Geneva to complete his theological studies; and in 1641 he was appointed minister of Meaux, where he remained till 1653. At this time he accepted a call to his native town, Metz; and he continued to officiate there till 1685, when the revocation of the Edict of Nantes compelled him to retire to Frankfort. He left this for Hanau, and finally settled at Berlin, filling the office of French Protestant pastor there, much esteemed by the highest classes, till his death in 1692. He was a scholarly writer, and a man remarkable for the moral beauty of his character.

ANCILLON, JOHANN PETER FRIEDERICH, a historian and Prussian statesman, one of the family of French Protestant refugees noticed above, was born at Berlin, 30th April 1766, and died there, 19th April 1837. Descended from a family of divines, he early selected the ecclesiastical profession, and studied theology first at Berlin and then at Geneva. Shortly after finishing his course he was appointed minister to the French community at Berlin, as well as professor of history in the military academy, and he attracted attention even at court by the eloquence of his style. In 1793 he visited Switzerland and, a few years after, France, the details of his journeys and observations being published on his return. He was a frequent and able contributor to the literary journals of the period, and in 1801 appeared as the author of *Literary and Philosophical Miscellanies*, revealing a shrewd, philosophic cast of mind. Ancillon took rank among the most famous historians of his day by his next work, *A Picture of Political Revolutions in Europe since the 15th Century*, which gained him the eulogium of the Institute of France, and admission to the Royal Academy of Berlin. It is unfortunate that this work was never finished, for it is one of the ablest and most philosophical on the subject. The merits of Ancillon were not overlooked. He was appointed tutor to the prince royal of Prussia and his cousin in 1806, by Frederic William III., and received various appointments from the Government. In 1814 he accompanied the princes to Paris, and there became acquainted with Guizot, De Broglie, and other persons of eminence. After completing the term of his office as tutor, he was attached to the department of foreign affairs, and made a counsellor of state. He took an active part in many diplomatic transactions, rendering his country some signal services, and securing more and more the confidence of the court. Soon after the revolution of July 1830, he was made minister of foreign affairs, with the entire control of the whole department; and he retained the title of minister of state till his death. Besides the works already mentioned, he published, in 1817, *New Literary and Philosophical Miscellanies;* in 1819, *The Science of Politics;* in 1824, *Objects of Faith and Knowledge in Philosophy;* in 1829, *Thoughts on Man—his Relations and Interests;* and a number of other works on politics and philosophy.

ANCONA, a province of the kingdom of Italy, bounded on the N. by the Adriatic Sea and the province of Pesaro-Urbino, on the W. by Pesaro-Urbino and Umbria, on the S. by Macerata, and on the E. by the Adriatic. It forms part of the old district of the Marches, which passed from the dominion of the Pope to that of Victor Emmanuel in 1860. The Marches comprise the March of Ancona on the north and the March of Fermo on the south, although the whole territory is sometimes called the March of Ancona. The name, however, has long ceased to be the official designation of any part of Italy, and the present province of Ancona, which has an area of 740 square miles, and a population of 262,369, corresponds in extent neither to the March of Ancona, nor to the Papal delegation of the same name. There is little that is peculiar in the physical features of the province; the rivers are small and unimportant, and the hills are of no great height. Agriculture is the chief industry, and the soil, although naturally poor, yields large and profitable crops through the energy of its inhabitants. Considerable attention is also paid to the rearing of cattle and sheep, and the vine and the mulberry are grown to some extent. The cultivation of the silk-worm has not of late years been very successful, owing to the prevalence of disease in the worm. Chalk, sulphur, and raw petroleum are found in different parts of the province, but as yet little has been done to utilise those discoveries. The principal towns are Ancona, Jesi, and Osimo.

ANCONA, a city of Italy, and capital of the province of the same name, is pleasantly situated on the Adriatic, 132 miles N.E. of Rome, in a sort of amphitheatre between two hills—Monte Ciriaco and Monte Guasco or Conero. The streets are narrow and irregular, but the city contains some fine buildings, among which may be mentioned the cathedral of St Ciriaco (which is said to occupy the site of an ancient and famous temple of Venus), several of the churches, and the citadel. The harbour, one of the best on the Adriatic, is defended by several forts and protected by two moles. On the older of these moles there is a magnificent triumphal arch of Parian marble, erected in honour of the Emperor Trajan, by whom the mole was built, while the other mole possesses a second arch, of much inferior beauty, dedicated to Pope Benedict XIV. Ancona ceased to be a free port in 1869, and this circumstance, together with the gradual accumulation of mud in the harbour, and the conversion of a mercantile ship-building yard into a naval arsenal, has had a very unfavourable effect upon the commerce of the place. In 1843 the value of the imports was £1,020,770, and of the exports £428,219; in 1869 the respective amounts had decreased to £585,296, and £157,969. The chief articles imported are coal, hardware, sugar, fish, cottons, woollens, linens, lead, iron, and petroleum; while the chief exports are wheat, maize, wine, rags, liquorice, and manufactured goods; the principal manufactures of the town being silk, paper, tallow, wax, and leather. Ancona has a population of 46,000, many of whom are Jews and Greeks. The city was founded about 380 B.C. by Syracusan exiles, who fled from Sicily in order to escape the tyranny of the elder Dionysius. From its admirable position it rapidly rose in importance as a seaport, and it also became celebrated for its purple dye. The exact time of its subjection to the Romans is uncertain, but it was probably about 268 B.C., when the rest of Picenum came under the power of Rome. After the dissolution of the Western Empire, Ancona was plundered by the Goths, Lombards, and Saracens successively, but it always recovered its strength and importance, and eventually became a semi-independent republic, under the protection of the Popes. It continued in this position until 1532, when Clement VII. made himself master of it, and incorporated it with the Papal dominion. In 1797 it was taken by the French, who, in 1799, had in turn to surrender to a combined force of Austrians, Russians, and Turks, after a long and gallant defence under General Meunier. The French recovered possession of it in 1805, and soon after annexed it to their kingdom of Italy, but the Treaty of Vienna restored it to the Pope in 1815. In 1832 the French seized Ancona, in order to check the Austrians, who were then occupying Bologna and the surrounding country; and they retained possession of it until the Austrians evacuated the Papal territory in 1838. In 1860 Ancona was held by a hastily organised body of Belgians and Irishmen under the command of the French general, Lamoricière. It was here that Lamoriciere retired after his disastrous defeat at Castelfidardo by Cialdini, when Victor Emanuel determined on invading the Papal States. On the 29th of September (eleven days after Castelfidardo), Lamoricière capitulated at Ancona with his entire army. In 1861 the city of Ancona, like the rest of the province, became part of the new kingdom of Italy.

ANCUS MARCIUS, the fourth king of the Romans, succeeded Tullus Hostilius about 638 B.C., and reigned until 614. He defeated the Latins and other tribes, enlarged Rome by joining to it the Janiculum, and made the harbour of Ostia. In his reign many of the conquered Latins were incorporated with the Roman state, and not receiving the full franchise, formed, according to Niebuhr, the first elements of the Roman *plebs*.

ANCYRA. See ANGORA.

ANDALUSIA, or ANDALUCIA, an extensive region in the south of Spain, bounded on the N. by New Castile and Estremadura, on the W. by Portugal, on the S. by the Atlantic and the Mediterranean, and on the E. by the Mediterranean and Murcia. Although no longer officially recognised, yet, like the other ancient divisions of Spain, it is probably better known and oftener referred to, at least in popular language, than the modern provinces which have been formed out of it. These are eight in number—Seville, Huelva, Cadiz, Jaen, Cordova, Granada, Almeria, Malaga. It also corresponds to the "four kingdoms"—Seville, Jaen, Cordova, and Granada—into which the Moors divided the south of Spain, to the still older Roman province of *Bœtica*, and probably, in part at all events, to the Tarshish of the Bible, a famous trading emporium and district belonging to the Phœnicians, who were the earliest known inhabitants of the country. The name Andalusia is said to be a corruption of Vandalusia, from the Vandals, who overran this part of Spain after the downfall of the Roman Empire; other authorities, however, consider that the Moors, who occupied the country after the Vandals, gave it its present name from their term *Andalosh*, "land of the West." Andalusia has an area of about 33,000 square miles, and in 1867 had a population of 3,200,944. The principal river of Andalusia is the Guadalquivir, the Roman *Bœtis*, which rises in the mountains of Jaen, and flows in a south-westerly direction to the Mediterranean at San Lucar. Its chief affluents are the Jandula, the Guadiata, and the Huelba on the right, and the Xenil on the left. Among the other rivers of the province are the Tinto, the Guadalete, and the Guadaljorce. The country is very mountainous; the chief ranges are the Sierras Morena and de Arsohe in the north, the Sierra Susana in the centre, and the Sierras Nevada, de Gador, and Bermeja in the south. There are several peaks of great elevation; among the highest are Mulahacen (11,781 feet) and Picacho de la Veleta (11,597 feet), both in the Sierra Nevada. Many of the mountains abound with metals, as silver, lead, copper, iron, and with coal; while marble and quartz are also found, the former in large quantities, and of a fine quality. Though its soil and climate vary with the elevation of the land, Andalusia must be considered the finest and most delightful of all the divisions of the peninsula. Some of the higher mountains are covered with perpetual snow, a luxury which is highly prized by the inhabitants of the valleys, where the summer is usually extremely hot, and in winter the snow falls only to melt when it reaches the ground. Here the more common European plants and trees give place to the wild olive, the caper bush, the aloe, the cactus, the evergreen oak, the orange, the lemon, the palm, and other productions of a tropical climate. On the coasts of the Mediterranean, about Marbella and Malaga, the sugar-cane is successfully cultivated; and no inconsiderable quantity of silk is produced in the same region. Agriculture is in a very backward state, and the implements used are of the most primitive description; nevertheless, owing to the natural richness of the soil, large crops of wheat and other cereals are grown. There are, however, considerable tracts of land which, from want of water, are neither cultivated nor inhabited; these occur chiefly in the west of the province. The horses and bulls of Andalusia are celebrated all over Spain; sheep and swine are extensively bred, and game is abundant. The inhabitants are a lively, good-humoured, and ready-witted people, fond of pleasure, lazy, and extremely superstitious, great boasters, and, like most boasters, very cowardly and unwarlike. The men are tall, handsome, and well-made, and the women are among the most beautiful in Spain; while the dark complexion and hair of both sexes, and their peculiar dialect of Spanish, so distasteful to pure Castilians, are as evident traces of the long rule of the Moors, as are the magnificent architectural remains which adorn many of the Andalusian towns.

ANDAMAN ISLANDS. These islands lie in the Bay of Bengal, 590 geographical miles from the Hoogly mouth of the Ganges, 160 miles from Cape Negrais in British Burma, the nearest point of the mainland, and about 340 from the north extremity of Sumatra. Between the Andamans and Cape Negrais intervene two small groups, Preparis and Cocos; between the Andamans and Sumatra intervene the Nicobar Islands, all seeming to indicate a submarine range stretching in a curve, to which the meridian forms a tangent, between Cape Negrais and Sumatra, and though this curved line measures 700 miles, the widest sea-space is less than 90. Some zoological facts are held to point to the former existence of continuous land from Negrais to Achin Head. If we can accept the doubtful authority of Wilford, Hindu legends notice this remarkable chain, and ascribe it to Rama, who attempted here first to bridge the sea, an enterprise afterwards transferred to the south of India, and accomplished at the place we call Adam's Bridge.

The main part of the group is a band of four islands, so closely adjoining, end to end, but slightly overlapping, that they have long been known as one, viz., "the Great Andaman." The axis of this band, almost a meridian line, is 156 statute miles long. The four islands are (north to south)—North Andaman, 51 miles long; Middle Andaman, 59 miles; South Andaman, 49 miles, and Rutland Island, 11 miles. Of the three straits which part these four islands, the two most southerly, Macpherson's and Middle Straits, though narrow are navigable. Andaman Strait, between Middle and North islands, is at low water a fetid swampy creek, not passable by a boat.

Little Andaman, 30 miles by 17, forming the southern extreme of the group, is detached from Great Andaman by Duncan Passage, 28 miles in width. One considerable island (Interview Island) lies immediately west of Great Andaman, and many islets are scattered round. The highest point in the group is Saddle Mountain, in North Andaman, approaching 3000 feet. From this southward the hills sink in height.

People.—These islands, so near countries that have for ages attained considerable civilisation and have been the seat of great empires, and close to the track of a great commerce which has gone on at least 2000 years, continue to our day the abode of savages as low in civilisation as almost any known on earth. Our earliest notice of them is in that remarkable collection of early Arab notes on India and China which was translated by Eus. Renaudot, and again in our own time by M. Reinaud. It accurately represents the view entertained of this people by mariners down to our own time. "The inhabitants of these islands eat men alive. They are black, with woolly hair, and in their eyes and countenances there is something quite frightful. . . . . They go naked, and have no boats. If they had, they would devour all who passed near them. Sometimes ships that are windbound, and have exhausted their provision of water, touch here and apply to the natives for it, in such cases the crews sometimes fall into the hands of the latter, and most of them are massacred." The traditional charge of cannibalism has been very persistent; but it is entirely denied by themselves, and rejected by all who have taken part in our recent colony. Of their massacres of shipwrecked crews, there is no doubt; such horrors have continued to our own day on these islands, as well as on the Nicobars.

The people are *Oriental Negroes*, and idle stories were once current of their descent from wrecked cargoes of African slaves. Races of somewhat like character are found in the mountains of the Malay peninsula (*Semangs*) and in the Philippine group (*Ajitas* or *Aëtas*); there is reason to believe a similar race exists in the interior of Great Nicobar; there are recent rumours of the like in Borneo; and, strange to say, late research has shown a possibility of near connection with the Andamanners of the aboriginal race of Tasmania, recently extinct—circumstances which seem to indicate a former diffusion of this variety of mankind over a large space of the south-eastern world. But, in truth, accurate comparison of these tribes has yet scarcely been attained. The Andaman countenance has generally impressed Europeans at first as highly repulsive, and as African in character; but when we come to particulars, it has usually neither the exaggerated blubber-lip nor to a like extent the prognathous profile, of the true Negro; nor has the Andamanner the Negro's large or ill-formed feet. The ear is small and well-formed; the hair grows in short detached tufts, curled in small rings close to the head, but is declared not to be woolly. (There are tribes of a long-haired race on Interview Island, and it is also said on Rutland. These are of superior stature, and may have been modified by alien blood from shipwrecked crews.) The skin is of a lustrous black; the people, especially the men, are often robust and vigorous, though their stature is low—seldom 5 feet, and generally much less. In this respect they can look down on the Cape Boschmen alone. The general resemblance of countenance ascribed to the people in some accounts is entirely denied by those who have become familiar with them. Professor Owen, in a skull which he examined, found none of the distinctive characters of the African Negro. The people, as a rule, are absolutely devoid of clothing. The men's nearest approach to it is to twist a few fibres round the forehead or neck, or below the knee; the women sometimes make a slight attempt at decent covering with leaves or tails of plaited fibre—the last appearing to be only a modern innovation, and the result of partial contact with our settlement. Adult males are alleged to be tattooed, or rather cicatrised (though photographs do not confirm the universality of this). The process begins about the age of eight, and goes on at intervals. It used to be done with a flint; now usually with bottle-glass. Till the process is complete, the youth is ineligible for marriage. With both sexes all hair is shaven off, except a narrow strip from crown to nape, which is kept cut close. The men rarely have beard, and in general their eye-lashes are few. The people are neither long-lived nor healthy. Indeed, few are believed to pass forty. They suffer especially from fevers, colds, and lung complications; but also from bowel complaints, headache, toothache, abscesses, and rheumatism. The malarious influence of newly-cleared jungle affects them as violently as Europeans. Formerly their almost sole remedial treatment was to coat themselves in whole or part with mud and turtle-oil. This mud daubing in various forms is also used as mourning, and as a protection against musquitoes or the sun's rays. Paint made from ferruginous red earth is used as a decoration. Of late the natives round the colony appreciate quinine highly.

They have nothing whatever approaching to agriculture, nor does their rude shelter of leaves deserve the name of hut. Their chief food in the hot season consists of turtle, wild fruits, and honey, which they procure with great dexterity. In the rains the seeds of an *Artocarpus* are a staple, and in the intermediate season the wild hog; when the hog becomes scarce, fish and turtle. They have large appetites: a man will consume 6 lb of fish at a sitting, and soon be ready to begin again. At their haunts *kitchen-middens* are formed from bones and shells till the stench becomes unbearable; then they shift quarters. Col. Man mentions a kitchen-midden at Hope Town 15 feet high and nearly 50 in diameter, almost exclusively composed of shells. They seem kindly among themselves, and capable of strong attachments; and though irritable, they are not vindictive. They are very fearless, and are formidable archers, shooting strongly and truly with a bow between 5 and 6 feet long, of tough wood, hard to bend. They shoot and harpoon fish with skill, and catch it also by hand; and have hand-nets, and stake-nets for turtle.

Monogamy seems the rule. A young man proclaims himself a candidate for marriage by eating a special kind of fish (a species of ray), whilst marriageable girls wear certain flowers. The young man, if a pig-hunter, abstains from pork for a year; if a turtle-hunter, from turtle; and during the probationary year honey is forbidden. The wife provides shelter and mats to lie on, does the cooking (*all* food is cooked), procures water and shell-fish, carries loads, shaves and paints her husband, and tends him when sick. The husband protects his wife, makes canoes, weapons, &c., and sometimes goes in search of food; but this generally devolves on the unmarried. They pet their children, but many perish. A family of three living children is rare. If an adult dies, he is quickly buried, and the tribe migrates 8 or 10 miles for about a month. Some months later the bones, as they dry, are taken up, and these, the skull especially, are carried about by the kinsfolk—for how long we are not told. Mourning is shown by a daily daubing of olive mud, particularly a thick coat on the head. It lasts a month. During their sorrow they are silent, refrain from red paint and decoration, and from much food, especially from pork and honey; but have daily to throw a piece of honey-comb into the fire.

A notable eccentricity with these people is *crying*, as an utterance of emotion. It is an expression of reconciliation with enemies, and of joy at meeting friends after long separation. Something similar is known in New Zealand, and, it would seem, among the Patagonians. When two Andaman tribes meet under such circumstances, the new-comers begin the process, the women weeping first; their men then take up the lugubrious function; finally, the tribe on whose ground the scene occurs reciprocate, commencing with their women. This doleful antistrophé is continued long—"sometimes through several days"—and then they take to dancing!

They are said to have no idea of a God or future state, though Colonel Symes in his narrative gives a different account, and perhaps information on this point is still too imperfect. We find reference made to their belief that evil spirits cause disease, and to their dread of the ghosts of the dead.

They were always very hostile to strangers, repulsing all approaches with treachery, or with violence and showers of arrows. This may have originated in ancient liability to slave raids. Not till five years after the establishment of Port Blair colony did they begin to abate hostility. Robberies were frequent, and the murder of persons straying into the woods. The Government established *homes* for the aborigines in the environs of the settlement—viz., sheds for shelter, with some aid in rations, &c., and this conduced to a better state of things. An orphanage also has now been established under European matrons.

They are perfect swimmers and divers, and expert in managing canoes. These are neatly formed, and, according to Mouat, some are fitted with outriggers, which enable them to go seaward for considerable distances.[1] Two centuries ago, according to Captain A. Hamilton, they used to make hostile descents on the Nicobars, and this is confirmed by a Nicobar tradition mentioned in the *Asiatic Researches*.[2] But there is apparently no later evidence of such expeditions, and they were probably confined to March and April, when the sea is generally like a pond.

The number of aborigines is unknown, and conjecture has varied from 3000 up to 10,000, or even 15,000. Dr Mouat, in 1857, whilst steaming rapidly round the islands, everywhere saw natives in considerable numbers, and was induced to believe that the older and lower estimates had been much under the truth; but there is reason to believe that the population is on the coast only. They are divided into tribes or groups, not usually containing more than thirty individuals; and among these the country is partitioned in some fashion, for we are told that trespasses are a common ground of war between tribes. Each tribe has a depôt, or headquarters, where the sick are tended and surplus stores are kept.

The name *Mincopie* is applied to the Andaman race in books originating with a vocabulary given by Lieutenant Colebrooke.[3] One suspects some misunderstanding about this. Of the language we have as yet little information. It is said to be very deficient in words, and there is the tendency usual in the circumstances to strong dialectic differences. Thus the people of Little Andaman are said not to understand those of South Andaman. Those near the settlement begin to incorporate English and Hindustani words. It is stated positively that they have *no numerals*. It was once believed that they had no proper names, but this proves erroneous. The child is named before birth; hence names seem of common gender, and as they are few—some twenty in all—a special epithet is prefixed to each, personal or local in origin.

Climate.—This is very moist, as might be expected. The islands are exposed to the full force of the south-west monsoon of summer, and also in some seasons share that rainy effect of the north-east monsoon of the late autumn which characterises the Coromandel coast in the same latitude. Hence Colonel Kyd, who was chief of the settlement abandoned in 1796, says only four months' fair weather could be counted on, and a later explorer uses nearly the same phrase. The natives divide the year into three seasons—(1.) The dry, literally "the northern sun," February to May; (2.) The rainy, June to September; (3.) The moderate season, October to January. There is, however, rather a remarkable want of uniformity in the seasons. The rainfall at Port Blair for four years is reported as follows:—

1869,	155·7 inches.
1870,	119·9 "
1871,	100·09 "
1872,	103·02 "

The annual mean temperature, reduced to sea-level, is about 81° Fahr.

Geology, &c.—The islands appear from the sea as a series of low hills. These being covered with dense and lofty forest, we have as yet little information on the geology. The surface is excessively irregular, and the islands are too narrow to have rivers. There has been no alluvial deposit, and in many places the rocky formation is bare. Near our settlement in South Andaman the principal rocks are grey tertiary sandstones, identical with those prevailing in Aracan. This sandstone affords excellent building material. Traces of coal have been found, but only small pockets in the sandstone, without seam. Serpentine rock occurs on the east coast south of Port Blair, and on Rutland. A broad strip of indurated chloritic rock extends from Port Blair north-north-east to the east coast of Middle Andaman. Coral reef barriers gird the islands on all sides. The general dip of the rocks is to the westward, and thus the depth of sea on the east is much greater. On the west the corals are continuous and very extensive, forming patches of reef even 20 or 25 miles from shore. Agate flakes have been found on the site of an old encampment. It is curious that Captain A. Hamilton speaks of an adventurer known to him who made money by *quicksilver* obtained from these islands, but no confirmation of this has been reported. No fossils have yet been got.

Vegetation.—On the east the prevailing character is of forest trees with straight stems of 100 feet in mean height, often entirely covered with climbing plants. On the west vegetation is not so lofty. Deciduous trees are everywhere sporadic, and large tracts of them occur, robbing the landscape in the hot season of its tropical richness by their grey sterile aspect. These trees are generally of little utility. *Bombax malabaricum* is abundant among them. The immense buttressing of the stems of many of the trees is notable. Extensive tracts are also occupied by bamboo jungle, 30 to 35 feet high, almost entirely of *Bambusa andamanica*, from which lofty forest trees stand out, very far apart. The bamboo seems to attach especially to the indurated chloritic rock. Mangrove swamps fringe the little bays and straits, with many orchids. Behind the swamps are palms, *Phœnix paludosa* and *Licuala paludosa;* also *Barringtonia* and *Excœcaria Agallocha*, recognised by their red decaying leaves in June and July, and *Lagerstrœmia* and *Pterocarpus* by their rich lilac or yellow blossoms. Arborescent euphorbias, screw-pines, and a *Cycas* of considerable height, give a remarkable aspect to the coast vegetation in many places. Above these are the coast forests, on the slopes of hills, and valleys influenced by the sea. *Mimusops indica*, believed to be a very valuable wood, forms whole forests; sometimes in equal proportions with *Hemicyclia andam.* Around these are tropical mixed forests, through which it is hard to force a way from the multitude of climbers. *Dipterocarpus lævis* is the typical tree here. Palms are numerous—*e.g.*, *Licuala peltata* and *Areca triandra.* On one small island (Termooklee) there is a gigantic *Corypha* with leaves 30 feet long, but stemless. The high forests of the interior are little known. The quantity of intricate climbers is less, and the uniformity of vegetation greater. Treeless spots are confined to craggy islands completely exposed to wind and weather. The general character of the vegetation is *Burmese*, altered by some unfavourable circumstances, principally the scarcity of running water. But there are also a number of Malayan types not found on the adjacent continent. There are no tree ferns, apparently. There

[1] The native boats near Port Blair have no outrigger.
[2] ii. 344.
[3] *As. Res.*, iv. 392.

are a considerable number of edible wild fruits. No indigenous coco-palms exist, though these are so plentiful on the adjoining Cocos and Nicobars. Much of the scenery of the islands is very beautiful.

Animal Life.—This is greatly deficient throughout the whole group, especially as regards Mammalia, of which the species are very few. There is a small pig (*S. andamanensis*), important to the food of the people—perhaps that found on the Nicobars; a *Paradoxurus;* a rat with spiny hairs (*M. andam.*); a small frugivorous bat (*Cynepterus marginatus*). A "wild cat" is alleged, but there seems doubt about it. No Quadrumana have been seen. Of birds several species seem peculiar to this group, or to the Nicobars, or to the two together; and some of the Andaman species are considered by Mr Blyth to accord better with corresponding species at a distance than with those on the adjoining part of the contineut. Thus, *Artamus* and *Oriolus* of the Andamans seem identical with those of Java, not with those of India or Burma; and a shrike of these islands agrees better with a species of China and the Philippines than with the nearest species in Bengal, Aracan, and the Malay peninsula. Caves on the coast are frequented by the swift, which forms the edible nest of the China market. Pigeons, kingfishers, and woodpeckers are numerous. Reptiles are pretty numerous, both as regards species (15 to 20) and individuals, including eight *Ophidia* and several *Geckoes,* of which four or five are peculiar. Among these is one (*Phelsuma andam.*) the immediate kindred of which is known only in Madagascar and the adjoining islands. The Indian toad is common. Turtle are abundant, and now supply Calcutta. The species of fish are very numerous, and many are peculiar. They have been especially studied by Dr F. Day. It is much to be desired that these islands should have a thorough scientific exploration whilst the type of their productions is still substantially uninfluenced by foreign agency.

History.—It is uncertain whether any of the names of the islands given by Ptolemy ought to be attached to the Andamans; yet it is probable that this name itself is traceable in the Alexandrian geographer. Andaman first appears distinctly in the Arab notices of the 9th century, already quoted. But it seems possible that the tradition of marine nomenclature had never perished; that the Ἀγαθοῦ δαίμονος νῆσος was really a misunderstanding of some form like *Agdamán,* while Νῆσοι Βαρούσσαι survived as Lanka *Bálús,* the name applied by the Arabs to the Nicobars. The islands are briefly noticed by Marco Polo, who probably saw without visiting them, under the name *Angamanain,* seemingly an Arabic dual, "The two Angamans," with the exaggerated but not unnatural picture of the natives, long current, as dog-faced Anthropophagi. Another notice occurs in the story of Nicolo Conti (*circa* 1440), who explains the name to mean "Island of Gold," and speaks of a lake with peculiar virtues as existing in it (the natives do report the existence of a fresh-water lake on the Great Andaman). Later travellers repeat the stories, too well founded, of the ferocious hostility of the people; of whom we may instance Cesare Federici (1569), whose narrative e given in *Ramusio,* vol. iii. (only in the later editions), and in Purchas. A good deal is also told of them in the vulgar and gossipping, but useful work of Captain Hamilton (1727). In 1788–89 the Government of Bengal sought to establish in the Andamans a penal colony, associated with a harbour of refuge. Two able officers, Colebrooke of the Bengal Engineers, and Blair of the sea-service, were sent to survey and report. In the sequel the settlement was established by Captain Blair, in September 1789, on Chatham Island, in the S.E. bay of the Great Andaman, now called Port Blair, but then Port Cornwallis. There was much sickness, and after two years, urged by Admiral Cornwallis, the Government transferred the colony to the N.E. part of Great Andaman, where a naval arsenal was to be established. With the colony the name also of Port Cornwallis was transferred to this new locality. The scheme did ill; and in 1796 the Government put an end to it, owing to the great mortality and the embarrassments of maintenance. The settlers were finally removed in May 1796. In 1824 Port Cornwallis was the rendezvous of the fleet carrying the army to the first Burmese war. In 1839, Dr Helfer, a German savant employed by the Indian Government, having landed in the islands, was attacked and killed. In 1844 two troop-ships, "Briton" and "Runnymede," were driven ashore here, almost close together. The natives showed their usual hostility, killing all stragglers. Outrages on shipwrecked crews continued so rife that the question of occupation had to be taken up again; and in 1855 a project was formed for such a settlement, embracing a convict establishment. This was interrupted by the great mutiny of 1857, but as soon as the neck of that revolt was broken, it became more urgent than ever to provide such a resource, on account of the great number of prisoners daily falling into our hands. Lord Canning, therefore, in November 1857, sent a commission, headed by Dr F. Mouat, to examine and report. The commission reported favourably, selecting as a site Blair's *original* Port Cornwallis, but pointing out and avoiding the vicinity of a salt swamp which seemed to have been pernicious to the old colony. To avoid confusion, the name of *Port Blair* was given to the new settlement, which was established in the beginning of 1858. At the end of 1871 the number of convicts in the colony was 7603. For some time sickness and mortality were excessively large, but the reclamation of swamp and clearance of jungle on an extensive scale by Colonel Henry Man when in charge (1868–1870), had a most beneficial effect, and the health of the settlement has since been notable. Of late years the European detachment of 120 men has sometimes been without a man in hospital.[1] Cattle have been introduced in considerable numbers; extensive gardens have been planted, embracing many thousands of valuable fruit and timber trees. Mangoes, oranges, pommeloes, pine-apples, and jack-fruit are grown with especial success. The Andaman colony obtained a tragical notoriety from the murder of the viceroy, the Earl of Mayo, by a Mohammedan convict, when on a visit to the settlement, 8th February 1872. Recently the two groups, Andaman and Nicobar, the occupation of the latter also having been forced on the British Government (in 1869) by the continuance of outrage upon vessels, have been united under a chief commissioner residing at Port Blair. Steamers run from Calcutta to both groups monthly.

(See, among other works, Lieut. Colebrooke in *Asiatic Researches,* vol. iv.; *New Acc. of the E. Indies,* by Capt. A. Hamilton; *Adventures and Researches,* by Dr Mouat; Papers in the *Journal* and *Proceedings* of the As. Soc. Bengal; Kurz, *Report on the Vegetation of the Andaman Islands;* and other official documents.)

(H. Y.)

ANDELYS (Les), a town in the department of Eure, France, formed by the union of *Le Grand* and *Le Petit* Andely, which are situated, the latter on the eastern bank of the Seine, and the former nearly half a mile from the river, at a distance of about 20 miles north-east of Evreux. Grand Andely, the older of the two, dates from the 6th century, and contains a collegiate church, whose stained-glass windows are remarkably beautiful. Petit Andely sprang up around the château Gaillard, which was built by Richard Cœur de Lion in 1195, and was formerly one of the strongest fortresses in France. The chief manufactures at Les Andelys are cloth, thread, and leather, and there is a considerable trade in grain and wool. Population (1872), 5379.

ANDENNE, a town of Belgium, in the province of Namur, situated on the right bank of the Meuse, 10 miles east of Namur. It contains no buildings of note, but is a place of considerable manufacturing activity. The principal productions are porcelain, tobacco-pipes, and paper, and in the neighbourhood are beds of pipe-clay and marble quarries. Population, 6370.

ANDERNACH, a small town of Rhenish Prussia, situated on the left bank of the Rhine, 10 miles north-west of Coblenz. It is the *Antunnacum* of the Romans, and in the Middle Ages was a fortified town of considerable importance, but at the present day the walls only add to its picturesque appearance. Among the objects of interest are a lofty watch tower, the Coblenz gate, and the fine parish church, built in the beginning of the 13th century. Andernach has a trade in leather, corn, and wine; but its most noted articles of commerce are millstones, made of lava and of tufa-stone, which when pounded and mixed with lime, possesses the property of hardening under water, and has been much used by the Dutch as a cement in the construction of their dykes. Populatiou about 4000.

[1] In 1867 the mortality among convicts was 10·16 per cent., and in only one previous year had it been below that figure, often in excess. 1868 gave 3·9 per cent.; 1869 2 per cent.; 1870, 1·07 per cent.; 1871, about the same.

ANDERSON, ADAM, a Scottish economist, was born in 1692, and died in London on the 10th January 1765. He was a clerk for forty years in the South Sea House, where he published a work entitled *Historical and Chronological Deduction of the Origin of Commerce, containing a History of the Great Commercial Interests of the British Empire* (1762, 2 vols. fol.) A third edition appeared in 1797–9, in four vols. 4to, the last volume being an appendix and continuation by the editor, Mr Walton.

ANDERSON, ALEXANDER, an eminent mathematician, was born at Aberdeen about 1582. In his youth he went to the Continent, and settled as a private teacher or professor of mathematics at Paris, where he published or edited, between the years 1612 and 1619, various geometrical and algebraical tracts, which are conspicuous for their ingenuity and elegance. He was selected by the executors of the celebrated Vieta to revise and edit his manuscript works, a task which he discharged with great ability. He afterwards produced a specimen of the application of geometrical analysis, which is distinguished by its clearness and classic elegance. The works of Anderson amount to six thin 4to volumes, which are now very scarce. As the last of them was published in 1619, it is probable that the author died soon after that year, but the precise date is unknown.

ANDERSON, SIR EDMUND, a younger son of an ancient Scottish family settled in Lincolnshire, was born at Broughton or Flixborough about 1540, and died in 1605. He was some time a student of Lincoln College, Oxford, and removed from thence to the Inner Temple, where he applied himself diligently to the study of the law, and became a barrister. In 1582 he was made lord chief-justice of the common pleas, and in the year following was knighted. He was one of the commissioners appointed to try Queen Mary of Scotland in 1586. His works are—1. *Reports of many principal Cases argued and adjudged in the time of Queen Elizabeth in the Common Bench*, Lond. 1644, fol.; 2. *Resolutions and Judgments on all the Cases and Matters agitated in all Courts of Westminster in the latter end of the reign of Queen Elizabeth*, Lond. 1655, 4to.

ANDERSON, JAMES, LL.D., was born at the village of Hermiston, in the county of Edinburgh, in the year 1739. At an early age he lost his parents, who were in humble life, but this did not interrupt his education, and being desirous to obtain an acquaintance with chemistry as a means of professional success, he attended the lectures of Dr Cullen. Enlarging the sphere of his employments, Anderson forsook the farm in Mid-Lothian which his family had occupied for several generations, and rented in Aberdeenshire a farm of 1300 acres of unimproved land. But previous to this he had become known to men of letters by some essays on planting, which, under the signature "Agricola," he published in the *Edinburgh Weekly Magazine*, in 1771. After withdrawing from his northern farm, where he resided above twenty years, he settled in the vicinity of Edinburgh, and continued to interest himself in agricultural questions. In 1791 he projected a periodical publication called *The Bee*, consisting of miscellaneous original matter, which attained the extent of eighteen octavo volumes. It was published weekly, and a large proportion of it came from his own pen. From this period till 1803 he issued a number of publications chiefly on agricultural subjects, which had no small influence in advancing national improvements. Dr Anderson, after a gradual decline, partly occasioned by excessive mental exertion, died in 1808.

ANDERSON, JAMES, a learned and industrious antiquary of Edinburgh, was born there August 5, 1662, and educated to the legal profession, in which he became a writer to the Signet. His reputation as a historian stood so high, that just before the Union the Scottish parliament commissioned him to prepare for publication what remained of the public records of the kingdom, and in their last session voted a sum of £1940 sterling to defray his expenses. At this work he laboured for several years with great judgment and perseverance; but it was not completed at his death in 1728. The book was published posthumously in 1739, edited by Thomas Ruddiman, under the title *Selectus Diplomatum et Numismatum Scotiæ Thesaurus.* The preparation of this great national work involved the author in considerable pecuniary loss; and soon after his death, the numerous plates, engraved by Sturt, were sold for £530. These plates are now lost, and the book has become exceedingly scarce. After the union of the crowns, Anderson was appointed in 1715 postmaster-general for Scotland, as some compensation for his valuable labours; but in the political struggles of 1717 he was deprived of this office, and never again obtained any reward for his important services to his country.

ANDERSON, JOHN, natural philosopher, was born at Roseneath in Dumbartonshire in 1726. In 1756 he became professor of Oriental languages in the University of Glasgow, where he had finished his education; but in 1760 he was appointed to the chair of natural philosophy, a subject more suited to his tastes and acquirements. In this department he laboured assiduously to apply scientific knowledge to the improvement of the mechanical arts, studying industrial processes in the various workshops of the city, and thus qualifying himself to be the scientific instructor of the artizan. He opened a class for the instruction of mechanics in the principles of their arts, in which his familiar extempore discourses were illustrated by appropriate experiments. He is thus to be regarded as the father of those Mechanics' Institutions which have since become so common. His anxiety for the improvement of artizans was not confined to his personal exertions. Shortly before his death in 1796, he bequeathed the whole of his property to 81 trustees, for the purpose of founding an institution for educational purposes in Glasgow. He had seemingly intended it as a sort of rival to the university in which he was himself a professor; for his will mentions the founding of four halls or colleges with nine professors in each, for the faculties of arts, medicine, law, and theology. But the trustees found the funds entrusted to them utterly inadequate to so gigantic a scheme; and they contented themselves with founding what is now called, in its official calendar, *Anderson's University.* This institution was opened in 1797, by the appointment of Dr Thomas Garnett as professor of natural philosophy, who commenced with a popular course of lectures, which was attended by a considerable audience of both sexes. In 1798 a professor of mathematics and geography was appointed; and the institution has since had the aid of many able teachers. In 1799 Dr Garnett was succeeded by Dr Birkbeck, who had the merit of introducing in the institution a system of gratuitous scientific instruction, given annually to 500 operative mechanics. On the removal of Dr Birkbeck to the London Royal Institution, he was succeeded by Dr Andrew Ure in 1804; and Dr Ure by Dr William Gregory. In recent years the institution has received several munificent endowments from private persons, and its staff of teachers has been consequently greatly strengthened. It now possesses a complete medical school, whose certificates are recognised by the various examining bodies both in England and Scotland. In 1872–3 there were 460 medical students, and 2508 persons in all attended the various classes of the institution.

ANDERSON, ROBERT, an author and critic of considerable note in his own day, was born at Carnwath, Lanarkshire, on the 7th January 1750. He was at first destined for the church, and was sent to the University of Edinburgh in 1767. After a few sessions, however, he quitted the divinity classes in order to study medicine. He was for a short time employed as surgeon to the dispensary at Bamborough Castle in Northumberland. Returning to Scotland he took the degree of M.D. at St Andrews, on the 20th of May 1778. He now began to practise as a physician at Alnwick; but his general habits were rather those of speculation than exertion, and a moderate provision, acquired by his marriage with the daughter of Mr John Gray, of Alnwick, had emancipated him from the necessity of professional labour. In 1784 he finally returned to Edinburgh, where he continued to reside till the close of his life. For several years his attention was occupied with his edition of *The Works of the British Poets, with Prefaces Biographical and Critical* (14 vols. 8vo, Edin. 1792–1807). His other publications were, *The Miscellaneous Works of Tobias Smollett, M.D., with Memoirs of his Life and Writings* (Edin. 1796); *Life of Samuel Johnson, LL.D., with Critical Observations on his Works* (Edin. 1815); *The Works of John Moore, M.D., with Memoirs of his Life and Writings* (Edin. 1820); and *The Grave and other Poems, by Robert Blair; to which are prefixed some Account of his Life and Observations on his Writings* (Edin. 1826). Dr Anderson died on the 20th Feb. 1830.

ANDES. The Andes form a mountain chain second only to the Himalayas in the vastness of its proportions, and possessing many remarkable peculiarities. The origin of the name appears to be unknown, although numerous meanings have been authoritatively assigned to it. It has been variously supposed to be derived from the Peruvian words *Anta*, or tapir; *Anti*, meaning metal or copper; and *Antis*, the name of a tribe resident in the mountains; or from the Spanish *Andenes*, applied to the gardens on the terraces which occur on the western slopes of the Andes in Chili. Humboldt believes its meaning has been lost. In connection with this may be noticed the curious fact mentioned by Colonel Tod, that the Hindoos of North India called the Himalayas by the name Andes.

The Andes form a continuous belt of mountainous highland along the western margin of South America, and have been considered by many writers as the southern continuation of the Rocky Mountains, which form a similar belt along the west side of North America. There are many objections against this view, and in favour of that which makes the Andes and Rocky Mountains two distinct ranges. In New Granada, or Columbia, as it is now called, the eastern range of the Andes terminates on the western side of the Gulf of Maracaybo, near 72° W. long. South of the gulf a branch range is thrown off, which traverses Venezuela. The central range dies out in the low lands south of the junction of the Cauca and Magdalena rivers. The western range also lowers and spreads in breadth in advancing northwards, and is lost in the low flats along the south margin of the Gulf of Darien. At the neck of the Panama isthmus, the Naipi and Cupica valleys stretch from the Atlantic to the Pacific Ocean, and are nowhere more than a few hundred feet above the level of the sea. North of the Atrato a serpentine ridge of mountains occurs, which terminates in Cape Tiburon. It is crossed by a pass called Tanela, which is about 5 miles in length, and 130 feet above the sea. Most of the isthmus between 8° and 9° N. lat. is below the level of this pass. Here the Isthmus of Panama curves round westwardly; and west of Panama there is another broad low tract stretching right across. This district cannot be regarded as belonging in any way to the Andes. In Central America the mountains form numerous isolated ranges. In Mexico there are two high sierras. The eastern sierra does not reach the Rio Branco. The western sierra terminates at its north end in the Sierra Madre de Durango, which dies out in the northern part of Chihuahua and in Sonora, without being in any way connected with the Rocky Mountains.

The Rocky Mountains commence in about 100° W. long. at their south end, and terminate in about 145° W. at the north end, and have a general north-westerly direction. The Andes, on the other hand, commence near 54° S. lat. and 70° W. long. The southern portion forms a gentle curve, bending round to 73° W. in Patagonia, and reaching 70° again in the south of Chili. It continues on this line to Coquimbo, where it bends easterly, and after a slight double curve it cuts the meridian of 70° again south of Lake Titicaca. There is then a sharp bend, corresponding to that in the coast, which carries the range nearly to 80° W. in Ecuador, beyond which it again has an easterly bend, so as to cause it to terminate between 72° W. and 76° W. The north and south ends are consequently nearly in the same meridian. There are other dissimilarities between the Andes and the Rocky Mountains.

The formation of the Andes is due to several causes operating at distinct intervals of time. They consist mainly of stratified material which has been more or less altered. This material was deposited at the bottom of a sea, so that at some former time the highest portions were submerged, probably in consequence, to a certain extent, of subsidence of the sea bottom. Since the latest deposits there has been upheaval and denudation. The range, then, has resulted from the accumulation of sediment on a subsiding area; from the subsequent upheaval of such deposits, which have been increased in height by the ejection of volcanic products, and from the operation of denuding agents.

As far as our present knowledge goes, it appears to be probable that the Andes mark an area on which sedimentary deposits have been accumulated to a greater thickness than on any other portion of South America. It is further demonstrable that these deposits belong to several geological periods, the elevation having occurred at different periods, while their axes extend in different directions. Hence it is a complex range of mountains formed by the combination of several distinct systems of ridges. The width of the range varies from about 60 to 300 or more miles, but, as compared with other mountains, the Andes are for the most part narrow relatively to their height. Where their special features are most characteristically developed, they consist of a massive embankment-like foundation, rising with a rapid slope from the low country on either side, and having its margins surmounted by lofty ridges of ragged or dome-like summits. These Cordilleras, as they are usually termed, flank longitudinal valleys, or plain-like depressions which form the highest levels of the central portion of the gigantic embankment, and which vary in width from 20 to 60 miles. At intervals the longitudinal depression is broken up, either by ridges connecting the Cordilleras, or by lofty plateau-like uplands. In several cases these transverse ridges and belts of high ground form the main watershed of the country. They are rarely cut across by the river systems, whereas both the marginal Cordilleras are intersected at numerous points, and more especially by the rivers draining the eastern slope of the country. In no case do these eastern rivers originate to the west of the western Cordilleras. A few of the central valleys, or plain-like depressions, have no connection either with the western or eastern river system. Roughly speaking, the height of the central plains or valleys is from 6000 to 11,000 feet above the sea; of the passes and knots, from 10,000 to 15,000 feet; and of the highest peaks, from 18,000 to 23,290 feet—the last being the altitude of Aconcagua in Chili, which is generally considered to be the highest peak in America. Judging from these estimates, we may regard the bulk of the Andes as somewhere about that of a mass 4400 miles long, 100 miles wide, and 13,000 feet high, which is equivalent to 5,349,801,600,000,000 cubic feet. On this basis we find that the Mississippi would carry down an equivalent mass of matter in 785,000 years. The rate of denudation in certain river basins varies from one foot in 700 years, to one foot in 12,000 years. Assuming that similar rates would apply to the Andes, they would be denuded away in from 9 to 156 million years. In all probability, much less than 9 million years would suffice. On the other hand, the Andes would be swept away in 135,000 years, supposing the denuding powers of the globe were concentrated on them alone. From the above data, and assuming the average specific gravity of the matter forming the Andes to be 2·5, the weight of the portion above the sea may be estimated at 368,951,834,482,750 tons, giving an average of about 1000 tons on each square foot at the level of the sea. Under Aconcagua the pressure would be about 1780 tons per square foot at the same level, provided, of course, it were not, as it no doubt is, more or less modified by lateral pressure. These figures afford some, though at best a vague, conception of the mighty grandeur of this range of mountains, and of the scope there is for the exertion of enormous pressure. How vast, then, must be those forces which have counteracted such pressures, and upheaved the ocean-spread sediments of the continent, until the Andes, that—

> "giant of the Western Star,
> Looks from his throne of clouds
> O'er half the world !"

But, however vast the Andes may seem to us, it should be remembered that they form but an insignificant portion of the globe itself. Aconcagua is about $\frac{1}{2000}$th of the earth's diameter, which is relatively not more than a pimple $\frac{1}{30}$th of an inch high on the skin of a tall man.

The range may be considered as commencing on the south with Cape Horn, although for several degrees it is much broken up by arms and straits of the sea. The first portion of any extent commences between Cape Good Success and Cape San Paulo, and stretches across Tierra del Fuego, by Mount Darwin and Mount Sarmiento, and the range of hills on either side of Admiralty Sound. The mountains named are from 6600 to 6800 feet high. The Strait of Magellan also cuts through and across the range, isolating the mountainous islands of Clarence and Santa Ines. Otway Water cuts through the range, and penetrates to the plain of Patagonia. North of this are several snowy eminences, and in some places glaciers descend almost to the sea-level. At Last Hope Inlet, or a little north of 52° S., we have the commencement of the Andes as a continuous range, Disappointment Bay being the most northern place where the Pacific reaches the plains to the east of the Andes. South of this, and for several degrees to the north, the islands which fringe the coast have a mountainous character, and appear to belong essentially to the Andes range, with which there is reason to believe they were once connected. Along this space the Andes encroach upon the ocean, and have no western slope proper. Many of the sea channels are very narrow and ravine-like in character; they appear to represent a valley between two ridges of mountains,—a feature which is most conspicuous farther north. The highest part or crest of the range is close to the sea, and consequently the streams which fall into the Pacific are all small. Towards the south the width is about 20 miles; and in the latitude of Mount Stokes, which is 6400 feet high, it is 40 miles. North of this the range is in places more than 40 miles across. From 46° to 42° S., the mountains become somewhat higher, the loftier peaks ranging from 4000 to 8000 feet. Among the more conspicuous are Mount Yanteles, 8030 feet; Mount Melimoyu, 7500 feet; Mount Corcovado, 7510 feet; and Mount Minchinmadiva, 7406 feet above the sea-level. The Eyre Sound glaciers descend to the sea-level. At about 41°30′ S. lat. there is a low pass across the Andes; and to the north of this the slope is more or less distant from the sea, except, perhaps, at one part where the desert of Atacama terminates in lofty cliffs on the shore. In Chili the Andes increase in height and width, and between about 38° and 28° S. run approximately north and south; and nowhere do they recede so far from the sea as in the southern part of Chili. At this part, or in about the latitude of Antuco (36° 50′ S.), the lower land on the west is more than 100 miles broad, and the width of the range itself is probably more than 100 miles. Here the Andes consist of two ranges, the crests of which are from 60 to 80 miles apart, enclosing a longitudinal valley. Across these ranges there is a pass, which, with the exception of those near the mountains Osorno and Villarica, is the most southern in Chili. The summit of this pass is not more than 12,000 feet above the sea. The pass of Planchon lies north of Mount Descabezado; and to the south of Peteroa is the pass of Las Damas, which is probably not more than 11,000 feet at its highest point. At the head of the Maypu valley a pass traverses the two ranges of the Andes as well as the included valley of Tunuyan. That through the western range is called Peuquenes Pass, and rises to 13,210 feet above the sea-level; while that through the eastern range is called Portillo, and rises to 14,365 feet above the sea. Near 32° 38′ S., Aconcagua rises to 23,290 feet, and is, so far as known, the highest peak in America, and the highest volcano in the world. A little to the south of it is the Cumbre or Uspallata Pass. In the western range it rises to 12,454 feet above the sea; and on its north flank is the pass of Los Patos. At about 30° S. the mountainous system becomes more complicated, owing to the appearance of several ranges which rise out of the plains towards the north-west corner of the Argentine Confederation, some of which run north and join the lofty highlands of the Bolivian Andes. It is doubtful whether all strictly belong to the Andes. Thus, in the latitude of Coquimbo, where both the mountains and the coast line trend somewhat to the east of north, there are three parallel mountain ranges. The western is called the Andes, the central range is known as the Sierra Famatina, and the eastern as the Sierra Velasco. The two latter ranges are quite isolated from the first-mentioned range, terminating abruptly on the north and south. North of 28° S., however, a number of sierras which rise from the Argentine plain form an extensive mass of mountains. These are continuous into the Cordilleras de los Valles, de Despoblado, and Abra de Cortaderas, which form the eastern margin of the lofty mountain plains of Bolivia. These plains slope down from the eastern side of the Andes, just as the Atacama desert seems to form part of the western slope. At about 22° S, the Andes begin to trend somewhat to the west of north. At about 20° S. the eastern and western ranges are connected by a lofty transverse chain about 60 miles broad, and similar to the mountain knots of Peru. North of this the ranges bend more to the west, and enclose the extensive valley of the Desaguadero river and Lake Titicaca, which is shut in on the north by the transverse chain of the Vilcañota Mountains. The width of the range is in this part from 200 to 250 miles; or if the offset running eastward to Santa Cruz be included, the width is between 500 and 600 miles. One special feature about this part of the range is, that the Desaguadero valley (13,000 feet above the sea) is the largest in the Andes which has no connection with the river systems on the outer flanks, whether to the east or to the west. There are one or two small ones of a similar kind in the north-west part of the Argentine Confederation. The highlands which surround this great valley (which might be appropriately called the navel of South America) form a continuous re-entering watershed, separating respectively the numerous small rivers flowing into the Pacific, the Amazon system, which drains a large portion of the northern part of South America, and the La Plata system, which drains most of the southern part of the same area. In this region, too, more especially in the eastern Cordillera, it was for a time believed, on the authority of Mr Pentland, that the highest peaks of the Andes were situated; his first estimates were, however, ascertained by himself and others to have been too great. The highest peak is the Nevado de Sorata, close to Lake Titicaca, and estimated at 21,286 feet high; next to it comes the twin peaked Illimani, a little further south, which rises to 21,181 feet. The passes crossing the valley have summits averaging 14,000 feet, but the one which skirts the Nevado de Sorata rises nearly to 16,000 feet above the sea. From about 18° the Andes, like the coast, runs north-west, so that whereas in about 18° S. the crest of the western Cordillera is in 70° W. long., at 14° S. it has reached a little beyond 75°. Here there is another change of direction, this portion of the western Cordillera stretching from about 14° S. to 6° S., the south end being near 75° W., and the north near 80° W., the westing being rather more than half a degree per degree of latitude. From 6° S. to the equator the direction is very slightly to the east of north; beyond this the trend is still more east, so that the termination of the west Cordillera lies between 76° and 78° W. long. in between 7° and 8° N. lat. The northern end of the eastern Cordillera is near 72° W. Returning again to the Peruvian Andes, we find some lofty peaks which rival, and it may be surpass, those of Bolivia. Thus Sehama is reputed to be 22,000 feet; Chungara somewhat less; Chipicani, 18,898 feet; Arequipa, 18,373; Chuquibamba, 21,000 feet. There are numerous passes over the Andes in Peru, such as those of Gnalillos, of the Altos de los Huescos, and of the Altos de Toledo—the first mentioned of which rise to 17,820 feet above the sea. North of the Vilcañota Mountains the eastern portion of the Andes is much cut up by the numerous feeders of the Ucayali and Madeira rivers, most of which originate on the flanks of the western Cordillera. At Pasco there is a lofty mountain knot or table-land, which connects the Cordilleras, and at the same time forms the watershed between the upper portions of the basins of the rivers Ucayali, Huallaga, and the Marañon, or Upper Amazon. From this table-land three Cordilleras extend northward, of which the eastern dies out between the Ucayali and Huallaga rivers; the central between the Huallaga and the Upper Amazon; while the western Cordillera is continuous into the mountain knot of Loja, which forms the southern portion of the Andes of Ecuador, and which is estimated to be 11,650 square miles in extent. From this knot two lofty Cordilleras, abounding in volcanoes, both active and extinct, run nearly parallel. They are separated at intervals by transverse ridges into three vast mountain valley plains, of which the two southernmost drain into the Amazon basin, and the northernmost into the basin of the Esmeraldas river. The two Cordilleras are again united in the north by the mountain knot of Los Pastos, on the borders of Ecuador and Columbia. The valley plains are about 40 miles wide. On the south is the valley of Cuenca, which is about 50 miles long, and about 7800 feet above the sea. From it the way into the central valley plain, that of Ambato, is across the transverse ridge by the pass of Assuay, which rises to 15,520 feet. It is about 130 miles long, and about 8000 feet above the sea. The mountain fringe comprises several important volcanoes, viz., Sangay, Tunguragua, and Cotopaxi in the eastern Cordillera; and the volcano Carguirazo in the western Cordillera, which also includes the lofty Chimborazo, estimated to reach 21,424 feet above the sea. Then crossing over the low transverse ridge of the Alto de Chisinche, we descend into the valley-plain of Quito, which is bordered by one of the most intensely volcanic areas on the globe. To the east are Sinchulagua, Antisana, and Cayambe; the last is now extinct, stands on the equator, and is 19,534 feet above the sea. It is the highest point on the equator in the globe, and is the only one along that line where perpetual snow exists. In the western Cordillera the prominent eminences are Pichincha and Imbabura. The valley-plain is about 9500 feet above the sea. Taking Cotopaxi as a centre, Orton observes that the other peaks may be arranged in concentric orbits thus. Ruminaqui and Sinchulagua are 10 miles distant; Iliniza, Corazon, Atacatzo, and Antisana are 25 miles; Quirotoa, Pichincha, and Guamani are 30 miles; Llanganati is 40 miles; Tunguragua, Carguirazo, Cayambi, are 50 miles; Chimborazo, Imbabura, and Cotocachi, are 60 miles; Altar is 65 miles; Sangay is 75 miles; lastly, Chiles and Assuay are 100 miles. Chimborazo is the most conspicuous feature in this part of the Andes, and from one point its outline resembles that of a lion at rest. Cotopaxi is the most symmetrical active volcano on the globe. Its apical angle is 122° 30′; and the slope is a little over 30° on the south, west, and east sides, and nearly 27° on the north side. Its summit was attained for the first time on November 27, 1872, by Drs Reiss and Stübel. The height was found to be about 19,500 feet. Beyond the mountain knot of Los Pastos two Cordilleras run in a north-easterly direction to about 2° N. The western Cordillera is broken by the valley of the Patia, which has its source on the slopes of the valley between the mountain knot of Los Pastos and the transverse ridge south of Popayan. The eastern Cordillera is continued into the Paramo de Guanacas, from which basis the Andes spread out fan-like into three Cordilleras. This paramo, like the cross range between Iliniza and Cotopaxi, forms part of the main watershed between the rivers draining into the Atlantic and Pacific Oceans. North of the paramo this watershed runs along the western Cordillera for some distance, and then crosses several minor ranges of hills with their intervening valleys. The low watersheds at the head of the Atrato basin coincide with it; and north of Cupica Bay it suddenly bends, passing from within a few miles of the Pacific to within a few miles of the Atlantic Ocean. Having commenced this general account of the Andes with a notice of the mountain ranges of Columbia, and of the lowlands of the Isthmus of Panama, we thus come round to our starting-point. In the article AMERICA there is a brief account of the chain from a geological point of view, as well as of the transverse chains of South America; and under the heads of the various countries through which these pass further particulars are given.

The following references will assist the reader who wishes to enter more minutely into this subject:—Humboldt's works on South America; his papers in the *Journal de Physique*, vol. liii. p. 30 (1801); another in Gilbert's *Annalen*, vol. xvi. pp. 394, 450 (1804); Pentland's papers in *Phil. Mag.*, vol. ix. p. 115 (1828), and in the *Journal of the Roy. Geog. Soc.*, vol. v. p. 30 (1835); papers by Pissis in *Comptes Rendus*, vol. xl. p. 764 (1855), and vol. lii. p. 1147 (1861), as also in *Annales des Mines*, fifth series, vol. ix. p. 81 (1856); D. Forbes, "On the Geology of Bolivia and South Peru," in *Q. Jour. Geol. Soc.*, vol. xvii.

p. 7; Rammelsberg in *Monatsbericht Akad. Wiss., Berlin*, p. 326 (1870); Orton, *The Andes and the Amazon* (1870); Rickard, *A Mining Journey Across the Andes* (1863); Cunningham (R. O.), *Natural History of the Strait of Magellan* (1871).

ANDOCIDES, a Greek orator and diplomatist, was born at Athens in 467, and died about 391 B.C. After holding a command for a time in the Athenian fleet, he was engaged in various embassies to foreign states. In 415 he was implicated with Alcibiades in the charge of mutilating the busts of Hermes, suspicion being specially roused against him from a large bust near his house having been almost the only one that was left entire. On the information he gave against others, they were put to death; and Andocides himself was deprived of his rights of citizenship, and went into exile. He returned to Athens on three different occasions, and though he was as many times driven again into banishment, he appears to have held a position of trust and influence in the city from 403 to 393. Three orations of his—*De Reditis*, *De Mysteriis*, and *De Pace*—are extant, which are of great historical value. The authority of a fourth, *Contra Alcibiadem*, which has been attributed to him, is disputed on what appear to be good grounds. Andocides was one of the ten Attic orators, whose lives were written by Plutarch.

ANDORRE, or ANDORRA, a small semi-independent state on the south side of the Pyrenees, between the Spanish province of Lerida and the French department of Ariège. It is surrounded by mountains, and consists of one main valley, which is watered by the Balira, a tributary of the Segre, which itself flows into the Ebro, and of several smaller valleys, the most important of which are those of the Ordino and the Os. It has an area of about 150 square miles, and is divided into six parishes, Andorra la Viéja (the capital), San Julian de Loria, Canillo, Encamp, Ordino, Massana. The population is under 7000. The territory was once densely wooded, whence probably its name, from the Arabic *Aldarra*, "a place thick with trees;" but the forests have been almost entirely destroyed for fuel. The pasturage is extensive and excellent; the mountains contain iron and lead mines; rye, potatoes, fruits, and tobacco, are grown on the lower grounds; game and trout are abundant. The population is rather pastoral than agricultural; but smuggling, together with the manufacture of tobacco, occasions some traffic. The Andorrans are a robust and well-proportioned race, of an independent spirit, simple and severe in their manners, but mostly ignorant and ill-educated, although they receive instruction gratuitously at the parish schools; they speak the Catalan dialect of Spanish, and are all Roman Catholics. This remarkable little state is a surviving specimen of the independence possessed in mediæval times by the warlike inhabitants of many Pyrenean valleys. Its privileges have remained intact, because the *suzeraineté* of the district became equally and indivisibly shared, in 1278, between the bishops of Urgel and the counts of Foix; the divided *suzeraineté* being now inherited by the French crown and the present bishop of Urgel, and the two powers having mutually checked innovations, while the insignificant territory has not been worth a dispute. Thus Andorra is not a republic, but is designated in official documents as the "Vallées et Suzeraineté." Before 1278 it was under the *suzeraineté* of the neighbouring counts of Castelbo, to whom it had been ceded, in 1170, by the counts of Urgel. A marriage between the heiress of Castelbo and Roger Bernard, count of Foix, carried the rights of the above-named Spanish counts into the house of Foix, and hence, subsequently, to the crown of France, when the heritage of the feudal system was absorbed by the sovereign; but the bishops of Urgel claimed certain rights, which, after long dispute, were satisfied by the "Act of Division" executed in 1278. The claims of the bishopric dated from Carlovingian times, and the independence of Andorra, like most other Pyrenean anomalies, has been traditionally ascribed to Charlemagne. Preserved from innovations by the mutual jealousy of rival potentates, as well as by the conservative temper of a pastoral population, Andorra has kept its mediæval usages and institutions almost unchanged. In each parish two *consuls*, assisted by a local council, decide matters relating to roads, police, slight taxes, the division of pastures, the right to collect wood, &c. Such matters, as well as the general internal administration of the territory, are finally regulated by a *conseil général* of 24 members (4 to each parish), elected, since 1866, by the suffrages of all heads of families, but previously confined to an aristocracy composed of the richest and oldest families, whose supremacy had been preserved by the principle of primogeniture. A general syndic, with two inferior syndics, chosen by the *conseil général*, constitutes the supreme executive of the state. Two *viguiers*—one nominated by France, and the other by the bishop of Urgel—command the militia, which consists of about 600 men, although all capable of bearing arms are liable to be called out. This force is exempt from all foreign service, and the chief office of the *viguiers* is the administration of criminal justice, in which their decisions, given simply according to their judgment and conscience, there being no written laws, are final. Civil cases, on the other hand, are tried in the first instance before one of the two *aldermen*, who act as deputies of the *viguiers*; the judgment of this court may be set aside by the civil judge of appeal, an officer nominated by France and the bishop of Urgel alternately; the final appeal is either to the Court of Cassation at Paris, or to the Episcopal College at Urgel. A tribute of 960 francs is paid annually to France, in return for which the Andorrans are permitted to import certain articles free of duty; the bishop of Urgel receives a tribute of almost the same amount. The expenses of government are defrayed by a species of rent paid by owners of flocks to the community for the use of the pasture land.

ANDOVER, an ancient market-town in the north-west of Hampshire, situated near the left bank of the river Anton, 63 miles from London, and 12 from Winchester. It is well built, and contains a large parish church—erected about forty years ago on the site of the old one, which existed in the time of William the Conqueror—several dissenting places of worship, various elementary schools, and a spacious town hall. It returns one member to parliament; and its corporation, which is said to date from the reign of King John, consists of a mayor, four aldermen, and twelve councillors. Andover is the centre of a large agricultural district; its weekly markets and its fairs, held three times a year, are well attended, while at Weyhill, a village about 3 miles to the west, a fair is held every October, which was formerly one of the most celebrated in England. Malting is largely carried on, and there is an extensive iron foundry near the town; but the silk manufactures, once so prosperous, are now almost extinct. The Romans had a station at Andover, and the remains of their encampment are still to be seen in the neighbourhood. Population in 1871, 5501.

Seal and Arms.

ANDOVER, a post township of Essex county, Massachusetts, U.S., pleasantly situated on the southern bank of the Merrimack river, 21 miles north of Boston. Its first settlers came from Andover in England in 1643, and purchased a part of the Indian domain known as Cochichewick from the natives for $26.64 and a cloth coat. The streams in the vicinity afford water power, which is employed to some extent in manufactures of flannels, linen, and shoe thread; but the town is chiefly known by its academic institutions. The Punchard High School has a high local reputation. Phillips Academy is one of the most popular schools in New England. It was endowed by the Phillips family in 1778 with $85.000 (£17,000) and considerable landed estates, and has always been well sustained. It has a principal and eight instructors, and the number of pupils in 1873 was 252. The Andover Theological Seminary was founded in 1807, under the auspices of the Congregationalists, but is open to Protestants of all denominations. It has five professors and generally more than 100 students. Tuition and room rent are free to all, and additional aid is given to indigent students. The Abbot Female Academy, for the education of female teachers (founded in 1829), is also a flourishing institution. Andover has a bank, four churches, and two hotels. Its population in 1870 was 4873.

ANDRADA, Diego Payva d' (born at Coimbra in 1528, died 1575), a learned Portuguese theologian, who distinguished himself at the Council of Trent, to which he was sent by king Sebastian. He wrote seven volumes of sermons, besides several other works, one of which, *De Conciliorum Auctoritate*, was much esteemed at Rome for the great extension of authority it accorded to the Pope. His *Defensio Tridentinæ Fidei*, a rare and curious work, in which he discusses, among other subjects, immaculate conception, was published posthumously (1578).

ANDRADA E SYLVA, Bonifacio Jozé d', a distinguished Brazilian statesman and naturalist, was born at Villa de Santos, near Rio Janeiro, 1765, and died at Nictheroy, 1838. In 1800 he was appointed professor of geology at Coimbra, where he had studied, and soon after inspector-general of the Portuguese mines; and, in 1812, he was made perpetual secretary of the Academy of Lisbon. Returning to Brazil in 1819, he urged Dom Pedro to resist the recall of the Lisbon court, and was appointed one of his ministers in 1821. When the independence of Brazil was declared, Andrada was made minister of the interior and of foreign affairs; and when it was established, he was again elected by the constituent Assembly, but his democratic principles resulted in his dismissal from office, July 1823. On the dissolution of the Assembly in November, he was arrested and banished to France, where he lived in exile near Bordeaux till, in 1829, he was permitted to return to Brazil. But being again arrested, in 1833, and tried for intriguing on behalf of Dom Pedro I., he passed the rest of his days in retirement. He has left no single work of any length, but a multitude of memoirs, chiefly on mines.

ANDRÉ, John, an accomplished soldier, who has gained a place in history by his unfortunate end, was born in London, in 1751, of Genevese parents. Accident brought him in 1769 to Lichfield, where, in the literary circle of Miss Anna Seward, he met Miss Honora Sneyd. A strong attachment sprung up between the two; but their marriage was disapproved of by Miss Sneyd's family, and Andre was sent to cool his love in his father's counting-house in London. Business was, however, too tame an occupation for his ambitious spirit, and in March 1771 he obtained a commission in a regiment destined for America, the theatre at that time of the war of independence. Here his conduct and acquirements gained him rapid promotion, and he became in a few years aide-de-camp to the commander-in-chief of the British forces, Sir Henry Clinton, who had so high an opinion of him, that in 1780 he raised him to the post of major and adjutant-general of the forces. While Andre was in this situation, the American general, Arnold, who had displayed much energy in the cause of the colonies, conceiving himself injuriously treated by his colleagues, made a proposition to the British to betray to them the important fortress of West-Point, on the Hudson River, the key of the American position. This seemed a favourable opportunity of concluding the war, and Major André was appointed to negotiate with Arnold. For this purpose he landed from a vessel bearing a flag of truce, and had an interview with Arnold; but before the negotiations were finished, an American fort had fired on the vessel, and forced her to drop down the river. André, therefore, could not return by the way he came, and it was necessary to pass the night within the American lines at the house of his guide, Smith, and set out next day by land for New York. Both were provided by Arnold with passports, and succeeded in passing the American outposts undetected. Next day, however, just when all danger seemed to be over, and Smith had left André in sight of the English lines, André was stopped by three militiamen of the enemy, and carried back a prisoner. Washington sent him before a court-martial, and notwithstanding a spirited defence, and the remonstrances of the British general, who did all he could to save him, Major Andre was executed at Tappan as a spy on the 2d October 1780—a sentence perhaps justified by the extreme rigour of martial law, as he had been in disguise within the lines of the enemy; but the traitor Arnold, through the address of poor Andre, escaped by timely flight the punishment he justly merited. Besides courage, and distinguished military talents, Major Andre possessed a well-cultivated mind. He was a proficient in drawing and in music, and showed considerable poetic talent in his humorous *Cow-chase*, a kind of parody on *Chevy-chase*, which appeared in three successive parts at New York, the last on the very day of his capture. One of his last letters gives an affecting incident relating to his first love. When stripped of everything by those who seized him, he contrived to retain the portrait of Miss Sneyd, which he always carried on his person, by concealing it in his mouth. He was not aware that this lady had breathed her last some months before. His unhappy fate excited universal sympathy both in America and all over Europe, and the whole British army went into mourning for him. A mural sculptured monument to the memory of Major André was erected in Westminster Abbey by the British Government, when his remains were brought over and interred there in 1821.

ANDREA, Giovanni, the most famous Italian canonist of the 14th century, was born at Mugello, near Florence, about 1275. He studied canon law at Bologna, where he distinguished himself in this subject so much that he obtained a professorship of law, first at Padua, then at Pisa, and lastly at Bologna, rapidly acquiring a high reputation for his learning and his moral character. Little is positively known of his history, though many curious stories are told regarding him—*e.g.*, that, by way of self-mortification, he lay every night for twenty years on the bare ground with only a bear's skin for a covering; that, in an audience he had with Pope Boniface VIII., his extraordinary shortness of stature led the Pope to believe he was kneeling, and to ask him three times to rise, to the immense merriment of the cardinals; and that he had a daughter, Novella, so accomplished in law as to be able to read her father's lectures in his absence, and so beautiful, that she had to read behind a curtain lest her face should distract the attention of the students. He is said to have died at Bologna of the plague in 1348, after having been a professor for forty-five years. He was buried in the church of the Dominicans, and the public estimation of his character is testified by his epitaph, in which he is styled *Rabbi Doctorum. Lux, Censor, Normaque Morum.* Andrea wrote the following works: *Gloss on the Sixth Book of the Decretals; Glosses on the Clementines; Commentary on the Rules of Sextus.* His additions to the *Speculum* of Durando are a mere adaptation from the *Consilia* of Oldradus, as is also the book *De Sponsalibus et Matrimonio*, from J. Anguisciola.

ANDREANI, Andrea, a celebrated engraver on wood, in chiaroscuro, was born at Mantua about 1540, and died at Rome in 1623. His engravings are scarce and valuable, and are chiefly copies of Mantegna, Dürer, and Titian. The most remarkable of his works are "Mercury and Ignorance," the "Deluge," "Pharaoh's host drowned in the Red Sea" (after Titian), the "Triumph of Cæsar" (after Mantegna), and "Christ retiring from the judgment-seat of Pilate."

ANDREASBERG, a town of Prussia, in the former kingdom of Hanover, situated in the Hartz mountains, at an elevation of nearly 2000 feet above the level of the sea, and at a distance of about 10 miles S.E. from Clausthal. It contains 3321 inhabitants, many of whom are employed in the manufacture of lace, thread, or matches. In the vicinity there are valuable mines of silver, iron, lead, cobalt, arsenic, and copper.

ANDREEVA, or Enderi, a town of Russia, in the district of the Caucasus, situated on the Aktash, 45 miles south of Kizliar. It once had a large trade in slaves. Population, 12,000.

ANDREOSSI, Antoine-Francois, Comte d', a very distinguished French officer, was born at Castelnaudary in Languedoc, 6th March 1761, and died at Montauban, September 1828. He was of Italian extraction, and his grandfather, Francois Andreossi, had taken part with Riquet in the construction of the Languedoc canal in 1669. At the age of twenty he became a lieutenant of artillery, and he early joined the republican party. He accompanied Bonaparte to Egypt as a *chef de brigade*, serving with great distinction, and was selected as one of Napoleon's companions on his unexpected return to Europe. Andreossi filled with honour many important offices of command during subsequent campaigns, and was appointed ambassador to London after the treaty of Amiens. When Napoleon assumed the title of Emperor, Andreossi was advanced to be inspector-general of artillery, and made a count of the empire. He was sent as ambassador to Austria, where he remained till the rupture with France in 1809; and when the fatal battle of Wagram prostrated Austria, he held the post of governor of Vienna as long as that capital was occupied by the French. He was afterwards sent by Napoleon as ambassador to Constantinople, where he conciliated the friendship of both Franks and Mahometans. In 1814 he was recalled by Louis XVIII., who sent him, however, the cross of St Louis. Andreossi now retired into private life, till the escape of his former master from Elba once again called him forth. After the battle of Waterloo he finally quitted the scene of political life, relieving the tedium of retirement by writing several scientific memoirs. He was a man of solid and extensive acquirements. While in Egypt he had contributed to the Institute of Cairo memoirs on the *Valley of Lake Natron*, and on *Lake Menzaleh*. Subsequently he published an account of the *Campaign on the Main and the Rednitz;* a memoir on the *Flow of the Black Sea into the Mediterranean;* a history of the *Canal du Midi*, known previously as the *Canal de Languedoc*, the chief share in the construction of which he claimed for his ancestor; and a memoir on the *Constantinople Water-works System.*

ANDRES, Juan (1740–1817), an erudite Jesuit, born in Valencia, and some time professor of literature in the university of Gandia. He is the author of a great number of treatises on science, music, the art of teaching the deaf and dumb, &c. But his chief work, the labour of fully twenty years, is one in 7 vols. 4to., entitled *Dell' Origine, dei Progressi, e dello Stato attuale d'ogni Letteratura*, where a great deal of information is accumulated. (See Hallam's *Lit. of Eur.* and Sismondi's *Lit. of S. Europe*, vol. i.)

ANDREW, St, the apostle, born at Bethsaida in Galilee, brother to Simon Peter. He had been a disciple of John the Baptist, and followed Jesus upon the testimony given of Him by the Baptist (John i. 35, 40, &c.) Andrew introduced his brother Simon, and they passed a day with Jesus, after which they went to the marriage in Cana (*ibid.* ii.), and then returned to their ordinary occupation. Some months after, Jesus meeting them while they were both fishing together, called them to him, and promised to make them fishers of men. Immediately they left their nets and followed him (Matt. iv. 19). Tradition assigns Scythia, Greece, and Thrace, as the scenes of St Andrew's ministry: he is said to have suffered crucifixion at Patræ in Achaia, on a cross of the form called *Crux decussata* (×), and commonly known as "St Andrew's cross." His relics, it is said, were afterwards removed from Patræ to Constantinople. An apocryphal book, bearing the title of *The Acts of Andrew*, is mentioned by Eusebius, Epiphanius, and others. It is now completely lost, and seems never to have been received except by some heretical sects, as the Encratites, Origenians, &c. This book, as well as a *Gospel of St Andrew*, was declared apocryphal by a decree of Pope Gelasius (Jones *On the Canon*, vol. i. p. 179, *et seq.*)

ANDREWES, Lancelot, D.D., Bishop of Winchester, one of the most illustrious of the prelates of England, was born in 1555 in Thames Street, Allhallows, Barking, London. His father Thomas was of the ancient family of the Suffolk Andrewes; in his later years he became master of Trinity House. Lancelot was sent while a mere child to the Coopers' Free School, Ratcliff, in the parish of Stepney. From this the youth passed to Merchant Taylors' School, then under the celebrated Richard Mulcaster. In 1571 he was entered at Pembroke College, Cambridge. He was here one of the first four scholars upon the foundation of Dr Thomas Watts, successor of the venerable Nowell. Contemporaneously he was appointed to a scholarship in Jesus College, Oxford, at the request of the founder (Dr Price), by Queen Elizabeth. In 1574–5, he took his degree of B.A.; in 1576 he was chosen to a fellowship at his college; in 1578 he proceeded M.A.; in 1580 he was ordained, and in the same year his name appears as junior treasurer: in 1581 he was senior treasurer, and on July 11, was incorporated M.A. at Oxford. On passing M.A., he was appointed catechist in his college, and read lectures upon the Decalogue, afterwards published, causing a *furor* of interest far and near, as his first quaint biographer Isaacson tells. The notes of these lectures printed in 1642 authenticate themselves; later editions have been suspiciously enlarged, and otherwise altered for the worse. The notes are historically valuable and important, inasmuch as with Bishops Jewell and Bilson, he teaches in them, that Christ is offered in a sacrament, that is, his offering is represented and a memory of his passion celebrated. Nothing can be more definite or emphatic than Andrewes' repudiation of a real external sacrifice in the bread and wine. From the university Andrewes went into the North, on the invitation of Henry Hastings, earl of Huntingdon, lord president of the North. In 1585 he is again found at Cambridge taking his degree of B.D. In 1588 he succeeded Crowley in the vicarage of St Giles, Cripplegate. Here he delivered his most penetrative and striking sermons on the *Temptation in the Wilderness*, and the *Lord's Prayer*—the former published in 1592, the latter in 1611. In a great sermon on April 10, in Easter week 1588, he most effectively, and with burning eloquence, vindicated the Protestantism of the Church of England against the Romanists. It sounds oddly to have "Mr Calvin" adduced herein and elsewhere as a new writer, with lavish praise and affection. Passing other ecclesiastical advancements, Andrewes was preferred by Grindal, at the suit of Walsingham, to the prebendal stall of St Pancras in St Paul's, London, in 1589. The prebendary had "the courage of his opinions," for Sir John Harington records that Sir Francis Walsingham, his patron, having laboured to get him to maintain certain points of ultra-Puritanism, he refused, having, as the garrulous Knight, in his *State of the Church of England* (pp. 143, 144), punningly remarks, "too much of the ἀνδρος in him to be scared with a councillor's frown, or blown aside with his breath," and accordingly answered him plainly, that "they were not only against his learning, but his conscience." On September 6, 1589, he succeeded Fulke as master of his own college of Pembroke, being at the time one of the chaplains of Archbishop Whitgift. His mastership of Pembroke was a success in every way. In 1589–90, as one of the twelve chaplains of the queen, he preached before her majesty a singularly outspoken sermon (March 4, 1590). In this year, on October 13, he preached his introductory lecture at St Paul's, upon undertaking to comment upon the first four chapters of Genesis. These form part of the *Orphan Lectures*, of the folio of 1657, than which there is no richer contribution to the theological literature of England, notwithstanding the imperfection of the notes in some cases. He was an incessant worker as well as preacher. He delighted to move among the people, and yet found time to meet with a society of antiquaries, whereof Raleigh, Sidney, Burleigh, Arundel, the Herberts, Saville, Stow, and Camden, were members. What by his often preaching, testifies Isaacson, at St Giles's, and his no less often reading in St Paul's, he became so infirm that his friends despaired of his life. His charities were lavish, and yet discriminative. The dearth of 1594 exhibits him as another Joseph in his care for the afflicted and poor of "the Israel of God." In 1595 appeared *The Lambeth Articles*, a landmark in our national church history. Andrewes adopted the doctrine of St Augustine as modified by Aquinas. Philosophically, as well as theologically, his interpretations of these deep things remain a permanent advance in theological-metaphysical thought. In 1598 he declined offers of the two bishoprics of Ely and Salisbury, his "nolo episcopari" resting on an intended alienation of the lands attached to these sees. On November 23, 1600, was preached at Whitehall his memorable sermon on Justification, around which surged a controversy that is even now unspent. The preacher maintained the evangelical view as opposed to the sacerdotal. On July 4, 1601, he was appointed dean of Westminster, and his sedulousness over the renowned school is magnified by Bishop Hacket in his *Life of Archbishop Williams*. On July 25, 1603, Andrewes assisted at the coronation of James I. In 1604 he took part in the Hampton Court Conference, and, better service, was one of the committee to whom we owe our authorised version of Holy Scripture. The dean frequently preached before the king, and his majesty's own learning, given him by George Buchanan, made him a sympathetic hearer. Many of these state sermons are memorable from their results and place in our ecclesiastical history. In 1605 he was appointed, after a third declinature, bishop of Chichester. In 1609 he published his *Tortura Torti*, in answer to Bellarmine's *Matthæus Tortus*. This work is one of many born of the gunpowder plot and related controversies. It is packed full of learning, and yet the argument moves freely. Nowhere does Andrewes' scholarship cumber him. It is as a coat of mail, strong but mobile. In this same year he was transferred from Chichester to Ely. His studiousness here was as intent as before. He again assailed Bellarmine in his *Responsio ad Apologiam*, a treatise never answered. From 1611 to 1618, Andrewes is to be traced as preacher and controversialist in season and out of season. In 1617 he attended the king to Scotland. In 1618 he was translated to the see of Winchester. In this year he proceeded to the Synod of Dort. Upon his return he became in word and deed a model bishop, while in every prominent ecclesiastical event of the period he is seen in the front, but ever walking in all beauty of modesty and benignity. His benefactions were unprecedented. His learning made him the equal and the friend of Grotius, and of the foremost contemporary scholars. His preaching was unique for its combined rhetorical splendour and scholarly richness, and yet we feel that the printed page poorly represents the preaching. His piety was that of an ancient saint, semi-ascetic and unearthly in its self-denial, but rooted in a deep and glowing love for his Lord. No shadow rests on his beautiful and holy life. He died 25th September 1626, and the leaders in church and state mourned for him as for a father. Two generations later, Richard Crashaw caught up the universal sentiment, when in his lines *Upon Bishop Andrewes' Picture before his Sermons*, he exclaims:—

> "This reverend shadow cast that setting sun,
> Whose glorious course through our horizon run,
> Left the dimme face of this dull hemisphere,
> All one great eye, all drown'd in one great teare."

It is to be regretted that the works of Bishop Andrewes have been only fragmentarily and uncritically collected and edited; but the edition of the Anglo-Catholic Series suffices to place him in the front rank of the theologians of England. (Works, as originally published, and as collected *ut supra*; Isaacson's Life in Fuller's *Abel Redivivus*; Buckeridge's *Sermon*; Russell's *Memoirs of the Life and Works* (1860), a medley of materials and discursive notes; British Museum Harleian MSS.) (A. B. G.)

ANDREWS, James Pettit, an English historian and miscellaneous writer, was the younger son of Joseph Andrews, of Shaw-house, near Newbury, Berks, where he was born in 1737. He was educated privately, and early discovered a taste for literature and the fine arts. Andrews was the author of several miscellaneous works, but his most extensive undertaking was his *History of Great Britain, connected with the Chronology of Europe, with Notes*, &c., of which, however, he lived to complete but two volumes. The first, which was published in 1794, in 4to, commences with Cæsar's invasion, and ends with the deposition and death of Richard II.; and the second, which appeared in 1795, continues the history to the accession of Edward VI. The plan of this work was new, and in some respects singular; a portion of the history of England is given on one page, and a general sketch of the contemporaneous history of Europe on the page opposite. He appears to have left off this work to prepare a continuation of Henry's *History of Britain*, which he published in 1796 in one volume 4to, and two volumes 8vo. He died at Brompton 6th August 1797.

ANDRIA, a town of Italy, in the province of Terra di Bari, situated in a plain 31 miles west of Bari. The town, which is said to derive its name from the caverns (*antra*) in the vicinity, is well built, and possesses a fine cathedral, founded in 1046 by Petro Normano, count of Trani. It has no manufactures of importance, but there is an extensive trade in almonds, which are imported in large quantities from the surrounding country. Andria was burned in 1799 by General Broussier, and in 1861 it became part of the new kingdom of Italy. Population, 34,000.

ANDRIEU, Bertrand, a celebrated engraver of medals, born, 24th November 1761, at Bordeaux. He is considered as the restorer of the art in France, which had declined after the time of Louis XIV.; and was so highly esteemed, that during the last twenty years of his life he was entrusted by the French Government with the execution of every work of importance. Many of his medals are figured in the *Medallic History of Napoleon.* He died at Paris 6th December 1822.

ANDRISCUS, a man of mean extraction, who, pretending to be the natural son of Perseus, last king of Macedonia, assumed the name of *Philip*, for which reason he was called *Pseudo-Philippus*, the False Philip. Escaping from Rome, where he was imprisoned for his pretensions, he found a sufficient number of partisans in Thrace to encourage him to assert his claim to the throne of Macedonia, and enable him to defeat the Roman prætor Juventius, who had been sent against him. His brief reign was marked by great cruelty and extortion. In 148 B.C. he was completely defeated, and was carried captive to Rome by Q. Cæcilius Metellus, for whom this triumph gained the name of Macedonicus. The victory placed Macedonia once more in the hands of the Romans, though at a cost of 25,000 men. Andriscus was put to death by order of the senate.

ANDROCLUS, a Roman slave who used to lead about the streets a lion that had forborne to injure him when turned loose upon him in the circus. The story is related, on the authority of an eye-witness, by Aulus Gellius (*Noct. Att.*, v. 14), who states that Androclus, having taken refuge from the severities of his master in a cave in Africa, a lion entered the cave and presented to him his swollen paw, from which Androclus extracted a large thorn.

ANDROMACHE, in Greek legend, was the wife of Hector (*Iliad*, vi. 395), and daughter of Eëtion, prince of Thebe in Mysia. Her father and seven brothers had fallen by the hands of Achilles, when their town was taken by him. Her mother, ransomed at a high price, was slain by Diana (*Iliad*, vi. 428). To Hector Andromache bore a son, Scamandrius or Astyanax, whose death by the Greeks she was forced to look on; and when, her husband also slain by them and Troy taken, the captives were apportioned, she fell to Neoptolemus, the son of Achilles, with whom she went to Phthia, or, as it is also said, to Epirus, and there bore him the sons Molossus, Pielus, and Pergamus. Neoptolemus having been slain by Orestes, left her to the Trojan seer Helenus, who had followed him, and who now married her, and governed the kingdom of Molossia for her sons. After the death of Helenus, Andromache returned to Asia Minor with her youngest son Pergamus, who there founded a town named after himself. The tragic poets found a favourite subject in the events of her life, and in her faithful and affectionate character as the wife of Hector. In works of art the death of Astyanax, and the farewell scene between Andromache and Hector (*Iliad*, vi. 323) were represented,—the latter, it is said, in a painting which drew tears from Portia the wife of Brutus (Plutarch, *Brut.* 23).

ANDROMEDA, in Greek legend, the daughter of Cepheus and Cassiopea, or Cassiepea, king and queen of the Æthiopians. Cassiepea having boasted herself equal in beauty to the Nereids, drew down the vengeance of Neptune, the sea god, who sent an inundation on the land, and a sea monster which destroyed man and beast. The oracle of Ammon announced that no relief would be found until the king exposed his daughter Andromeda to the monster, and accordingly she was fastened to a rock on the shore. Perseus, returning from having slain the Gorgon, found her in this position, slew the monster, set her free, and married her against the opposition of Phineus, to whom she had before been engaged. Before leaving Æthiopia she bore a son, Perses, from whom the Persian kings traced their descent, as did also the kings of Pontus and Cappadocia, who had a portrait of Perseus on their coins. Returning with her husband first to Seriphus, and finally to Argos, Andromeda bore him Alcæus, Sthenelus, and Electryon, and thus founded the dynasty of the Persides. After her death Andromeda was translated by Minerva to a constellation in the northern sky, near Perseus and Cassiopea. The tragic poets used the legend of her life, and in works of art the slaying of the monster by Perseus was represented.

ANDRONICUS I. (Comnenus), Emperor of Constantinople, son of Isaac, and grandson of Alexis I. Comnenus, was born about the beginning of the 12th century. He was endowed by nature with the most remarkable gifts both of mind and body. He was handsome and eloquent, but licentious; and at the same time active, hardy, courageous, and an excellent soldier. His early years were spent in alternate pleasure and military service. In 1141 he was taken captive by the Turks-Seljuks, and remained in their hands for a year. On being ransomed, he went to Constantinople, where was held the court of his cousin, the emperor Manuel, with whom he was a great favourite. Here the charms of his niece, the princess Eudoxia, attracted him. She became his mistress, while her sister Theodora stood in a similar relation to the emperor Manuel. In 1152, accompanied by Eudoxia, he set out for an important command in Cilicia. Failing in his principal enterprise, an attack upon Mopsuestia, he returned, but was again appointed to the command of a province. This second post he seems also to have left after a short interval, for he appeared again in Constantinople, and narrowly escaped death at the hands of the brothers of Eudoxia. About this time (1153) a conspiracy against the emperor, in which Andronicus participated, was discovered, and he was thrown into prison. There he remained for about twelve years, during which time he made repeated but unsuccessful attempts to escape. At last, in 1165, he was successful; and, after passing through many dangers, reached the court of Jaroslav, grand duke of Russia, at Kiev. While under the protection of the grand duke, Andronicus brought about an alliance between him and the emperor Manuel, and so restored himself to the emperor's favour. With a Russian army he joined Manuel in the invasion of Hungary, and assisted at the siege of Semlin. After a successful campaign, they returned together to Constantinople; but a year after (1167), Andronicus refused to take the oath of allegiance to the prince of Hungary, whom Manuel desired to become his successor. He was removed from court, but received the province of Cilicia. Being still under the displeasure of the emperor, Andronicus fled to the court of Raymond, prince of Antioch. While residing here he captivated and seduced the beautiful daughter of the prince, Philippa, sister of the empress Maria. The anger of the emperor was again roused by this dishonour, and Andronicus was compelled to fly. He took refuge with Amaury, king of Jerusalem, whose favour he gained, and who invested him with the town of Berytus, now Beirout. In Jerusalem he saw Theodora, the beautiful widow of the late king Baldwin, and niece of the emperor Manuel. Although Andronicus was at that time fifty-six years old, age had not diminished his charms, and Theodora became the next victim of his artful seduction. To avoid the vengeance of the emperor, she fled with him to the court of the sultan of Damascus; but not deeming themselves safe there, they continued their perilous journey through Persia and Turkestan, round the Caspian Sea and across Mount Caucasus, until at length they settled among the Turks on the borders of Trebizond. Into that province Andronicus, with a body of adventurers, made frequent and successful incursions. While he was absent upon one of them, his castle was surprised by the governor of Trebizond, and Theodora with her two children were captured and sent to Constantinople. To obtain their release Andronicus made abject submission to the emperor; and, appearing in chains before him, implored pardon. This he obtained, and was allowed to retire with Theodora into banishment in the little town of Œnoe, on the shores of the Black Sea. In 1180 the emperor Manuel died, and was succeeded by his son Alexis II., a youth of twelve or fourteen years, who was under the guardianship of the empress Maria. Her conduct excited popular indignation; and the consequent disorders, amounting almost to civil war, gave an opportunity to the ambition of Andronicus. He left his retirement, secured the support of the army, and marched upon Constantinople. Alexis was compelled to acknowlege him as colleague in the empire. The empress was put to death, and her son soon shared the same fate. His dead body is said to have been insulted by Andronicus, but the authorities for this and similar stories are in all probability prejudiced. Andronicus, now (1183) sole emperor, married Agnes, widow of Alexis II., a child eleven years of age. His short reign was characterised by strong and wise measures. He resolved to check many abuses, but, above all things, to limit the power of the nobles. The people, who felt the severity of his laws, at the same time acknowledged their justice, and found themselves protected from the rapacity of their superiors. The aristocrats, however, were infuriated against him, and summoned to their aid William of Sicily. This prince landed in Epirus with a strong force, and marched as far as Thessalonica, which he took and destroyed; but he was shortly afterwards defeated, and compelled to return to Sicily. Andronicus seems then to have resolved to exterminate the aristocracy, and his plans were nearly crowned with success. But in 1185, during his absence from the capital, his lieutenant ordered the arrest and execution of Isaac Angelus, a descendant of the first Alexis. Isaac escaped, and took refuge in the church of St Sophia. He appealed to the populace, and a tumult arose which spread rapidly over the whole city. When Andronicus arrived he found that his power was overthrown, and that Isaac had been proclaimed emperor. His offers of a general pardon, and even of abdication in favour of his son, were rejected; and, after an unsuccessful attempt at escape, he was seized and dragged before the new emperor. Isaac delivered him over to his enemies, and for three days he was exposed to their fury and resentment. At last they hung him up by the feet between two pillars. His dying agonies were shortened by an Italian soldier, who mercifully plunged a sword into his body. He died on the 12th September 1185.

ANDRONICUS II. (Palæologus), Emperor, was born 1260. He was the elder son of Michael Palæologus, whom he succeeded in 1283. During his reign the Turks under Osman conquered nearly the whole of Bithynia; and to resist them the emperor called in the aid of Roger de Flor, who commanded a body of adventurers. The Turks were defeated, but Roger was found to be nearly as formidable an enemy to the imperial power. He was assassinated in 1308. His adventurers declared war upon Andronicus, and after devastating Thrace and Macedonia, settled in the southern part of Greece. From 1320 onwards the emperor was engaged in war with his grandson, Andronicus, in whose favour he was compelled to abdicate, 1328. He retired to a convent, and died about 1334.

ANDRONICUS III., grandson of the preceding, was born about 1296. His conduct during youth was so violent, that his grandfather resolved to deprive him of his right to the crown. Andronicus rebelled, and in 1328 compelled his grandfather to abdicate in his favour. During his reign he was engaged in constant war, chiefly with the Turks, who greatly extended their conquests. He died in 1341.

ANDRONICUS of Cyrrhus, a Greek astronomer, about B.C. 100, built at Athens an octagon tower, with figures carved on each side, representing the eight principal winds. A brazen Triton at the summit, with a rod in his hand, turned round by the wind, pointed to the quarter from which it blew. From this model is derived the custom of placing weathercocks on steeples. A considerable portion of this tower still exists; and, instead of "tower of the winds," it should be called *horologium*, the name by which it is designated by Varro.

ANDRONICUS of Rhodes, the eleventh scholarch of the Peripatetics, lived about B.C. 70. His chief work was the arrangement of the writings of Aristotle, the materials for which had been supplied to him by Tyrannion. Besides arranging the works, he seems to have written paraphrases and commentaries, none of which have come down to us. Two writings under the name Andronicus are sometimes erroneously attributed to him, one on the Emotions, the other a commentary on Aristotle's *Ethics*.

ANDROS, or Andro, the ancient *Andros*, an island of the Grecian Archipelago, the most northerly of the Cyclades, lying 6 miles S.W of Eubœa, and about 2 N. of Tenos. It is nearly 25 miles long, and its greatest breadth is 10 miles. Its surface is for the most part mountainous, with many fruitful and well-watered valleys, which produce vines, grain, olives, pomegranates, lemons, figs, and oranges, and supply food for cattle, silk-worms, and bees. At Andros, the capital, a town on the east coast, containing about 5000 inhabitants, there are silk and carpet manufactures, the former of which gives rise to a considerable export trade; but the harbour does not afford accommodation except for vessels of small size, and is much inferior to that of Gaurio (*Gaurium*) on the west coast, near the ruins of an older Andros, the ancient capital of the island. This Andros, which was situated on the brow of a hill that commands the whole coast, contained a famous temple, dedicated to Bacchus, and a spring that was said to flow with wine during the feast of the god. The island is supposed to contain about 15,000 inhabitants, the bulk of whom belong to the Greek Church. According to the ordinary account, Andros, which is said to derive its name either from Andreus, a general of Rhadamanthus, or from a seer called Andrus, was colonised by the Ionians about 1000 B.C., and soon became a place of some importance. In 480, after the battle of Salamis, Themistocles made an attempt to take the capital, wishing to punish the inhabitants for their readiness to assist the Persians in their invasion of Greece; and, although he failed in this enterprise, the island afterwards became for a time subject to the Athenians. In 333 it was added to the Macedonian empire; and after the death of Alexander the Great, became part of Ptolemy's kingdom. In 200 it was taken by the Romans, who handed it over to Attalus I., king of Pergamos; and in 133 it reverted to the Romans, in accordance with the will of Attalus III. On the dissolution of the empire of the East, Andros came under the rule of the Turks; but now, along with the island of Tenos, it forms a government of the modern kingdom of Greece.

ANDUJAR, a town of Spain, in the province of Jaen, Andalusia, situated near the Guadalquivir, 20 miles N.W. of Jaen. It is a dull, unhealthy place, possessing few buildings of any architectural beauty; but there is a road leading to an old bridge over the Guadalquivir which is lined with fine trees. The town has an inconsiderable trade in cattle, grain, oil, and fruit. It is most widely known for its porous earthenware jars, called *alcarrazas*, which possess the property of keeping water cool in the hottest weather, and which are manufactured in great numbers from a whitish clay found in the neighbourhood. The Convention of Baylen was signed at Andujar in 1808; and the decree of the duke of Angoulême, by which all Spanish authorities were subordinated to the French, was published in the same town in 1823. Population, 14,096.

ANDUZE, a town of France, in the department of Gard, situated on the Gardon d'Anduze, about 6 miles S.W. of Alais. It possesses considerable manufactures of serges, stockings, hats, silk, and leather, and has 5303 inhabitants, many of whom are Protestants.

ANECDOTE, a word derived from α privative and ἐκδίδωμι, to give out or publish, means originally something not published. It has two distinct significations. First, the primary one is something not published, in which sense it has been used to denote either secret histories,—Procopius, *e.g.*, gives this as one of the titles of his secret history of Justinian's court,—or portions of ancient writers which have remained long in manuscript and are edited for the first time. Of such *anecdota* there are many collections; the earliest was probably Muratori's, in 1709. Besides it, there are *anecdota* by Bekker, Bachmann, Cramer, Boissonade, Matranga, Miller, Wolff, Villoisin, Amaduci, Tischendorf, and, the most recent, Val. Rose, 1864–71. There are also *anecdota* of more modern writers; some of these are given by Martene and Durand, *Thesaurus Novus Anecdotorum* (1717), and Pez, *Thesaurus Anecdotorum Novissimus* (1721). Second, in the popular acceptation of the word, which is to be traced to their being, in the first instance, colloquial, anecdotes are relations of detached interesting particulars. Of such anecdotes the collections are almost infinite; the best in many respects is that compiled by Byerley and Clinton Robertson, known as the *Percy Anecdotes* (1820–23).

ANEL, Dominique, an eminent French surgeon, born at Toulouse in 1679. He is celebrated for his successful treatment of aneurism and *fistula lachrymalis*, and was the inventor of the probe and syringe still known by his name. He wrote several medical works, published at Amsterdam 1707, Turin 1713, and Paris 1822. He died about 1730.

ANEMOMETER, or *wind-measurer* (from ἄνεμος, wind, and μέτρον, a measure), a contrivance for indicating the rate and direction of the wind. Ever since the birth of true experimental science, it has been recognised as a matter of great importance and interest to man that he should know something of the laws according to which the atmospheric currents and changes are produced. Among meteorological phenomena, none deserve more attention than the elements of the wind; and none have received more. Yet anemometry has been all along the least successful department of meteorology, partly owing, of course, to the nature of the agent to be dealt with, which is the very type of fluctuation, and partly to a mistaken path of observation that was too long followed. The error which, from the days of Hooke, in the middle of the 17th century, to within a comparatively recent period, misdirected the efforts of inventors, was the idea that the elements to be determined in the case of the wind are its direction and *pressure*, whereas practically they are its direction and *velocity*. If the currents of air were anything like uniform, it would be a comparatively simple matter to deduce the velocity from the pressure; but their variability is so very great, that the relations between the velocity and the pressure become unworkably complex. We know, from the elementary principles of dynamics, that the pressure at any instant will vary as the square of the velocity. Obviously, therefore, the relative variations of the pressure will be *twice as great* as those of the velocity; and the latter are too great, as we find them, to encourage us to double them artificially. It must also be remembered that, from the inertia of the indicating apparatus, errors will in every case arise; and these also will be doubled if we take the pressure instead of the velocity variations. From all this it will appear that comparatively little importance is to be attached to the earlier and to all statical modes of anemometry.

The essentials of every anemometer are two: (1), a *wind-vane*, to show changes of direction; and (2), a *wind-gauge*, to show changes of velocity, or of force. There is also a distinction which we may have in every kind of meter. They may be either *non-recording*, as merely exhibiting the variations to the eye; or *recording*, or marking them permanently on paper.

The wind-vane, or weather-cock, is simply a flat sheet of thin metal, or two sheets in the shape of a thin wedge, at the end of a metal rod, the whole turning freely on a vertical axle. Besides serving to show the direction of the wind itself, the vane is often used to turn the gauge, so as to present the pressure-surface with its face always direct to the wind.

Of all the gauges that have been invented or proposed it would be impossible to give even the names. The primitive statical forms of anemometer—that is, such as set against the force of the wind a gradually increasing resistance, with some means of indicating the point of balance—have been divided by Dr Robinson (*Trans. Roy. Irish Acad.*, vol. xxii. p. 150) into three classes:—First, vertical windmills, kept facing the wind by a vane, and acting by winding on their axle a string against some form of graduated resistance. Of this nature were Dr Hooke's anemometer (which is generally considered the first practical attempt in wind-measuring), and those of Wolfius and Martin. The second class consists of those in which the wind acts on a flat plate, usually a foot square, pressing it against the elasticity either of a metallic spring or of a mass of confined air, a previous graduation of the elastic force having been made for each instrument. The first gauge of this type was invented by the celebrated Bouguer about the middle of last century; and since his time there have been many attempts at improvement of this principle, the apparent simplicity of the spring-measure being its recommendation. Modified forms of Bouguer's wind-pressure gauge are in use even at the present day; and about a quarter of a century ago a self-registering adaptation of it was constructed by Osler, and very generally employed. The third class measures the wind-force by the difference of level it is capable of producing in an inverted syphon, or U tube, containing water or some other liquid. Lind's anemometer, invented in 1775, is the best known of this type, and is still in common use. It is simply a U tube, with one leg bent at right angles towards the upper end, and attached to a vane, so as to have its mouth constantly facing the wind. It is about half-filled with water, and a scale graduated to hundredths of an inch is attached. The difference of level in the legs of the syphon indicates the force of the wind; but it is only by experiment that the pressures corresponding to these differences can be laid down. Thus each instrument requires a carefully-constructed reference table of pressures and velocities corresponding to its readings. According to Lind, a difference of level of 1 inch indicates a pressure of 5·2 lb on the square foot, and that corresponds to a velocity of about 32½ miles an hour, which is in common language a *high wind*. A difference of 3 inches would indicate a *storm*, and one of 6 inches a *hurricane.* Rivalling this in simplicity is a fourth class, that may be added to Dr Robinson's, viz., *pendulum anemometers*, where the pressure-plate is swung as a pendulum, and indicates the wind-force by its deviation from the vertical. The first of this form was invented by the Marquis Poleni, and gained the prize of the French Academy in 1733. They are still employed as simple rough-and-ready indicators to the eye of the strength of the wind.

Several other anemometers have been contrived, which, from being essentially non-recording, may be mentioned as more curious than valuable. Among these are—(1.) A *musical anemometer*, suggested by Dr Hooke, and constructed by Delamanon, in which the wind was caused to sound automatically, in a set of pipes, a particular note corresponding to its velocity; (2.) *Leslie's anemometer*, or rather anemometric principle, which deduces the velocity of the wind from its effect in cooling a thermometer, it being supposed that the rate of cooling is proportional to the velocity of the wind; (3.) *Brewster's evaporation anemometer*, by which the velocity may be deduced from the amount of water evaporated in a given time from a rough open surface, such as sponge or flannel, the two being in proportion.

Osler's anemometer, the last of the pressure-gauges we shall mention, being one of the most trustworthy and most common registering anemometers in this country, merits a more particular description. It traces with pencils on a sheet of paper (which is moved along, either in a vertical or a horizontal position, at a constant rate by means of clock-work) lines which indicate changes of the wind, both in direction and in pressure. Its general principle will be readily understood without a diagram. Changes of *direction* are recorded in this way. The axle that carries the vane, and turns with it, has keyed on its lower end a pinion which, working in a horizontal rack, moves it backwards or forwards as the axle turns one way or the other; and a pencil fixed to the rack traces its movements on the register-sheet. Changes of *pressure*, or *wind-force*, are measured by means of springs. A square foot of a light metal plate, placed vertically and turning with the vane-rod, receives the impulse of the wind, and is forced against three springs, so arranged that one, two, or all of them may be pressed on according to the violence of the wind. The extent of compression against the springs is transmitted through the hollow vane-axle, by means of chains and pulleys, to a light spring, which presses a pencil gently against the paper. Variations of motion of the upper plate thus correspond to definite lateral deviations of this second spring pencil, and a wavy line is traced on the paper as it moves along. The register-sheet is ruled across its length into twenty-four equal parts, one of which passes the pencil points each hour; and lengthways it is ruled—first, with lines corresponding to the cardinal points, under the direction-pencil; and secondly, on the field of the other pencil, with lines spaced by actual experiment so as to correspond to gradations of 5, 10, 15, 20, &c. lb of wind-pressure on the square foot. Thus the pressure-curve, in the same way as on the indicator of a steam-engine, includes between it and the horizontal line of zero-pressure a space proportional to the amount of *work done* by the wind on the upper pressure-plate. Of course, so long as the wind blows in one direction, the direction-pencil traces a horizontal line; and if there be no wind at all, both pencils trace the zero horizontal lines.

We have not space to enter particularly into the history of the direct velocity-measuring anemometers. As long ago as 1783, one was contrived on this principle by Mr Edgeworth for the measurement of air-currents; but to Dr Whewell belongs the credit of first appreciating at its true value the velocity as opposed to the pressure measure. In the *Cam. Trans.*, vol. vi., he describes an instrument of his own devising, which was afterwards extensively used. Sir W. Snow Harris recommended it strongly to the British Association in 1844, exhibiting results of his own observations with it during three previous years. Owing, however, to some practical defects, such as the great frictional resistance of toothed wheels and endless screws, which have more effect on the indications of a gentle wind than of a high one, and to the want of an arrangement for indicating the *times* of the variations, Dr Whewell's instrument has now fallen into disuse. A description of it may be found in Drew's *Practical Meteorology*. One of the most valuable contributions to this science was made by Dr Robinson, of Armagh, who between the years 1843 and 1846 conducted a number of experiments and calculations on the proper form to be given to the revolving vanes. He found radical defects in the principle of all the vanes previously employed; either their moving power was not sufficiently great to make the frictional correction inconsiderable, or their velocity, in place of being less, was often three or four times greater than that of the wind, requiring greater complicacy of machinery to reduce the speed of the tracing point; or, lastly, their results were not identical, though constructed after the same type. The form adopted by Robinson to remedy these defects is that shown in the figure. Though it had been suggested to him by Edgeworth, it deservedly bears the name of *Robinson's Cups* (fig. 1), as he was the first to show experimentally and analytically its advantages. The arrangement consisted of four light metal hemispheres C, of as large a diameter as convenient, extended at the ends of light and strong metal radii, so that they shall be as far from the axis of motion as possible, and so reduce the effect of friction to a minimum. They require no vane to keep them facing the wind, that represented by F, F, in the figure having a movement quite independent of the cups, as will be explained presently. He found that the cups move at almost exactly one-third of the rate of the wind—a happy simplicity of ratio—and this for all instruments made after one type. Experiments were made with sets of two, three, four, and six cups; but the velocity ratio between the cups and the wind was simplest and most constant with four, the number now universally employed. In the paper already quoted (*Trans. Roy. Irish Acad.*, vol. xxii.), Dr Robinson describes a self-registering apparatus, to which he had fitted the horizontal cups. But we shall describe instead one of the more modern and simple registers, which seems to leave little further to be desired in the way of compactness and accuracy. It is the invention of Mr Beckley, of the Kew Observatory, and is described in full in the *Report of the British Association*, 1858, p. 306. The outside, or wind-receiving parts are represented in the above figure, and consist of Robinson's cups C, for the wind-velocity, and a double fan F, or windmill governor, for wind-direction. The fans serve as a vane, turning so as to keep their axes constantly at right angles to the wind, and are more steady than the ordinary vane. They are connected with the outer brass tube B, and carry it round with them on any change of wind-direction. The second figure shows the manner in which the motions of the fans and cups are recorded. R is a cylinder, which carries the register-sheet, on which the

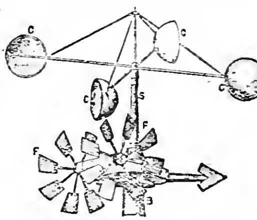


FIG. 1.—Cups and Vane of Anemometer.

two pencils P, Q, press lightly. It is turned round at a uniform rate by clock-work in K, making a complete revolution in twenty-four hours, or moving through half an inch per hour. Horizontal lines divide the sheet into hour spaces, marked 1, 2, 3, &c., in the figure. The fan, or direction-axle B (fig. 1), communicates its motions to a mitre wheel M (fig. 2), which, gearing into the bevel wheel T, moves the cylinder D, with its brass pencil P. By a change of the wind from north to south, the pencil would trace a line along the cylinder between the vertical lines N and S. In like manner the velocity of the cups is communicated by a shaft passing through the direction-axle to a mitre wheel W, which moves the bevel wheel N, the cylinder L, and its pencil Q. Vertical lines are drawn on the paper, so that the pencil moves over one space, while the wind travels 10 miles, or the cups

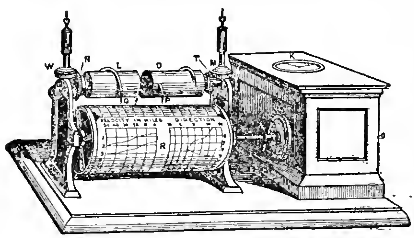


Fig. 2.—Recording Apparatus.

one-third of that distance. The velocity range does not extend beyond 50 miles, that being sufficiently high above the *average* rate of the winds. The sheet requires to be renewed, and the clock-work rewound every twenty-four hours, a matter of only a minute or two. The figure shows a simple brass spiral pencil; but the pencil devised by Beckley for the Kew Observatory consists of a strip of brass fixed spirally on edge, so that for equal increments of rotation of its cylinder its point of contact with the register-sheet shifts along by equal increments horizontally.

Anemometry now forms a most important feature in all meteorological observations, and many important and remarkable results have appeared since the invention of self-recording apparatus. See Meteorology.

ANET, a town of France, in the department of Eure-et-Loir, situated between the rivers Eure and Vègre, 9 miles N.E. of Dreux. It contains the ruins of a magnificent castle, built by Henry II. for Diana of Poitiers, and near it is the plain of Ivry, where Henry IV. defeated the armies of the League in 1590. It has 1418 inhabitants, who carry on a small trade in corn, wood, and fodder.

ANEURISM (from ἀνεύρυσμα, a dilatation), a cavity, which contains blood, either fluid or coagulated, and which communicates with an artery; the walls of the cavity are formed either of the dilated artery or of the tissues around the vessel. This affection, a malady of middle life and old age, may arise in consequence of injury or disease of the blood-vessels.

ANGARA, Upper and Lower, two rivers of Asiatic Russia, in the government of Irkutsk. The former rises in the mountains to the east of Lake Baikal, and falls into the head of the lake after a course of nearly 300 miles. The latter, which is sometimes called the Upper Tungonska, flows out of Lake Baikal, near its southern extremity, and passing the town of Irkutsk, falls into the Yenisei, after a course of about 1100 miles. The current of the river is very strong, forming several rapids in its progress. The scenery on its banks is frequently extremely beautiful.

ANGARIA (ἀγγαρεία), a sort of government postal system adopted by the Romans under the empire, borrowed from the ancient Persians, among whom, according to Xenophon, it was established by Cyrus. Couriers (*angari*, ἄγγαροι) on horseback were posted (*positi*), at certain stages along the chief roads of the empire, for the transmission of royal despatches by night and day in all weathers. The supply of horses and their maintenance were compulsory, constituting under the Romans a burden from which the emperor alone could grant exemption. Hence the word came to mean generally compulsory service in the despatch of royal messages.

ANGEL is a transcription of the Greek ἄγγελος, *a messenger*, but in signification corresponds to the special theological sense which the latter word assumed among the Hellenistic Jews (and hence in the New Testament and in Christian writings), by being adopted as the translation of the Hebrew *Mal'akh.* Thus both name and notion of angel go back to the Old Testament.

The Old Testament belief in angels has two sides, being, on the one hand, a particular development of the belief in special manifestations of God to man; and on the other hand, a belief in the existence of superhuman beings standing in a peculiar relation of nearness to God. These two sides of the doctrine are historically associated and co-operate in the later developments of Biblical angelology, but are not in all parts of the Old Testament fused into perfect unity of thought.

The first side of the belief in angels is expressed in the word *Mal'akh*, a messenger or ambassador,—more fully, *messenger of Jehovah* [*E. V.*, angel of the Lord], *messenger of God.* The whole Old Testament revelation moves in the paradox that God is invisible and inaccessible to man, and yet approaches man in unmistakable self-manifestation. This manifestation takes place in various ways,—in the priestly oracle, in prophecy, in the glory of God within the sanctuary [shekhina]. But in particular the early history represents God as manifesting himself by his *messenger.* In special crises "the messenger of Jehovah" calls from heaven to Hagar or to Abraham (Gen. xxi., xxii.) Or if God seeks to commune more fully with a man, his messenger appears and speaks to him. The narratives of such angelophanies vary in detail. Generally there is but one angel, but Abraham is visited by three (Gen. xviii.) Sometimes the dignity of the heavenly visitor is detected while he is present, at other times he is mistaken for a prophet, and recognised only by something supernatural in his disappearance (Judges vi. 21, *f.*, xiii. 20). Jacob wrestles all night with a "man," who at length with a touch dislocates his thigh (Gen. xxxii. 24, *ff.*) At other times no human form is seen. It is the angel of Jehovah who speaks to Moses in the burning bush, and leads the Israelites in the pillar of cloud and smoke (Exod. iii. 2, xiv. 19).

In all this there is perfect indifference to the personality of the angel, who displays no individuality of character, refuses to give a name (Gen. xxxii.; Judges xiii.), acts simply as the mouthpiece of God. This is carried so far that in his mouth the pronoun *I* indicates Jehovah himself; while the narrative passes, without change of sense, from the statement, "the angel of Jehovah appeared; spoke," &c., to "Jehovah appeared, spoke." (*Cf.*, for example, Exod. iii. ver. 2 with ver. 4; xiii. 21, with xiv. 19.) Those who see the angel say they have seen God (Judges xiii. 22; Gen. xxxii. 30). The angelophany is a theophany as direct as is possible to man. The idea of a full representation of God to man, in all his revealed character, by means of an angel, comes out most clearly for the angel that leads Israel in the very old passage, Exod. xxiii. 20, *ff.* This angel is sent before the people to keep them in the way and bring them to Canaan. He speaks with divine authority, and enforces his commands by divine sanctions, "for my name [*i.e.*, the compass of my revealed qualities] is in him." The question naturally arises, how the angel who possesses these high predicates stands related to angels who elsewhere appear not representing the whole self-manifestation of God to his people, but discharging isolated commissions. The Biblical data for the solution of this question are very scanty. An essential distinction between the "angel of the Lord," who speaks in all things with full divine authority, and subordinate angels, is sought mainly in Gen. xviii. and in Exod. xxxii. 30, *ff.*, xxxiii. compared with Isaiah lxiii. 9. In the former case, though two of the three angels leave Abraham, Jehovah goes his way only on the departure of the third. Yet the two angels when they come to Lot are apparently as direct a manifestation of God to him as the third was to Abraham (xix. 18, *ff.*) And in the other passage it has not been clearly made out that there is really a distinction drawn between an angel who represents God's presence and an angel of a lower kind who does not do so. The notion (long current in dogmatic theology, and which goes back to the earliest controversies between Jews and Christians) that "the angel of the Lord," as contradistinguished from created angels, is the Logos—the second person of the Trinity—has found defenders down to the present day (Hengstenberg, Keil, &c.), but certainly does not express the sense of the Old Testament writers. And it seems equally unprofitable to base on such passages as we have cited, a controversy whether "the angel of Jehovah" is one special angel charged throughout history with special functions towards the covenant people, or is any angel who from time to time has a special commission, or is to be viewed, at least in some cases, not as a hypostatic being, but simply as a momentary sinking of the invisible God into the sphere of visibility. The *function* of the angel so entirely overshadows his *personality*, that the Old Testament does not ask who or what this angel is, but what he does. And the answer to this last question is, that he represents God to man so directly and fully, that when he speaks or acts God himself is felt to speak or act. The strongest passage perhaps is Gen. xlviii. 15, *f.*

The disposition to look away from the personality of the angels and concentrate attention on their ministry, runs more or less through the whole Old Testament angelology. It is indeed certain,—to pass to the second side of the doctrine,—that the angelic figures of the Bible narrative are not mere allegories of divine providence, but were regarded as possessing a certain superhuman reality. But this reality is matter of assumption rather than of direct teaching. Nowhere do we find a clear statement as to the creation of the angels [Gen. ii. 1 is ambiguous, and it is scarcely legitimate in Psalm cxlviii. to connect ver. 2 with ver. 5]. That they are endowed with special goodness and insight, analogous to human qualities, appears as a popular assumption, not as a doctrine of revelation (1 Sam. xxix. 9; 2 Sam. xiv. 17, xix. 27). Most characteristic for the nature of the angels is the poetical title "sons of God" (*Bnê Elohim*, or, with a slight modification, *Bnê Elim*, in English version incorrectly "mighty," "sons of the mighty," Ps. xxix. 1, lxxxix. 6), which, in accordance with the idiomatic force of the word *sons*, may be paraphrased, "Beings who in a subordinate way share something of divine majesty." Perhaps in Psalm lxxxii. the name Elohim itself varies with the more usual "sons of Elohim."

Taken collectively, the angels form the hosts of Jehovah (Ps. ciii. 21, &c.), or the host of heaven (1 Kings xxii. 19), names correlative to the new title of God which springs up at the close of the period of the Judges, "Jehovah [God of] hosts." The notion of angels as divine armies is not like that of the individual "messenger" closely connected with the theophanic history (yet compare Gen. xxxii. 1, 2; Joshua v. 13, *sqq.*), but belongs rather to the delineation of the majesty of God in poetry and prophecy. As the whole conception of the heavenly palace and throne is obviously symbolical, we must allow for conscious poetic art when the angels are represented surrounding God's throne in the form of an *assembly* or *privy council* of holy ones (consecrated servants), praising his name, or receiving his commands, and reporting their execution (Ps. xxix., lxxxix. 6–8; 1 Kings xxii. 19, *ff.*; Job i.) Similarly much must be allowed for the free play of fancy when in the last judgment against the enemies of his people, Jehovah descends to battle with his *heroes* (Joel iv. 11), his *holy ones* (Zech. xiv. 5), or when he triumphantly enters Zion amidst myriads of heavenly war chariots (Ps. lxviii. 17). Compare Isa. lxvi. 15, Hab. iii., which show how closely such imagery is connected with the physical phenomena of the thunderstorm.

With the development of the idea of countless hosts of divine ministers is naturally associated, in place of the old angelic theophany, the conception of an invisible agency of angels, who are henceforth seen only in vision or to eyes specially opened (Num. xxii. 31; 2 Kings vi. 17). To the guidance of Israel by the angel of Jehovah succeeds the belief in angelic guidance of individuals (Ps. xxxiv. 7), more or less poetically worked out (Ps. xci. 11). Conversely, pestilence and other judgments are angelic visitations (2 Sam. xxiv.; 2 Kings xix. 35; Ps. lxxviii. 49, where the "evil angels" of the English version are not wicked angels, but angels of evil). At length this is carried so far that all natural forces that serve God are viewed as his messengers, Ps. civ. 4: "He makes winds his messengers, flaming fire his ministers." This passage clearly shows the elasticity of the whole conception. Similar is the way in which the stars, which share with the angels the name "host of heaven," appear associated with the latter (Job xxxviii. 7). Hence the later elemental angels.

Angelic interpretation between God and man reappears in Job xxxiii. 23 (*cf.* iv. 13, *ff.*), and converse with angels forms a large part of the visionary setting of the later prophetical books (Ezekiel, Zechariah). But these visions, to which the prophets do not ascribe objective reality, illustrate rather the religious imagination than the theology of the period.

The idea of ranks and classes of angels, though naturally suggested by the conception of a host (*cf.* Joshua v. 13, *sqq.*), was up to this time undeveloped; for neither the purely symbolical cherubim, nor the unique and obscure seraphim of Isaiah vi., have in the Old Testament the meaning later conferred on them of distinct classes of angels. But the angels of Zechariah present something of a systematic scheme, though it seems unsafe, with Ewald and others, to see in the seven eyes of Jehovah (iii. 9, iv. 10) a developed doctrine of seven chief angels (as in Tobit xii. 15; Rev. viii. 2), parallel to and influenced by the *Amesha-çpentas* of the Eranian mythology. The book of Daniel shows a much fuller development in a similar line. Israel, Persia, &c., have special angels (princes), whose contests represent those of human history (chaps. x., xii., *cf.* Isa. xxiv. 21, *f.*) "The great prince who presides over" Israel is named Michael (who is like God?), and the *angelus interpres* is called Gabriel (man of God). The analogy of these notions to those of Zarathustrism is less decided than has often been supposed; but the freedom which Old Testament writers allow themselves in matters of imaginative representation, to which these conceptions mainly belong, is such as to render foreign influence quite credible.

The ranks, classes, and names of angels are a favourite topic of post-canonical, and especially of Apocalyptic literature. In the book of Enoch, cherubim, seraphim, and even the wheels of Ezekiel's vision, become distinct classes of angels; and Rafael (*cf.* Tobit xii. 5), Phanuel, Uriel, &c., are added to the names of individual archangels. Specially celebrated is the interpretation which this book gives of Gen. vi. 2, where the sons of God are understood as angels. This interpretation seems to have influenced Jude, ver. 6 (*cf.* 2 Pet. ii. 4), was current in the early church as well as in Judaism, and (though the narrative so understood is quite unique in the circle of Biblical ideas) is defended on philological grounds by the best recent scholars, the occurrence being viewed as history or as myth according as the interpreter is theosophically or critically inclined. Of other passages in later Jewish literature it may suffice to refer to the full account of the creation of angels of various functions, presiding over various powers of nature, in the *Book of Jubilees* (*cf.* Rœnsch, *Das Buch der Jubiläen*, p. 259).

The angelology of the New Testament attaches closely to the notions already developed. The ministry of angels is, as in the Old Testament, specially connected with the work of salvation (Heb. i. 14), and with the person of Christ (John i. 51), to whom after the temptation (and at Gethsemane?) angels minister, and who can at will command their aid (Mat. xxvi. 53). As in the later Old Testament books, revelations by angels are given in vision or dream, but even waking eyes see the angel or angels who minister at the resurrection. So an angel delivers Peter (Acts xii.), &c. As in the Old Testament, the figure of angels is human, their raiment white, and their aspect luminous. A multitude of angels appear singing praises at the nativity (Luke ii. 13), and in general they sympathise with the repentance of sinners and the progress of the divine kingdom (Luke xv. 10; 1 Pet. i. 12). Gabriel reappears in Luke i. The belief in special guardian angels of individuals appears as current (Acts xii. 15), but the words of Jesus (Mat. xviii. 10) hardly go farther than the statements of the Psalms. The angelic hosts of the prophetic eschatology are naturally transferred to the second coming (Parusia) of our Lord. The saints after the resurrection are like the angels (Mat. xxii. 30; Luke xx. 36). In the Apocalypse angels play a great part. Notable features, in addition to the seven highest angels (viii. 2), are the angels of the seven churches (who, however, are by many taken as human figures, church officers), and the association of special angels with cosmical forces, *e.g.*, angels of fire and water (xvi. 5, xiv. 18). The same idea appears even more sharply expressed in the writings of Paul, if, as Ritschl has rendered plausible, the elements (elemental powers) of the world (Col. ii.; Gal. iv. 3) are the angels, and specially the angels of the law. This view is connected with the characteristic position of Paul and the Epistle to the Hebrews, that the inferiority of the old covenant is stamped by the fact that the law was given and enforced by angels (Gal. iii., iv.; Heb. ii.; *cf.* Acts vii. 53), an idea partly based on Exod. xxiii. 20, *f.*, and partly on a transference to Sinai of the usual poetico-prophetic imagery of a theophany—a transference suggested by Ps. lxviii. 17, Deut. xxxiii. 2, and actually carried out in the LXX. translation of the latter text, and in the current Jewish theology of the period. Angel worship is condemned in Col. ii. (probably with reference to Essene doctrine); *cf.* Rev. xix. 10. In Heb. ii., and 1 Cor. vi. 3, Christians are superior to angels.

Theological reflection on the doctrine of angels already begins among the Alexandrian Jews; and Philo, who calls them "a chorus of unembodied souls" occupying the air, places them in close parallelism to his speculations on the divine *ideas* or *powers*. From this association the transition is easy to Gnostic speculations, where the ranks of angels appear as produced by successive emanation, and thus serve to fill up the interval which Gnosticism puts between God and the world. In this connection we find also a doctrine of creation by angels (Basilides), and dualistic views of good and evil angels. Against these heresies the early church emphasises the creation of angels and the fall of the evil angels, but Origen tells us that up to his time the ecclesiastical doctrine did not define "quando isti creati sint vel quales aut quomodo sint." On these topics, however, many subtle questions arose, *e.g.*, whether angels have bodies of an ethereal kind, whether they were created before the world or along with the light, &c. Gradually angel-worship sprung up, and in spite of the opposition of the best fathers (Theodoret, Augustin, &c.), became firmly established, and is still acknowledged in the Roman catechism. An elaborate theory of the angelic hierarchy, based on Neoplatonic doctrines, is laid down in the work of Pseudo-Dionysius, *De Hierarchia Celesti* (5th century), and exercised much influence on mediæval theology, which accepted the work as a genuine product of the apostolic age. The schoolmen treat of angels under the doctrine of creation, dividing rational creatures into angels, who are pure spirits, and men (*Sent. Lib.* ii., dist. i., *sqq.*), and the nature and powers of angels form the most notorious problems of the misdirected subtlety of the schools (*cf. e.g.*, Duns on the *Second Book of Sentences*). Protestant theologians have always felt less interest in the subject, and generally reduce the doctrine of angels to a mere appendix to the doctrine of creation or of God's works. Recent writers often go much farther. Thus, Schleiermacher sums up the whole doctrine of angels by saying, that the possible existence of angels should not influence conduct, and that revelations of their being are no more to be looked for. A reaction, partly rooted on the later philosophy of Schelling, has led several German theologians (Hofmann, &c.) to lay more weight on the doctrine.

The Biblical doctrine of angels must be studied with the aid of the best books on Biblical theology (Schulz, Oehler, Ewald, Weiss, &c.), and of the commentaries on special passages. The book of Enoch is accessible in Dillmann's translation, and other Jewish notions may be found in Eisenmenger. The literature of the subject, theological and theosophic, is immense. (W. R. S.)

ANGEL, a gold coin, first used in France in 1340, and introduced into England by Edward IV. in 1465. It varied in value between that period and the time of Charles I. from 6s. 8d. to 10s. The name was derived from the representation it bore of St Michael and the dragon.

ANGELICA, a genus of plants of the natural order of the Umbelliferæ. The name Angelica is popularly given to a plant of an allied genus, *Archangelica officinalis*, the tender shoots of which are used in making certain kinds of aromatic sweetmeats.

ANGELO, MICHEL. See MICHEL ANGELO BUONARROTI.

ANGELUS SILESIUS, a German philosophical poet, was born in 1624 at Breslau or Glatz, and died at Breslau in 1677. His family name was Johann Scheffler, but he is generally known under the assumed name which marks the country of his birth. Brought up a Protestant, and at first physician to the duke of Würtemberg, he embraced, in 1653, the Roman Catholic religion, and took orders as a priest. His peculiar religious faith, founded on his early study of the works of Tauler and Böhme, as expressed in his hymns (*Cherubinischer Wandersmann*), is a mystical pantheism founded on sentiment. The essence of God he held to be love: God, he said, can love nothing inferior to himself: but he cannot be an object of love to himself without going out, so to speak, of himself, without manifesting his infinity in a finite form; in other words, by becoming man. God and man are therefore essentially one. A selection of his hymns, which are very popular in Germany, was published in 1820 by Varnhagen Von Ense.

ANGERMANN, a river of Sweden, which rises about lat. 65° N. and long. 15° E., among the mountains that separate Sweden from Norway, and flows in a south-easterly direction through Westerbotten and Westnorrland, entering the Gulf of Bothnia near Hernosand, after a course of about 250 miles, during which it passes through several lakes. It is navigable for upwards of 50 miles from the sea, and the scenery on its banks is sometimes very beautiful.

ANGERMÜNDE, a town of Prussia, capital of a circle of the same name in the province of Brandenburg, situated on Lake Münde, 43 miles from Berlin, by the Berlin-Stettin railway. It contains about 6400 inhabitants, who are chiefly employed in the manufacture of woollen and linen goods.

ANGERS, an ancient city of France, capital of the department of Maine-et-Loire, and formerly of the old province of Anjou, situated on the Maine, about 4 miles from its junction with the Loire, and 161 miles S.W. of Paris. The streets of the upper and older quarter of the city, which occupies the slope of a rising ground on the left bank of the river, are narrow and often very steep, and the houses have a sombre, although somewhat picturesque appearance, from the quantity of slate that is used in their construction. Many of these buildings, however, have given place to others of a more modern style, particularly near the site of the old ramparts, now occupied by beautiful boulevards, while on the opposite side of the river a new quarter has sprung up, which is regularly and tastefully built. Among the principal buildings in Angers are the castle, situated on a rock commanding the city, once a place of great strength, but now used as a prison, barrack, and powder magazine; the fine cathedral of St Maurice, rebuilt in 1225, and remarkable for its beautiful stained glass windows; the Hôtel Dieu, built by Henry II. of England; and several of the parish churches. Angers is the seat of a bishop, and possesses schools of different grades, various learned societies, a library of about 40,000 volumes, and a gallery containing a good collection of pictures and statues, including some fine works by the sculptor David of Angers. There was once a university in the town, as well as a military college, at which the Earl of Chatham and the Duke of Wellington received part of their education; but the former has been abolished, while the latter has been removed to Saumur. The chief manufactures at Angers are sail-cloths, ropes, linen goods, hosiery, sugar, leather, wax, and oil; there is also a considerable trade in corn, wine, and fruits, and in the neighbourhood there are extensive slate quarries, which give employment to about 3000 workmen. Population, 58,464. Angers is the ancient *Juliomagus*, or, as it was latterly called, *Andecava*, whence the city is said to derive its present name. It was captured by Odoacer in 464 A.D., and by Clovis in 486; it suffered severely from the invasions of the Northmen in 845 and the succeeding years, and of the English in the 12th and 15th centuries; the Huguenots took it in 1585, and the Vendean royalists were repulsed near it in 1793.

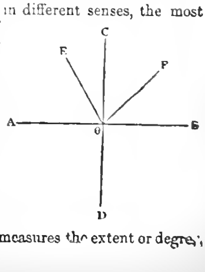
ANGERSTEIN, John Julius, an opulent London merchant, and a distinguished patron of the fine arts, was born at St Petersburg in 1735, and settled in London about 1749. His collection of paintings, consisting of about forty of the most exquisite specimens of the art, purchased by the English Government, on his death in 1822, for £60,000, formed the nucleus of the National Gallery.

ANGHIARI, a small town of Italy, in the province of Arezzo, situated 10 miles N.E. of Arezzo, not far from the Sovara, a tributary of the Tiber. The Milanese, under Niccolo Piccinino, were here defeated by the Florentines in 1440. Population of the commune, 6,000.

ANGILBERT, St, the most distinguished poet of his age, was the secretary and friend of Charlemagne. After filling the highest offices under that monarch, and receiving the hand of his daughter Bertha in marriage, he retired in 790 to the monastery of Centule, or Saint Riquier, of which in 794 he was made abbot. He left this retreat from time to time when the king required his services, and in 800 assisted at Rome at his coronation. He died in 814. Angilbert was called by Charlemagne the *Homer* of his time.

ANGINA PECTORIS, a term applied to a violent paroxysm of painful sensations in the chest, arising for the most part in connection with some form of heart disease. An attack of angina pectoris usually comes on with a sudden seizure of pain, felt at first over the region of the heart, but radiating through the chest in various directions, and frequently extending down the left arm. A feeling of constriction and of suffocation accompanies the pain, although there is seldom actual difficulty in breathing. When the attack comes on, as it often does, in the course of some bodily exertion, the sufferer is at once brought to rest, and during the continuance of the paroxysm experiences the most intense agony. The countenance becomes pale, the surface of the body cold, the pulse feeble, and death appears to be imminent, when suddenly the attack subsides, and complete relief is obtained. The duration of a paroxysm rarely exceeds two or three minutes, but it may last for a longer period. The attacks are apt to recur on slight exertion, and even in aggravated cases without any such exciting cause. Occasionally the first seizure proves fatal; but more commonly death takes place as the result of repeated attacks. Angina pectoris is generally held to be a *neurosis*, or nervous affection of the heart, but its causation is still a matter of uncertainty. It seems occasionally to manifest itself where no organic heart disease is discoverable, either in life or after death, but in the great majority of cases some morbid condition of the heart's structure is undoubtedly present. A diseased state of the coronary arteries, the nutrient blood-vessels of the heart, has been found in a large proportion of the cases examined *post mortem*; but, on the other hand, these arteries may be found diseased where no paroxysm of angina had ever occurred; and further, it is well known that various other forms of heart disease may have angina pectoris associated with them as a prominent symptom. Angina pectoris is extremely rare under middle life, and is much more common in males than in females. It must always be regarded as a disorder of a very serious nature. In the treatment of the paroxysm much relief is obtained by opiates, and by the inhalation, under proper precautions, of anæsthetic vapours, such as ether, chloroform, and nitrite of amyl. To prevent the recurrence of the attacks, something may be done by scrupulous attention to the state of the general health, and by the avoidance of mental or physical strain, for it is certain that attacks in those who are the subjects of the disorder are often precipitated by errors in living, and by undue exertion or excitement.

ANGLE, a term employed in different senses, the most common and simplest use of it—to which all the rest may be referred, and by which they may be explained—being to indicate the inclination of two straight lines to each other. Suppose O F in the figure to turn about O from the position O B towards O C, like the opening out of the legs of a pair of compasses, the angle formed by O B and O F, which is distinguished as the angle B O F, measures the extent or degree



of the turning or opening, being of course entirely independent of the length of the lines. The ordinary method of measuring angles is based on the division of the circumference of a circle into 360 equal parts, called degrees, the angles formed by lines radiating from the centre being proportional to the arcs of the circumference which the lines intercept. If O C makes equal angles with the straight line A O B, each of them is a right angle, or an angle of 90°. In the figure A O E is an angle of 60°, and C O F and F O B are each 45°; whence E O F is 75°, E O B 120°, &c. By the angle curved lines make with each other is meant the rectilineal angle contained by the tangents to the curves. See GEOMETRY and TRIGONOMETRY.

ANGLES. According to the usual account, which rests on the authority of Bede, the Angles were one of three tribes who passed over from the Continent in the 5th and 6th centuries, and taking possession of different parts of England, formed the main and dominant element in its subsequent population. The Saxons, he tells us, and he is followed by the authors of the Saxon chronicles, were situated in what is now Holstein; the Angles occupied the district to the north, probably extending across the peninsula, and beyond the Angles were the Jutes, in (approximately) the modern Jutland. Hypothetically they are identified with the *Angli* of Tacitus, who were seated on the Lower Elbe; and certainly they belonged to the Low German race. Some historians, as Professor Henry Morley, regard the distinction between Saxon and Angle as a mere accidental difference of name; the people themselves employing the name of Angles, while Saxon was a foreign designation applied to them by the Romans and Celts; and this view might be supported by the fact that, while the boys admired by Gregory, according to the well-known tale, were "Angles," his missionaries were sent to the Jutish kingdom of Kent. It must be admitted, however, that whatever the origin of the words Angle and Saxon may be, they expressed, from the time of the invasions downwards, a difference that was, if not radical and of long continuance, at least real and obvious. The Angles were a strong and vigorous people, and not only founded three kingdoms in England,—Northumbria, East Anglia, and Mercia (which all, and especially the first, exercised a great influence on our early history),—but also spread through a large part of the Lowlands of Scotland. Their language was soon brought under literary culture, and supplied a groundwork for the later and richer developments of the southern Saxons; and it is still to be distinguished in the Northumbrian dialect and the Lowland Scotch. They have left us, though in the form of a *rifacimento*, one of the most remarkable literary legacies we possess—the poem of Beowulf, and claim the honour of producing Cædmon and the venerable Bede. See Thorpe's Lappenberg; and Morley, *Writers before Chaucer.*

ANGLESEA or ANGLESEY (*i.e.*, the Angle's Island), the *Mona* of Tacitus, an insular county of North Wales, separated from the mainland of England by the Menai Strait, over which Mr Telford's magnificent suspension bridge was thrown in 1826, followed by the renowned tubular railway iron bridge in 1850. The island contains 193,511 acres. The surface is for the most part flat, and the soil but moderately fertile. The exports consist of barley, oats, cattle, sheep, and hogs; and a considerable trade is carried on in butter, cheese, hides, tallow, wax, and honey. It contains valuable minerals, and furnishes (though not so abundantly as formerly) copper, lead, silver, marble, asbestos, limestone, marl, and coal. The chief copper mines are at Parys, and were first worked in 1768; and those of coal are at Maltraeth and Tredfaeth. The stones for the towers of the tubular bridge were quarried at Penmore, 4 miles north of Beaumaris. There are no manufactures of importance. The herring fishery in some years gives employment to a part of the inhabitants; and other kinds of sea-fish are abundant. Anglesea was anciently famous as the seat of the Druidical pontiff, and a Druidical college; and a number of (so-called) Druidical remains—such as the cromlechs at Plas Newydd—are still to be seen. In 61 A.D. Suetonius Paulinus attacked the Druids in this their safest retreat, and they were utterly subdued by Agricola in 78. About 450 Caswallon, prince of Cambria, chose this island for his seat of government, and it continued to be the residence of the princes of North Wales till the final subjugation in 1277. At present the northern form of Welsh is spoken by the peasantry, but in the towns English is very generally understood. The county is divided into 6 "hundreds," and 76 parishes. The number of inhabitants in 1861 was 38,157; and in 1871, 35,127. This decrease is ascribed to emigration, occasioned by the depressed state of the mining trades and lack of agricultural employment. The county returns one member to parliament, and one is also returned by the boroughs of Beaumaris, Holyhead, Amlwch, and Llangefni.

ANGLESEA, ARTHUR ANNESLEY, EARL OF, lord privy seal in the reign of King Charles II., the son of Sir Francis Annesley, Lord Mount-Norris, and Viscount Valentia, in Ireland, was born at Dublin 10th July 1614. He was for some time at the university of Oxford, and afterwards studied law at Lincoln's Inn. In the beginning of the civil war he sat in the parliament held at Oxford; but afterwards became reconciled to the opposite party, and was sent commissioner to Ulster in 1645, to oppose the designs of the rebel Owen Roe O'Neal. He was president of the council of state after the death of Cromwell, and was principally concerned in bringing about the Restoration. He succeeded to his father's titles in 1660, and in 1661 was enrolled in the English peerage as Lord Annesley of Newport-Pagnell, Bucks, and Earl of Anglesea. During Charles's reign he was employed in various important affairs, was made treasurer of the navy, and for some time held the office of lord privy seal. Annesley was a person of great abilities and of very extensive learning, and was well acquainted with the constitution and laws of England. In his lifetime he published several works, chiefly of a polemical and political character. He died in April 1686.

ANGLESEY, HENRY WILLIAM PAGET, FIRST MARQUIS OF, one of the most distinguished British generals of the 19th century, was born on the 17th of May 1768. He was the eldest son of Henry Lord Paget, first Earl of Uxbridge, of whose family of twelve sons and daughters he was the last survivor. He received his early education at Westminster school, and passed thence to Christchurch, Oxford, where he took the degree of M.A. Quitting the university in 1790, he entered parliament the same year as member for the Carnarvon group of boroughs, for which he sat six years. But to his high-spirited and impetuous nature the soldier's life was most attractive; and during the excitement which was occasioned by the outbreak of the wars of the French Revolution, Lord Paget raised on his father's estate the regiment known at first as the Staffordshire Volunteers, and afterwards as the 80th Foot in the regular army. Of this regiment he was named lieutenant-colonel. Having entered the army, and passed rapidly through the subordinate grades, he obtained his commission as lieutenant-colonel on the 12th September 1793. In the following year he commenced his career of active service in the campaign of Flanders, under the Duke of York. So greatly did he distinguish himself, especially during the retreat which followed the repulse of Turcoing, that notwithstanding his youthful years, he was appointed, in the temporary absence of Lord Cathcart, to the command of his brigade. Transferred soon after his return to England to a cavalry regiment, 16th Light Dragoons, he was thenceforth attached to that branch of the service which he was to raise to the highest degree of efficiency, and in connection with which he was to achieve his greatest triumphs. About the same time (July 1795), Lord Paget married Lady Caroline Elizabeth Villiers, daughter of the Earl of Jersey. Promoted colonel in 1796, he was transferred in April 1797 to the command of the 7th Light Dragoons, and then began to apply himself strenuously to the improvement of discipline, and the introduction of a new system of cavalry evolutions. In 1799 he took part in the campaign, brief and disastrous, of the Duke of York in Holland. In the general attack (Oct. 2) he distinguished himself by a dashing and successful charge on a superior body of the enemy's cavalry. On him devolved the arduous task of guarding the rear in the retreat, and while thus engaged, he routed a much larger body of French cavalry under General Simon, recovering some captured cannon, and taking five of the enemy's guns. Devoting himself through the following eight years, with zeal equal to his abilities, to the discharge of his regimental duties, and to the perfecting of the reforms which he had previously introduced, he attained the rank of major-general in April 1802, and that of lieutenant-general in April 1808. At the close of this year the great war with the French in the Peninsula began, and Lord Paget was sent, with two brigades of cavalry, to join the division of the army under Sir David Baird, who was then marching to join Sir John Moore in his advance on Salamanca. He landed at Coruña, and in the face of very great difficulties succeeded in effecting the junction. It was during this march that the first conflict with the French in Spain took place,—a small party of French posted at Rueda being surprised and cut off by Lord Paget. In the retreat ordered by Sir John Moore, after the fall of Madrid, Lord Paget was charged with the protection of the rear, and, notwithstanding the frequent harassing attacks of the enemy, the losses of the British were trifling. He especially distinguished himself by brilliant and successful encounters with the French at Sahagun, Mayorga, and Benevente. His spirited repulse of the advanced guard of the French at Benevente, where he also captured the commander of the imperial guard, General Lefebvre Desnouelles, especially contributed to the safe arrival of the British at Coruña. At the battle of Coruña, fought on tha 16th January 1809, and mournfully memorable for the fall of the brave Sir John Moore, Lord Paget had the command of the reserve; and while the dying commander was being carried from the field, his lordship, by a swift, courageous movement, repulsed a superior force of the enemy, thus deciding the fate of the day and securing the safe embarkation of the British army. With this action his services in the Peninsular war terminated, and in the autumn he returned to England, where he applied himself to his parliamentary duties as member for Milbourne Port. He sat for that borough six years (1806 to 1812). In 1810 he obtained a divorce from his wife, by whom he had had eight children, but with whom he had not lived a happy life. The same year he married Lady Cowley, who had about the same time been divorced from Lord Cowley. Lady Paget was soon after married to the Duke of Argyle. In 1812 he succeeded his father and took his seat in the House of Lords as Earl of Uxbridge. Three years later his services as general were called for on a grander field, and his reputation was raised to the highest pitch. In the spring of 1815 all Europe was startled by the news of the escape of Napoleon I. from his island prison, Elba, of his reappearance in France at the head of an army, and of his reassumption of the imperial dignity. Without delay the armies of the allies were sent again into the field, the English under the Duke of Wellington as commander-in-chief, and the English cavalry under the command of the Earl of Uxbridge. At the decisive battle of Waterloo (18th June), after twice leading the guards to the charge, he placed himself at the head of the heavy brigade, and, by a third rapid and terrific charge, completely overwhelmed the trusted French guards, led by Count D'Erlon, making 3000 prisoners, and killing most of the rest. Other brilliant feats followed, which won for the Earl of Uxbridge on that day a place of honour second only to that of the great duke himself. In the confusion which followed, Napoleon, from a low rising ground, directed the fire of four guns, and by one of their discharges, almost the last shot that was fired, the earl was struck on the knee, and amputation of the limb was found to be necessary. This was effected in a private house at Waterloo, and the limb was buried in the garden. Visitors are shown the chair in which the earl sat during the operation, the boot taken from the amputated leg, and the monument over its burial-place. A pension of £1200 a year was voted to him on account of the loss of his limb, but he generously declined to accept it. Five days after the battle the services of the earl were rewarded by the dignity of Marquis of Anglesey, conferred on him by the Prince Regent; and he was soon after nominated Knight Grand Cross of the Bath. Similar honours were bestowed on him by the emperors of Austria and Russia and the king of Hanover. In 1818 he was elected Knight of the Garter. He attained the full rank of general in the following year. His support of the proceedings against Queen Caroline made him for a time unpopular, and when he was on one occasion beset by a crowd, who compelled him to shout "The Queen," he added the wish, "May all your wives be like her." At the coronation of George IV. the Marquis of Anglesey filled the post of lord high steward of England. At the close of April 1827 he became a member of the Canning administration, taking the post of master-general of the ordnance, previously held by Wellington. He was at the same time sworn a member of the privy council. Under the Wellington administration he accepted the appointment of lord-lieutenant of Ireland (March 1828), and in the discharge of his important duties he greatly endeared himself to the Irish people. The spirit in which he acted, and the aims which he steadily set before himself, contributed to the allaying of party animosities, to the promotion of a willing submission to the laws, to the prosperity of trade, and to the extension and improvement of education. On the great question of the time his views were opposed to those of the Government. He saw clearly that the time was come when the relief of the Catholics from the penal legislation of the past was an indispensable measure, and in December 1828 he addressed a letter to the Roman Catholic primate of Ireland distinctly announcing his view. This led to his recall by the Government, a step sincerely lamented by the Irish. He pleaded for Catholic emancipation in parliament, and on the formation of Earl Grey's administration, in November 1830, he again became viceroy of Ireland. The times were changed; the great act of emancipation had been accomplished, and the task of the viceroy in his second tenure of office was to resist the agitation commenced and carried on by O'Connell. He felt it his duty now to demand Coercion Acts for the security of the public peace; his popularity was diminished, differences appeared in the cabinet on the difficult subject, and in July 1833 the ministry resigned, the viceroy retiring at the same time. To the Marquis of Anglesey Ireland is indebted for the Board of Education, the origination of which may perhaps be reckoned as the most memorable act of his viceroyalty. For thirteen years after his retirement he remained out of office, and took little part in the affairs of government. He joined the Russell administration in July 1846 as master-general of the ordnance, finally retiring with his chief in March 1852. His promotion in the army was continued by his appointment to the command of the horse guards in 1842, and completed by his advancement to the rank of field-marshal in 1846. A life of brave service and faithful devotion to duty was closed by a peaceful death on the 29th April 1854. The character of the Marquis of Anglesey, appreciated and admired by all classes and parties, was sketched by a contemporary journalist in the following terms:—"Seldom have bravery, gentleness, and generosity been combined in such noble proportions. In his character there was not a fold, it was all open as the day. His politics were thoroughly liberal, and with more far-sighted and sound statesmanship in them than the world has perhaps given him credit for. . . . He had a sound, shrewd understanding, a judgment seldom at fault, often acting like an instinct, and accompanied with a moral courage not inferior to his brilliant physical bravery in the field of battle." He strenuously supported every measure of reform in church and state, and, with sagacious forecast anticipating public opinion, earnestly advocated in their days of unpopularity the great measures of Catholic emancipation, parliamentary reform, and free trade. The marquis had a large family by each of his two wives,—two sons and six daughters by the first, and six sons and four daughters by the second. His eldest son, Henry, succeeded him in the marquisate. (W. L. R. C.)

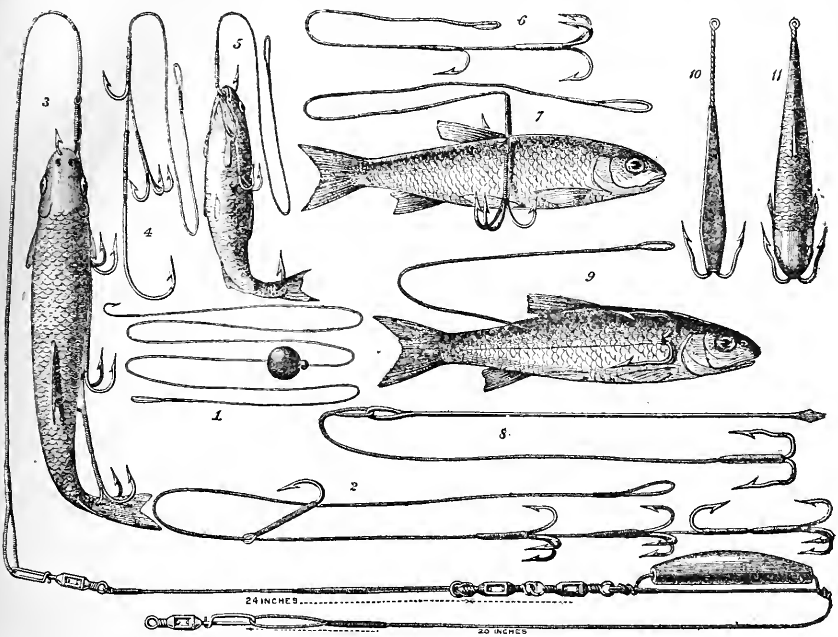
ANGLING

THE art of angling, or of catching fish by a rod and line, is of very ancient derivation. The earliest writer upon it in our country was the Dame Juliana Berners, who wrote a treatise on it in the *Book of St Albans*, printed by Wynkyn de Worde in 1496. Between that time and the present there have been nearly a thousand books, or parts of books, written and published upon this subject.

The practice of angling may be arranged under three heads, viz., top or surface, mid-water, and bottom angling. Surface angling includes fishing with an artificial fly, or daping with a live fly or other insect; mid-water fishing includes spinning or trolling with a dead bait and fishing with a live bait; bottom fishing includes angling with worms and other baits, either resting on or travelling with the stream along the bottom. The last is usually the first practised by the angler, and we will therefore take it first.

Bottom Fishing.

The school-boy who comes home for the midsummer holidays, usually commences his apprenticeship to the art of angling by fishing for some of the carp tribe in some pond or river near his residence. For this purpose he provides himself with a rod usually of from 12 to 14 feet long, and generally made of bamboo-cane, which is the best for the purpose. A small reel, with 30 or 40 yards of silk line, a light quill float, a yard or two of fine silk-worm gut, and a hook tied on at the end of it, which for general work should be either Nos. 6, 7, 8, or 9 in size, and a few split shots pinched on the line for sinkers. He then plumbs the depth of the water by the aid of a plummet, and fixes his float on the line at such a depth that the hook barely or just touches the bottom. His chief baits are worms and gentles or maggots. The worm (the reddest are the best) is stuck on the hook by being threaded from head nearly to the tail. The gentles, to the number of two or three, being stuck on as may be convenient. For gentles the smaller hooks are used; and the hook being baited, is cast into the water and hangs suspended by the float. When there is a bite the float bobs under, and the angler jerks the rod up or strikes, hooks his fish, and, if a big one, plays it,—that is, allows it to swim violently about until tired,—when he draws it ashore and lands it. In still-water fishing for carp, tench, roach, &c., the angler uses now and then a handful of what is termed ground-bait to draw the fish round his hook. There are many substances used for this,—worms, gentles, grains, boiled barley or wheat, &c., &c.,—but the best and most general is a mixture of bran, soaked bread, and a little boiled rice worked up together; if with this is mixed a few handfuls of carrion gentles, usually obtained from horse slaughter-yards, there is no better bait. To ensure sport it is often necessary to bait a spot, or pitch, as it is termed, one or two evenings previously. In still-water fishing this is all that has to be done. In bottom fishing in running water the same preliminaries are observed in taking the depth of the water, baiting, &c.; but when the tackle is dropped into the water the stream carries it along, and the angler, keeping the top of his rod over his float, follows it down his swim, as it is called, until he reaches the end, or as far as he desires to fish, when he pulls his tackle out, and returns to the head of the swim, and recommences striking at every bob or dip of his float. In stream fishing he must either cast his ground-bait in so far up stream that it will find bottom in his swim, or he must knead it into balls with a stone in the middle or mixed with clay, so as to sink it to the bottom at once. In choosing a swim on the banks of a river, if the angler cannot see a good stock of fish anywhere, he should choose some spot which fish may be supposed to haunt,—a spreading root, or bough, or overhanging bank with a hole under it, a deep hole near banks of weeds, or a deep eddy off some sharp stream. Here the bottom should be pretty level and free from obstructions, and the stream not too swift nor too slow, so that the float may travel steadily and evenly without hinderance throughout. If he cannot decide on any spot, let him look along the bank for places worn by the angler's feet, or where *debris* of bran, &c., points out that some angler has previously fished and baited the stream. Having baited a pitch one day, it should never be neglected on the next, as the fish will have had time to find out the bait, and will perhaps be collected together there. Of course the choice of a pitch will be guided very much by the species of fish the angler desires to fish for. The places they frequent are noted hereafter. When the angler has hooked a big fish which he cannot lift out without danger to tackle, he uses a landing-net, that is, a bag-net on an iron ring fastened to the end of a pole, which he slips under the tired fish and lifts securely to the bank. When fishing on a river bank the last words in Walton's *Complete Angler* are to be strictly observed, viz., "Study to be quiet," for violent disturbance or motion is fatal to sport. Having deliberately chosen a pitch and baited it, the angler should not desert it hastily, or if he leaves it for a time for another, he should return to it and give it another trial. In angling from a punt or boat a shorter rod is used than from the bank, from 10 to 12 feet being the limit. In the Thames plan the punt or flat-bottomed boat is fixed directly across the stream by means of two iron-shod poles which are driven into the bottom. The depth being taken, and the ground-bait thrown in, the angler, sitting with his face down stream, drops his tackle in close to the boat, and allows it to float down stream unchecked as far as the line, which is generally a yard or two longer than the rod, will permit, when he strikes, pulls up the tackle, drops it again in close to the punt, and repeats the operation time after time. In the middle of these punts there is generally a well, so that the fish when caught are kept alive in the well until the day's fishing is over. On the Trent the method adopted is different. The punt or boat, if used at all, is fixed diagonally and not directly across the stream. A very fine and light silk line is employed, which will float easily and does not sink much at any time. A very easy-going reel or winch is used, which turning on an oiled spindle lets off the line very rapidly, and is set running with the lightest touch of the finger. The rod being held at an angle of 90°, the line is allowed to run freely, until the float and bait go sometimes as far as 50 or 60 yards down the stream,—a plan which has many advantages, as much more ground is covered than in the restricted swim of the Thames method, and the fish are less shy in biting so far from the boat. The ground-bait is usually thrown in loosely above the punt, and generally consists of chopped worms or greaves (tallow-melters' refuse), and as the swim is so long an one the ground-bait is certain to fetch the bottom somewhere within it. In Norfolk a different plan still is adopted. The punt is anchored lengthwise straight up and down, and the anglers fish on either side of it; but the water being usually very deep the rods are longer and the tackle heavier, and besides the moving float they have another rod, the tackle to which is so heavily weighted that the baited hook rests on the bottom, and is not to be moved by the stream—the fish picking up the bait at leisure, and the float showing the bite. This is termed "tight corking." These are the chief methods employed in float fishing at the bottom. But other methods of fishing with a stationary bait without a float are often



adopted. The ledger is the chief of these (see fig. 1 in the cut). This consists of a gut line a yard or two long, which runs through a bullet or a lump of lead pierced with a round hole. On the hook side of the line an obstruction is fastened so that the lead cannot slip down to the hook, but the line is free on the rod side of the lead. The hook being baited, the lead is dropped into the water and rests on the bottom, a tight line between the rod top and the lead being kept. The instant a fish bites at the hook, the line being free in that direction, it is felt at the rod top, and the angler, yielding a little line to let the fish get the bait and hook well in his mouth, strikes, lifting the lead, and so hooks the fish. Another method, called the clay-ball, is to tie a bit of stick across the line a little above the hook, which is baited with gentles and greaves, and then to weld a lump of clay and ground-bait on the line round about the bit of stick. This is dropped to the bottom, and the fish, attracted by the ball of bait, come up to devour, and in time find the baited hook and take it most unsuspectingly. Sometimes the baited hook is buried in the ball of bait, and the fish are allowed to dig it out. Sometimes a float is used in conjunction with a small clay ball to show the bites. Another plan of bait fishing at the bottom is with a free line, with only a very light sinker of a split shot or two on the line. The hook is baited with a worm, and allowed to travel along the bottom, the bite being felt or seen in the action of the line on the water or the rod top. This is chiefly employed in trout fishing.

Mid-Water Fishing.

Spinning is the first branch of this kind of fishing, and is used chiefly for pike and trout, though salmon and other fish occasionally are fished for and taken thus. It consists in drawing along through mid-water a bait so disposed on a series of hooks as to revolve rapidly, thus showing its silvery sides constantly to the fish of prey, and attracting them to run after it and capture it, when the hooks which are about it in turn capture them. A small fish—a little trout, dace, gudgeon, or bleak principally, as these are the best fish for the purpose—is hung on a range of hooks called a flight. This flight generally or mostly consists of three triangles, or three hooks welded back to back, tied upon gut or gimp at intervals of half an inch or so, a reversed hook near the tail to keep it bent, and above them a sliding hook working in an eye, called the lip hook (see fig. 2 in cut). A fish is then chosen suitable to the length of the flight, the lowest triangle is stuck on the middle of the side of the tail, the reversed hook just above it is then stuck into the fish a little below the vent, so as to keep the tail of the fish bent or crooked. The other two triangles are then stuck into the side of the bait in a straight line towards the fish's mouth. The line is then twisted two or three times round the shank of the lip hook, so as to bring it just to the bait's mouth and to keep it firmly there. The hook is then passed through both lips of the bait, and the bait is ready for use (see fig. 3 in cut); then it is hung on to a tackle called the trace. This consists of a yard or two of gut, single or twisted, or gimp, as may be desired; and at intervals of 18 or 20 inches or so, one or more swivels are placed to permit the bait to revolve freely without also turning the line, which would cause the whole running line to snarl and tangle, and a lead or sinker, so disposed as to promote the same object, is put on just above the swivels, aud the trace is complete. (The upper part of the tackle in fig. 3 from swivel to swivel shows the trace). The whole apparatus then being looped on to the main or reel-line, is dropped into the water, and being drawn rapidly through it, if the bait be properly arranged on the hooks, spins with wonderful swiftness, often like one long line of flashing silver. If it does not spin well, but "wobbles," as it is termed, the hooks are not properly fastened into the bait, and either do not lie straight and even along the side, or the head or tail of the bait is too slack or too tight. This must be amended as the bait cannot spin too well. The object of its spinning well is not only to attract the fish, but to conceal the hooks. The arrangement of the hooks on the flight given above is the one most commonly adopted by Thames spinners, who are the best hands in this branch of fishing, but there are many other arrangements which are sold by tackle-makers, of which the Francis and Pennell tackles are perhaps the chief. The reel-line used in spinning is usually made of plaited silk, dressed with a composition to stiffen it and to prevent tangling; and the line is heavier or lighter according as the bait and tackle to be used is heavier or lighter. In working a spinning-bait, the angler first tries all the nearer water to the spot where he stands, and gradually lengthens his line, allowing it to lie loose on the ground, or in the boat or punt's bottom, in coils at his feet Then with about half as much line as the length of rod hanging down from the rod point, he gently waves the bait backwards to the left or right, according to the side he wishes to cast to, and then suddenly urging the rod forward with a sweep, releases the running line which he has held fast against the rod, and the impetus the bait has acquired by the swing sends it forward from 20 to 40 yards towards the point the angler desires to cast to; then lowering the point of the rod to allow the bait to sink to mid-water, he holds the rod in the right hand, and draws the line home through the rings with the left hand, allowing it to fall at his feet as before, and raising and dipping the rod at every draw, makes the bait spin and shoot, and rise and fall, as it comes towards him, in a most attractive manner. The line being all drawn in, lies at his feet as before, and lifting the bait out of the water again, he repeats his cast in a new direction, and having fished all the water within reach he moves on. Should a fish run he feels a jerk at the rod point, or sees the line stop, and he strikes smartly and plays his fish, drawing in line by hand, and taking care that no tangle ensues. To avoid this at any time, he must see that there are no twigs or other obstructions about his feet where the line rests between each cast, which may catch in the coils and cause a snarl or knot, as this spoils the cast by preventing the line from running. In trout spinning smaller and lighter tackles, rods, and lines are used than are employed for jack. For the big Thames trout, and for trailing for the great lake trout, similar fashioned but lighter flights and traces are employed; but for spinning the minnow for small river or brook trout a different kind of flight is used. This flight is shown unbaited and baited at figs. 4 and 5 in the cut. The big hook is inserted into the mouth of the minnow, and by a little humouring the point is carried down the body along the back-bone to the tail, where it is brought out, and the lip hook inserted through both lips of the bait; and, if any attention has been paid to the size of the minnow selected, the tail will be nicely bent round on the curve of the hook so as to make the bait spin rapidly. Many anglers do not use any other hooks than these two; but it is so easy for a trout to run and seize such a bait and to miss being hooked, that to make sure, it is usual to employ in addition the little triangle of hooks, which is inserted half way down the side of the bait. Even with this safeguard, when fish are running shyly, the angler will find that he misses from one-third to one-half of the runs which he gets. In spinning for small trout various methods are pursued: some fish down stream, some up; and where it is requisite to wade, and a moderate rod is used, it is best to fish up, wading in mid-stream, and casting on either hand towards the opposite banks, the angler brings the bait diagonally down towards him, with a curving sweep in front. When, however, he can fish from the bank, it is best to fish down, and to cast across, drawing with a diagonal sweep up stream. Usually it is just as the bait is making the bend round that the fish seizes it, and therefore it behoves the angler to keep a sharp look out then. Some anglers cast the minnow over hand, and some under; the best plan is to cast it under, and, taking hold of the reel-line between two of the rings on the middle joint of the rod with the left hand, to draw a good portion of line off the reel, holding it tight until the cast is made, when it is released, and doubles the length of cast which the angler could make in the ordinary way,—as in minnow fishing the tackle is too light, as a rule, to cast off loose line from coils on the ground, and so, ordinarily, little more line than a yard or so more than the length of the rod can be used; by this means, however, nearly double that length can be got out. Of course the weight or sinkers on a minnow tackle will be proportionate to the requirements of the stream, and though the trace will be of lighter gut than it is customary to use for large trout, the fashion of the tackle is similar. In this case, also, there are many other arrangements of hooks used, but there are none so good as the one figured in the plate. In the north there is another method of spinning practised, called par-tail fishing, which is used chiefly when and where minnows are difficult to obtain, though some persons prefer par-tail as a bait to minnow. For this only two hooks are used similar to the two in the figure for minnow fishing, minus the triangle. A par is taken and cut diagonally in two from the front part of the dorsal fin to the middle of the space between the ventral and anal fins. The tail part being taken, and the tail snipped off, the lip hook is put through the root of the tail, and the big hook stuck into the bait so as to curve the broad end of the bait on to the hook; the bait, if properly adjusted, spins pretty well. Some anglers, however, cut a slice out of the back from before the dorsal fin down to the tail, leaving a small part of the tail and only part of the belly, and by adjusting this on hooks suited to it, it rather more resembles the natural fish. These baits are used exactly like the minnow.

In fishing for larger trout, as the large lake trout or the *Salmo ferox*, the method generally adopted is that of trailing. Here a small trout or par is used on the three-triangle tackle already mentioned above. The line is weighted according to the depth of the water, and the boat is rowed slowly along, some 30 or 40 yards of line being let out, so as to permit the bait to sink and to tow some distance astern. Two rods are chiefly employed for this sport—one being placed at each corner of the stern of the boat, and each having on a different bait, weighted differently, and with a longer or shorter line out, so as to give any fish inclined to feed a double chance. The proper line to take for these large trout when moving along the shores of a lake is just where the water begins to go off between the deep and the shallow; and the bait should travel as near to the bottom as it can, without catching in weeds or stumps; as, though fish will frequently rise some distance to a bait, it is not desirable to compel them to do so. When a big lake trout strikes, he usually runs heavily, and bores down to the very depths of the loch, showing fine sport. They frequently run to a large size, reaching 16 and 18 ℔ weight, and sometimes heavier. They are, however, better for the table when 4 or 5 ℔. The small lake trout are spun for by trailing a minnow in the same way, but in shallower water; and often when the fish are dull at the fly, they take well on the trail. There are various artificial baits used for spinning, some of them imitating fish of different kinds, and made of bone, horn, gutta-percha, mother-of-pearl, glass, and other substances. One of the best and most generally known and used is the "phantom bait," invented and made by Mr Brown of Aberdeen. It is made of oiled silk, and painted to represent a small trout or par; being cylindrical, when drawn against the stream, it fills with water and plumps out to the size of a fish; when seized, however, it compresses to a mere rag of oiled silk, leaving nothing but the hooks in the fish's mouth. There are various other spinning-baits which do not exactly imitate any fish, as spoons, otters, kill-devils, &c.

Live Baiting.—The plan pursued in this kind of fishing for pike is generally to use either what is termed "live snap or gorge tackle." In the former, the object is to strike as soon as the pike takes the bait into his mouth; in the latter, to allow him to swallow or gorge it. In both cases a float is used. This is usually a lump of cork nearly as large as a hen's egg, to carry a good-sized bait. The bait used generally is either a small roach, dace, or gudgeon; failing these, any other that can be obtained. The best kind of snap tackle may be seen in fig. 6. In the cut it consists of a single hook and a triangle. The single hook is hooked through the root of the dorsal fin of a small roach, dace, or gudgeon, and the triangle hangs down at the side of the bait, as shown in fig. 7. Now, when a pike first seizes a bait he takes it across his mouth, so that while the head and tail appear outside his jaws on either side, the whole of the middle parts of the body are well within them; and, as will be seen from the position of the hooks, they will most probably be within the pike's mouth also; consequently, as soon as the pike has had time to take the bait so arranged into his mouth, the angler strikes smartly, and very often hooks his fish and lands him. It will of course happen sometimes that the triangle is not well in the fish's mouth, in which case either the fish is missed altogether, or, being very slightly hooked, he breaks away. Another method of using the live bait is what is termed the "live gorge." In this case a pair of hooks, tied back to back, are used. The loop of the gimp on which they are tied is hooked into a long needle, called a baiting needle. (See fig. 8, which shows the hooks and the needle.) This is inserted under the skin at the shoulder of the bait, and carried down just under the skin, towards the tail, being brought out just behind the dorsal fin. The gimp is drawn through, and the hooks stand as shown in the illustration. (See fig. 9.) In the illustration the loop is hung on to the trace, and the tackle used as in ordinary live bait fishing; only, when a pike takes the bait he is allowed to gorge it before the angler strikes, being permitted to go where he will with the bait, and ten minutes being allowed for him to gorge or pouch, as it is termed. This is a tedious method of fishing, and is only used for pike,—as often the fish runs the line foul of some weed, and leaves the bait; or, after mumbling it and killing it, refuses to gorge, and the constant waiting whenever there is a run is wearisome. But as there is less show of hooks, more runs are obtained in clear water than with the live snap tackle. Another method of using the live bait is with the paternoster, though this is chiefly used with minnow or small fry for perch fishing. It is, however, sometimes used for pike, when a gimp tackle is preferred and only two hooks used. For perch fishing, the paternoster simply consists of a line of gut about 4 or 5 feet long; at the bottom of this is a leaden bullet or plummet to sink it to the bottom; about 6 or 8 inches above this a hook, on some 6 inches of gut, is fastened; a foot above this another hook is fixed on, and a foot above that again, a third. This third hook is often a gimp hook, when pike and perch are found in common, and a rather larger hook and bait are used, so that if a pike should come to the bait, there may be a fair chance of capturing him. A minnow being hooked through the lips on each of the other hooks, the tackle is dropped into an eddy where perch are supposed to be, and the three baits swim round and round the main line; so that, no matter whether the fish are resting at the bottom or searching for their prey in mid-water, they may be attracted. As soon as there is a bite from a perch the angler feels it at the rod-point, slackens line for two seconds to let the fish get the minnow well into his mouth, and then strikes. Should the immediate neighbourhood not afford a bite, the tackle is cast to a distance, and after being allowed to rest for a minute, it is drawn in a few feet, when another cast is made, and then another draw, until the tackle is worked up on the boat or bank, when another cast is made. In the winter, after the floods, very many perch are caught in this way on the Thames, from 100 to 200 in a day being not very uncommonly taken. Trolling with the dead gorge is another way of fishing; and this is employed chiefly when the water is full of thick weeds and rush-beds, which prevent either spinning or live bait fishing, and solely also for pike. An elongated piece of lead is cast on to a bit of twisted brass wire, which has a couple of hooks similar to those on a live bait gorge tackle at the other end (fig. 10); a gudgeon (which is the best bait for the purpose) to suit the length of the lead is chosen; the loop of the gimp, to which the brass wire is fastened, is slipped into the eye of a baiting needle. The needle is passed in at the mouth of the bait and down along the spine, out at the tail. The lead being drawn into the stomach of the bait, the two hooks lie on each side of the mouth. The tail is tied tightly on to the gimp with three or four laps of silk, to prevent it from slipping (see fig. 11), and the tackle and bait fastened on to the trace used, which is usually a yard of gimp, with one hook or spring swivel to loop the tackle and bait on. This bait is then dropped into holes between the weeds or rushes, and is worked up and down by the lifting and falling of the rod-point, the lead within the bait causing it to shoot and dart along as though the fish were alive. When a pike seizes it, ten minutes must be allowed for him to pouch, when the angler must strike firmly, hold on, and get his fish out as well as he can. It is by no means the pleasantest method of fishing, as the waiting is tedious. The fish constantly runs the line foul of the weeds, &c.; and often, after a tedious waiting, it is found that the fish has rejected the bait after all. Added to these, there is this objection to all gorge fishing, that the angler must kill every fish he catches, as the hooks are in the fish's throat, and small under-sized fish, which ought to be returned to the water, are sacrificed, as well as fair takeable ones

Sometimes grubs and worms are used in mid-water fishing, being cast up stream and allowed to float down in mid-water This is chiefly for trout. The angler uses a long, light bamboo rod, and a single shot for a sinker. Two small worms are generally used; the brandling or gilt-tail is more frequently used (a worm found in rotten manure, &c.) Some use a single hook, some three small hooks tied one above the other. This is called "the Stewart tackle," after the author of the *Practical Angler;* and the worms are twined round and impaled on them. Wading up stream, the angler casts before him into every likely stream and eddy, allowing the line and bait to come down towards him in mid-water, and striking the moment he perceives a check. This is a very killing plan, and is adopted with a modification of tackle, to fish with beetles, larvæ, palmers, and, in fact, almost any kind of insect; for the trout is a very omnivorous fish, and will hardly refuse anything that is small enough. The lure is cast overhand, as in fly-fishing, and practice enables the angler to cast nearly twice the length of the rod.

Surface or Fly Fishing.

This method of fishing is conducted with the natural or the artificial fly The first of these ways is called daping, dibbing, or shade fishing, and consists of using a long light rod with almost 2 yards of fine strong gut, to the end of which is tied a No. 7 or 8 hook, not too coarse in the wire. A fly, beetle, or insect of some kind is then put on the hook by transfixing the thorax of the insect. Then the angler, having watched the fish rising under some bank or projecting tree or bush, creeps very softly to the place, and, keeping himself out of sight, pokes the point of his rod through some open spot in the bushes, and allows the insect to drop on the surface, just over or a little above the spot where the fish he wants to catch has been rising. Probably he will not be able to see or to feel the fish rise, and he will have to trust to a third sense—his hearing. He will hear a slight "plop," like a bubble coming out of a submerged glass. A gentle strike then is required, and a tight hand on the fish, as such places are usually near old roots or boughs, in which the fish will try to shelter himself and entangle the tackle. The best fish are frequently taken in this way. Another method of using the natural fly or insect is by casting it. In this case a single-hand fly-rod is used, and it requires great care to avoid whipping the insect off the hook. Having cast the bait to the extent required, the line and bait rest on the surface, and the bait floats down quite naturally unchecked, and the fish rise at it in the ordinary manner. What is called the blow-line is another favourite method of using the live fly. A length of light floss silk is fastened on to the running line with about 2 feet of fine gut and a light hook at the end. Baiting the hook with a fly, the angler turns his back to the wind, holds the rod (a long light cane one) upright, allows the wind to blow the light floss line as far out as it will go, when he gradually lowers the rod and guides the fly till it touches the water a yard above a fish, when he floats over it. A little wind is required for this kind of fishing. Some insects, beetles, creepers, or larvæ of the stone-fly, &c., are used in mid-water, as already noted. A word or two as to the method: a couple of shots being fixed on the line, the bait is cast with an underhand swing, as in minnow fishing, up stream, and allowed to travel down towards where the angler stands. At every stop or check of the line it is necessary to strike, for the bait being tender, whether it be a twig, mud, or fish that arrests it, it will be spoilt; therefore the angler must always strike on every suspicion of a bite. For full particulars of this kind of fishing, as well as for all relating to trouting in the North British streams, the angler cannot do better than get *The Practical Angler*, by the late Mr Stewart, one of the best works ever published on such subjects. The best flies used for live-fly fishing are the large ones, as the green and grey drake, the stone fly, known often in Scotland as the May-fly, the big alder, the blue-bottle, and, indeed, any that are large enough. In casting them the angler must be careful to let his line make rather a sweep or circuit behind him, or he will easily flick off or destroy his bait. In using the artificial fly the angler employs either a single or a double handed rod,—generally he commences his apprenticeship with a single one. This is usually made either of hickory, green-heart, or split bamboo tied and glued up in lengths, runs from 10 to 12 feet long, and is tolerably pliant,—more or less so, according to the taste of the angler. The line used is generally twisted or plaited hair and silk, or fine dressed silk. The first is the lightest. A piece of gut, knotted together until it is about 3 yards long, is termed the casting-line, point, lash, or collar. This is fastened to the end of the reel or running-line, and to the other end of it is looped on an artificial fly. Sometimes two or more flies are used; in this case they are called droppers or bob flies, and are looped or tied on to the casting-line about 18 inches or 2 feet apart. The end fly is called the tail or stretcher. The best way of fastening on the drop flies is to whip the gut round with silk a few times, just above one of the knots, to prevent chafing; then take a fly with only about 5 inches of gut to it, tie a knot at the extreme end of the gut, and then knot on it once or twice, if required, over the whipped silk, and if the gut be moistened and drawn tight to the knot, even when only once knotted, it rarely slips, and the more it is pulled of course the tighter it gets. When it is desired to take the dropper off, a sharp knife slips off the extreme end knot, and the tie comes off easily. The loss of gut is infinitesimal, and the fly wears out before the gut is materially shortened. The angler having his rod and line ready, and his cast of flies selected, begins by letting out a little more line than the length of his rod, waves the rod back over his right shoulder, so as to extend the line behind him, and then, making a slight curve, impels it forward towards the point he desires to reach, letting it fall on the water as lightly as possible; then he allows his flies to float down the stream as far as they will go, when he draws out and repeats the cast, lengthening out line as he does so until he has as much out as he requires, or can cast comfortably. If in casting he does not make a curve with the rod-point behind him, but returns the line too directly, he will crack his fly off, or so crack the gut at the head of the fly that the first good fish will carry it away. When the angler sees a fish rise at his fly, if he is fishing for small fish, he cannot strike too quickly,—if for large ones, he may be a little more leisurely. In fishing over a fish that is rising, the best way is to cast a little above, and to allow the flies, with as little of the line as possible, to come over or past him. Some anglers fish up stream and some down. In fishing down stream the angler exposes himself more to the fish, and is more apt to miss his fish when they do rise; and if his tackle is fine and the fish heavy, having the weight of the stream against him is also more apt to break it than when fishing up; perhaps the best method is to fish diagonally up and across the stream. The angler pursues one of two systems. He either waits till he sees fish rise and fishes over them, wasting no time on intermediate water when he sees no rises; or he fishes the water out thoroughly, searching every hollow, bank, weed, and stone, that may hide a trout. In burn fishing for small trout the latter method is generally the one adopted. In larger rivers, where the fish are heavy and few, the former is more often preferred. When a good fish is hooked it will often resist strongly, and rush violently about, seeking to hide itself under weeds and roots, which are dangerous to the tackle. The angler must guide the fish as well as he can until it is tired, letting out line from the reel when resistance becomes too severe a strain on the tackle, and winding it in again when opportunity serves, but always keeping a tight line on the fish, as a slack line frequently loses it. When tired the fish should be towed gently to a favourable bank, and the landing-net quietly slipped under him. There must be no dashing or hasty movement with the net, lest the fish be frightened and make another effort to escape, as fish frequently do, and successfully, as it is a dangerous moment in the struggle. In fishing with a double-handed rod the rod is longer and the line a little heavier; in other respects there is no difference. The rod will vary from 13 to 15 feet for trouting. The left hand grasps it below the reel, and the right hand above; though, if the angler desires a change, or the necessities of the stream or wind require it, the hands can be reversed. The double-handed rod has several advantages over the single, having more power with big fish, and keeping the line and flies higher above obstructions.

The question of why fish take bunches of feathers tied on hooks, and what they mistake them for, has often been asked; and it is now pretty generally allowed that they take them for flies in the majority of instances, though in others they may mistake them for water-beetles, larvæ, or spiders, of which latter insect there are several that inhabit the water. Now, there are two classes of disputants on this matter: one which holds altogether to the fly theory, and therefore strives to imitate each fly that comes out closely; the other, which inclines more to the general insect theory, and merely gives a few flies of different colours, not caring to imitate anything in particular. Probably the best fishermen recognise both theories, but bind themselves exclusively to neither. But before entering upon the selection of flies it may be well to point out the difference in the practice of the north and south. We may, perhaps, take the late Mr Stewart[1] as the exponent of the north; and, perhaps, Mr Francis Francis[2] may be held as the latest exponent of the south. Mr Stewart gives a short list of a bare half-dozen of insects, three of which he calls spiders—black, red, and dun—and which are what are known in the south as "hackle" flies; that is, flies dressed with only a body and hackle.[3] The hackle is wound on round the hook, over the body, and is supposed to represent the legs of the fly, there being no wings. Mr Stewart also has three flies of three general colours, yellow, brown, and dark bodies; but as these may be varied with all sorts of wings and legs, the last may embrace in reality any number of flies which the taste of the angler may suggest. Mr Stewart's standards, however, are dressed thus:—(1.) A woodcock wing, with a single turn of a red hackle or landrail feather, dressed with yellow silk freely exposed on the body. For fishing in dark-coloured waters the fly may be dressed with scarlet thread. (2.) A hare-lug body, with corn-bunting or chaffinch wing. A woodcock wing may also be put on the same body, but should be made of the small light feathers taken from the inside of the wing. (3.) The same wing as the last, with a single turn of a soft black hen-hackle, or a small feather taken from the shoulder of a starling, dressed with dark-coloured silk. These, as Mr Stewart says, can be varied to any extent; but he pins his faith on those mentioned and the spiders: the black spider being a small dark starling feather wound over a brown silk body; the red one, the small feather outside the wing of the landrail, wound on over a yellow silk body; and the dun spider, the small soft ash-coloured feather from outside the dottrel's wing, with hardly any body but the tying of the hook. This is Mr Stewart's *repertoire*—it is not overburdensome; but in the south Mr Francis says that fish are much less numerous, and are larger and more critical, their feeding-time being much longer and food being more plentiful than in the north, and their taste, therefore, has to be more carefully considered; he therefore gives a list of flies for each month. Space does not permit us to name the whole of them, but we can enumerate a few of the best of them. The duns run through the whole year, and are therefore with the angler the *pièce de résistance*. These comprise varieties of the blue and yellow dun, and should be varied from the darkest slate-blue to the lightest shade yellow, from almost golden yellow up to the lightest fawn, almost a white, and these, slightly combined, go also to an olive. The earlier duns are the blue dun, which comes in in March, and is one of the best spring flies. It is in the water more or less throughout the season. Then there is the small dark iron-blue dun, which appears in April or May, with wings almost as dark as the body; and the bright yellow dun, with greenish-yellow body and pale slate-coloured wings. If these three be taken as the darkest of their class, and varieties, each of a shade or two lighter in colour, be made, they will take in the whole of this important class of flies. These duns are all imperfect insects, and have another change to go through before they are complete and able to propagate, and when they have completed this they usually die. The fly casts its skin and becomes a perfect insect, brighter in colour and more brisk in its motions. In this form they are called by the angler "spinners." Thus the blue dun becomes the red spinner, the yellow dun the brown spinner, the iron-blue dun the jenny spinner, and so on. All these flies belong, with several others, to the class or order *Neuroptera*, or nerve-winged flies—flies with clear gaudy wings, intersected with a network of veined markings. They form the most important order for the angler; but there is another order, the *Trichoptera*, or hairy-winged flies, which is scarcely less important, and which includes a very large number of flies on which fish habitually feed. These flies have soft feathery folding wings, which lie close on the back. They differ from the former order in having one less change to go through, for when they emerge from the pupa state and become flies, they are complete, and have no further change to go through. There are, besides these, which are flies born from water, other orders of land flies, imitations of which are used by anglers, as the cow-dung, hawthorn, and oak flies, the house-fly, &c., but they are comparatively insignificant,

[1] *The Practical Angler*. A. & C. Black, Edinburgh.
[2] *A Book on Angling*. Longmans & Co., London.
[3] The pointed feathers on a cock's or hen's neck are called hackles, but any small feather with a soft shortish fibre may be used as a hackle.

and with the exception of the cow-dung, which is a very useful fly, may be dispensed with. It is impossible here to give the dressing of the various flies; but if the angler goes to any respectable tackle-maker and mentions the names of the flies he requires he will get them. To commence then with the month of—

March, which is early enough for fly-fishing. The earliest fly found on the water is the February red. This, with the blue dun and the March brown, will do well during March, if anything will. The same flies kill well enough also in—

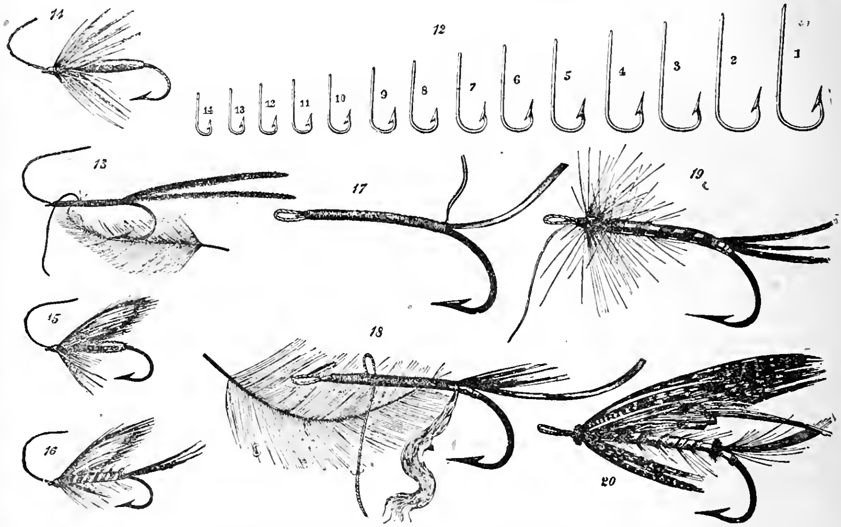
April, and to them may be added the red spinner, the cow-dung, the red and black hackles, the needle brown, and towards the end of the month, or entering on May, the yellow dun and the iron-blue dun.

May.—In addition to many of these, the angler may use the stone-fly, the sedge-fly, and the orl or alder fly—a very celebrated and general fly—with the little black gnat and the pale evening dun,—a fly which only comes on in the evening towards dusk, when the fish feed ravenously on it.

June.—In this month the standing dish with the trout in most rivers is the green drake, better known as the May fly, though it rarely appears until May is over. This and its transformations, the grey drake, with the well-known Welsh fly, the coch-y-bondu, otherwise the bracken clock, shorn-fly, &c.; these, with various light-coloured duns and spinners, may be used through the month with effect, as this is the prime month for fly-fishers.

July, as a rule, is rather an indifferent month. The weather is hot, the water low and clear, and fish do not feed well till the evening, when the white and brown moths may be used. In the day-time the red and black ant flies often kill well, and these, with various light-coloured duns and diminutive green, blue, and grey midges, must make up the bill of fare.

August.—The August dun and the cinnamon now are added to the list, many of the previous flies being still on.



September brings the whirling dun and the willow-fly, and this closes the angler's fly-fishing for trout.

In the latter months many of the earlier flies reappear, and with the list here given the angler should have no difficulty in killing fish anywhere. Most of the smaller trout-flies are dressed on hooks that range from the sizes No. 10 to 17 in the scale of hooks given in fig. 12 in the cut—the larger flies, as the May-flies, stone-fly, the moths, &c., running up to sizes 6, 7, and 8. There are, besides these flies, which are definite imitations of insects, a few of such general make and colour that though they do not strictly imitate one fly, may have a general likeness to several, and which are called general flies, and are often used when the angler is in a difficulty in knowing what to put on his cast. Among the best of these are the Hoffland, the Francis, the governor, the coachman, the soldier palmer, the wren-tail, the grouse and partridge hackles, &c. As a rule, the smaller flies are used in the day-time, the size being increased as the evening and night come on. In some waters, owing to the excessive fishing, the trout get so wary that after the May-fly there is very little chance, unless the day be particularly favourable, of hooking a trout before the evening, and fishing is often carried on till ten or eleven o'clock at night. Of course at such times the angler has to trust more to his senses of feeling and hearing than sight. In the majority of instances it is the custom to let the tackle soak, and when fishing to allow the fly to sink a little under the surface—to fish with a "wet fly," as it is called; in others, where the fish are more wary, in order to imitate nature more closely yet, it is the custom to fish with a dry one—that is, to make the fly and line rest on the surface, without becoming submerged. To this end, when the fly and line become wet, they are waved to and fro from the rod point in the air to make them become dry again. The fly should always be allowed to float down stream, as natural flies do, and should not be jerked or "played," as it is termed, unless the angler is fishing down stream and drawing his fly against it, when he will allow it to sink under water, and in that position it may be supposed to represent some quick darting larva. So far, stream fishing only has been dealt with.

Lake Fishing differs in its practice materially from stream fishing, and though some flies which are used on streams will also kill on lakes, yet, for the most part, there is a fancy *repertoire* in this respect which differs wholly from that employed in streams. Lake-trout flies, particularly in Scotland, are made with wool bodies, the prevailing colours being red, claret, orange, yellow, green, and black, with a light spiral up the body of gold or silver tinsel. The hackles are chiefly either black or red, or red with a black centre; the wings are either of teal, mallard, or woodcock. Here and there the white tip feather in the drake's wing is a favourite wing for flies. They are usually dressed on 7, 8, or 9 hooks; the same flies a size or two larger do equally well for sea-trout flies.

Lake-trout fishing is conducted either from a boat or from the shore. The best depth of water in which to fish for trout varies from 6 or 8 to 12 or 14 feet, and between these depths the best sport is obtained; and the angler should therefore fish over them for choice, though occasionally fish may be caught in both deeper and shallower water. In lake fishing it is always desirable to have a good ruffling breeze, as the fish do not rise or take well in a calm. The best places are in sheltered bays, by rocky points or islands, or where burns flow in; drifting along by these, and casting ahead and shorewards, the angler watches every break in the water. While drifting along in his boat, it may happen that, the wind being high, he drifts too fast to fish thoroughly and properly over the ground. To obviate this a stone or an anchor is cast over and allowed to drag along the bottom, so as to check the way of the boat, and to give time to the angler to fish. A good boatman and netsman is here a great desideratum, and much of the chance of sport depends upon him. The great fault of most boatmen is that they go too quickly over the casts; and it requires a man with a knowledge of the lake, as well as experience in managing the boat, so to conduct matters that the angler has the best chance of sport. When rowing to his ground, or from point to point, the angler should always put out the spinning minnow, and thus he may take one or two of the best fish. As fish do not always lie in the same places, wind and weather have to be sedulously consulted. In fishing from the shore the angler seldom gets the best sport, and often has to wade to reach fishable water, while the best casts are often beyond his reach; and therefore, whenever a boat can be employed, it is to be preferred for lakes.

Salmon Fishing.

The salmon is the noblest and strongest fish on which the angler essays his art, and fish from 40 to 50 lb in weight, and sometimes of even more, are occasionally taken by the rod and line; though for the ordinary pur-

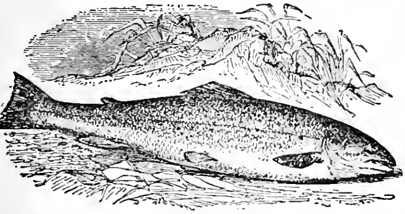


FIG. 21.—The Salmon.

poses of sport, fish from 7 or 8 lb up to 20 are far more generally taken. When a salmon in good condition is first hooked he makes a strong and violent resistance, dashing through the water frequently for a distance of 60 or 70 yards or more at a time, and compelling the angler to let so much line off the reel; springing out of the water, often to a height of several feet, several times during the struggle; and finding that force is unavailing to break the line or withdraw the hook, he will often have recourse to cunning, and cut the line or rub the hook out of his nose against some rock; or, hiding himself at the bottom behind big stones and boulders, he will sulk and remain immovable for a long time. Occasionally he will run up or down rapids or falls in his terror and rage. To control all these vagaries, to combat his cunning, the angler, with his bending rod and practised skill, lets him take out line when his struggles are dangerous, cautiously winding it back again when he is able to do so safely, and thus keeping a certain strain upon the fish he gradually tires him out and wears his strength down, and at last, when unable to resist any longer, he is led in towards the shore, where upon some convenient rock or strand the attendant gaffsman stands or crouches, with a sharp-pointed steel hook attached to a short ashen staff called a gaff, waiting his opportunity. As the salmon is led past or near him, almost on the surface of the water, the hook is extended beyond the fish, the gaffsman makes a short sharp stroke with it, and digging the hook into the side of the salmon, with a sudden and instantaneous pull drags it out of the water to the land; a rap on the skull from a stick or stone terminates the poor salmon's life, and henceforth he becomes mere provender. Sometimes a large landing-net is used to land the fish, but though this prevents the spoiling of a portion of the fish by avoiding the need for making a hole with the gaff, it is less convenient and of more risk to the safety of the fish. The most favourite plan of fishing for salmon is with the fly, though in many places they will also take both worm and minnow freely, and are thus fished for. The salmon-fly is a most wonderful conglomeration of feathers, silks, and tinsels, and oftentimes is as brilliant as the most glittering humming-bird. What the salmon mistakes it for is not easy to say, for there is nothing like it in nature. Probably a semi-transparent shrimp or prawn reflecting the gorgeous tints of the surrounding sea vegetation may be the nearest approach to it. The manufacture of the salmon-fly is given hereafter. They are made of various sizes,—the longest for the early spring when the rivers are much swollen and very turbid, when hooks of 3 inches in length, and sometimes even longer, are employed; and from this extreme size they diminish gradually to a large sea-trout size, which is about in accordance with the hooks numbered 6 and 7 in the scale given in the illustration. These are used when the rivers have sunk down to their summer level, and are very clear and still, and the flies in the intervening sizes are carefully adjusted to suit the size and clearness of the water. There is a great difference in the method of using the trout and the salmon fly. In salmon fishing there are certain spots in the river upon which salmon are known to rest and to feed, and these are called salmon-casts, throws, lodges, or stands. They may be but a few yards in length, and comprise a favourite ledge, or a rock or two, behind which salmon like to shelter,—for a salmon always has his lair or resting-place behind some projecting rock or stone; or they may extend for 100 or 200 yards, or even more. There are, too, in many rivers plenty of places where salmon may be seen sporting and jumping about, but where, owing to the depth of water or some other reason, they never feed or at least take the fly. The angler, therefore, who knows thoroughly the cast he is about to fish, has a great advantage, for he knows where the big stones and the particular eddies are in which a salmon may be expected to rise, and how the fly should be drawn over the fish so as to show itself in the most tempting manner; whereas the angler who has not much knowledge is often apt to dwell upon spots that are comparatively barren, and to pass quickly over those that would perhaps repay particular attention. In fishing a cast, the angler casts diagonally across down stream, and draws the fly up stream towards him, softly raising and lowering the top of the rod so as to check and loosen the fly alternately, and to make all its fibres open and shut so as to counterfeit life. When a salmon rises to the fly he either makes a big bulge or boil in the water, or, if he is unusually eager, he throws his head and half his body above the surface, rolling over like a porpoise in his endeavour to seize the fly; but a salmon very often misses the fly in his eagerness, and when he does, the very worst the angler can do is to pull it away from him, as after such a miss it is not at all uncommon for a salmon to turn round hastily and to make a second snatch at the fly, which he then rarely misses; but if the fly is whipped away from him, he is frightened and disgusted, and goes down sulkily, refusing to rise again. It is therefore the safest plan to wait till you feel your fish, and then to strike, and even then it is not desirable to be too rough. A violent stroke is not the best one,—a slight elevation of the rod so as to fix the point, and then a steady strain, enough to force the barb of the hook home in the next minute, is the best way of getting a firm hold. Many fishers strike the moment they see the boil of the fish, under the belief that the boil is made by the tail of the salmon as he turns to go down, and that they do not see him till he gets the fly in his jaws. This is true, provided he does not miss his aim altogether; if he does (as he certainly often does, for it must be remembered that the fly is constantly in motion, which of course renders it not very easy to see), then to strike is to pull the fly away and to deprive the salmon of another chance. When he has hooked a fish, the angler should look round and study what dangers there are which may prove destructive to his hopes, and determine if possible so to manage his fish as to avoid them. He must, therefore, always retain his coolness and presence of mind; flurry and confusion are often fatal to success. If a salmon jumps out of water the point of the rod should be lowered, so that the line be slackened, for if it be tight the sudden weight is apt to pull it out of the fish's jaw. If he sulks, the only way is to frighten him out of his hole by poking a long pole into it, or by throwing stones, or by some other device. If he runs for the edge of a fall or rapid, it is often a very good plan to let out a lot of loose line, and the salmon, fancying himself free again, will not go over, but will head round and face up stream again. As the devices of the salmon to escape are numerous, they cannot be dealt with fully here. No two salmon-casts are alike, and therefore no two can be fished in the same way; each one must be fished to suit the particular capabilities it possesses.

The method of casting the salmon-fly is similar to that adopted with the double-hand trout-rod; the only difference being that the rod is larger and heavier, running up to 21 feet, and even more sometimes, and seldom less than 16 or 17 feet. The line is stout, well-dressed. 8-plait silk; the casting-line a yard or two of treble-twisted gut, and a yard or two of stout single salmon gut. Having mastered his rod well, the angler will find it comparatively easy to cast up to 20 yards of line; from this up to 30 yards every extra yard he can throw proves him more and more a good fisherman, while every yard he can cast beyond 30 shows him to be a master of his craft. The angler should never cast more line out than he can work and fish comfortably; if he does, he has a slack line when he requires a tight one, and he will often raise and scratch fish, and spoil his own sport and other people's, when a yard or two less of line would have enabled him to catch his fish. Very long throws are only necessary under unusual circumstances; 25 yards will generally cover fully all that the angler really needs to fish.

Salmon-Flies.

We may give a short list of general salmon-flies such as the angler will find it useful to have always by him, and which he can employ if he does not know the general flies used on the river, and every river has some pet fly, some different combination of feathers and fur from its neighbour. The flies given are all standard flies, and may be had at any respectable tackle-maker's. The method of dressing them is the one which experience has shown to be the best for attracting the notice of the salmon.

The Claret.—One of the most useful general flies. Beginning the dressing at the bend of the hook, which is the tail end of the fly, a turn or two of gold twist and golden-coloured floss silk is taken for the tag; above this is lashed on a tail formed of a golden pheasant topping and some strips of blue and red macaw. Over the stump of the tail is fastened the but, a sort of ruff made of two or three turns of the herl or strands of a black ostrich feather. Then comes the body—first three turns of orange floss silk, then reddish claret pig's wool wound on to the top of the body; over the wool spirals of stout gold thread; and, beginning halfway down the body, a hackle of reddish claret to the shoulder, and at the shoulder two or three turns of black hackle. The wing is made first of tippet feather of the golden pheasant, which forms a sort of short under wing; above that is a mixed wing of fibres from the golden pheasant tail, turkey, bustard, and peacock wing, with a few fibres of green and red parrot; above all a single topping, with a rib to either wing, of blue macaw fibre,—the head of the fly being black, either ostrich, herl, or chenille. This fly may be used of various sizes, and is a very general favourite in most waters.

The Black and Teal.—Another very general favourite, the leading points of which are a black body with silver spirals of twist or tinsel; a single topping for the tail; black hackle up to the shoulder, over which either a teal feather or a gallina feather (with the large spots), and a wing of teal or rather pintail, and over it two jungle cock feathers with or without a topping. This fly also may be used of all sizes; dressed small, it is good for either lake or sea trout.

The Blue Doctor.—Tag, a few turns of fine gold twist; tail, a topping; but, scarlet crewel or wool; body, pale blue floss silk, with a hackle a shade darker, or a blue jay's feather; silver tinsel (in large flies with silver twist beside it); grouse, partridge, or bustard hackle at the shoulder; a blue jay feather or blue hackle over it. The wing is mixed of fibres of the bustard, dark turkey, argus pheasant, claret, blue, and yellow fibres of dyed swan; sometimes a topping over all and a head of scarlet crewel.

The Silver Doctor.—Also a very great favourite. Tag, silver tinsel; tail, a topping; but, a turn of red crewel; body of silver tinsel entirely; hackle, blue, with brown hackle at the shoulder, and a small speckled gallina feather hackled on over it; wing chiefly pintail, with a few red and blue fibres and a topping; head, red crewel.

The Butcher.—A very killing fly, and generally used. Tag, gold twist and dark orange floss; tail, a topping; but, black ostrich herl; body, two or three turns of scarlet. The same of a medium blue, then of red, and lastly of dark blue pig's wool; broad silver tinsel; a medium red claret hackle with a gallina at the shoulder; under wing a tippet and rump feather of the golden pheasant, and over them strips of brown mallard, bustard, or peacock wing.

The Parson.—If a gaudy fly is required, there are few more showy ones than this. Tag, silver tinsel and mauve floss; tail, two toppings, a few sprigs of tippet, and a green kingfisher feather; body, two turns of gold floss silk, golden pig's wool merging into orange; silver twist; golden orange hackle, red orange hackle above it; three or four short toppings tied on at the breast; wing, a tippet feather of the golden pheasant, a strip of pintail on either side, seven or eight toppings, and a couple of kingfisher feathers at the shoulder on either side; black head. A more subdued parson may be made by using a jay's hackle at the shoulder instead of the short toppings, by reducing the number of toppings in the wing, and adding some darker fibres of golden pheasant tail, bustard, &c.

The Drake Wing.—Tail, tippet sprigs and a yellow toucan feather; body, orange red and black pig's wool; silver tinsel; hackle, a coch-y-bondu stained of a dark orange red; a lavender hackle at shoulders; wing, two strips of drake or pintail. Bodies of orange, claret, dark blue, and black pig's wool graduated up to the head, are very great favourites, and, wedded to various hackles and wings, kill extensively.

The Orange and Grouse.—Flies with orange or golden floss silk bodies, and various hackles and wings, also kill widely. The above fly is tied with a tag of silver tinsel. Tail, a topping and king fisher feather; but, black ostrich herl; body, three turns of magenta floss, and the rest of light orange floss; hackle, grouse with the tips snipped off—not on the back—with three or four toppings over the long grouse fibre for wing; blue jay tied sparely at the shoulder; blue macaw ribs; a black head.

A very good series of plain flies, very much used, can be made thus:—Tag, two turns of tinsel; tail, a topping and some tippet sprigs; body, a turn of bright orange brown followed by yellow in the centre, and the rest of lightish blue pig's wool; a broadish silver tinsel, the wool rough and picked out, with a black hackle, and wings of peacock wing, sometimes with a tippet in the centre or a topping over. By varying the wing or hackle, a very taking series of flies can be had.

With this list of flies the angler ought to be able, in default of knowing the special flies suited to the river, to fish any river with confidence, and, if the fish are in the humour to rise, to get sport in it. The colour, and particularly the size of the fly, are things to study in catering for a willing salmon. Too large a fly often causes a false rise; when this is found to occur, the size should be reduced.

Sea-Trout Fishing.

Next to the salmon ranks in value for sport the sea-trout. Of these there are two kinds: 1st, The salmon-trout (*Salmo trutta*); and 2d, The bull or grey trout (*Salmo eriox*). The former is much the better fish for sport and for the table, the latter being coarser for the table and rather shy of the angler's lures. Sea-trout abound in several rivers in the north, and many are taken in the tributaries of the Tweed and other northern rivers; but they are perhaps more abundant and show better sport to the angler in some of the western Irish waters. The salmon-trout usually average below 4 ℔ each, perhaps from 1 to 2 ℔ being the prevailing size, though now and then much larger fish are taken. The bull-trout often runs up to a far greater size, and fish of above 20 and even up to 30 ℔ are not very uncommon. The salmon-trout, called in Ireland the white trout, and on Tweed and the northern rivers the herling or silver white, is a smart, bold-rising fish; it takes freely at times, and plays with wonderful agility, frequently when hooked springing from the water like an acrobat many times in succession, and trying all the angler's skill to bring it into the basket. In lakes they frequently abound in profusion, and a hundredweight of them, and sometimes more, are or have been often taken in one day. The tackle, of course, is lighter than that used for salmon, and somewhat heavier than is used for the common trout. The flies are also of a size between those used for the other two; bodies of claret, yellow and orange, green, blue, and black, either of silk or fur, are the favourites. In Ireland they prefer a mixed wing, chiefly made up of fibres of yellow, red, and green parrot, with bustard and other dark feathers; the hackles being suitable. In Scotland they prefer plain wings of drake, teal, woodcock, and the black and white tip from the wild drake wing; but the fashion of the dressing is not a very important matter, so that the colour is right. At times sea-trout rise very badly, and the angler will get a number of rises, but succeed only in hooking a very few fish; but when the fish are taking well, few branches of the sport show better amusement than a day's sea-trout fishing. They also, unlike the salmon, take a spinning bait well while still in the salt water, and many are thus captured in the estuaries and salt-water lochs of Scotland while they are making their way to the mouths of the rivers up which they eventually would run to deposit their spawn.

Trout Fishing.

The trout (*Salmo fario*) has already been fully dealt with as regards the means employed in capturing him, and very little more needs to be said. He may be caught on the surface by the natural and artificial fly, by spinning a minnow, &c., in mid-water, by a live minnow, by casting a beetle or grub also in mid-water, and by fishing with a worm at the bottom. There are very few fish that have so wide a range as the trout. From the poles to the outside boundaries of the tropics they are found on every continent, either in running or still waters, for neither comes amiss to them. From the huge lake trout, vying with the salmon in size and strength, the species dwindles down to the

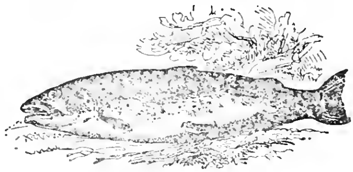


FIG. 22.—The Common Trout.

small burn fish of six or eight to the pound. There is hardly any way of using the rod that is not more or less suitable for their capture; and though salmon fishing is held the nobler pursuit of the two, yet far more skill is required to make an expert trout fisher, so cunning and wary do they become when much fished over.

Greyling Fishing.

The greyling (*Salmo Thymallus*) is not so widely distributed as the other members of the Salmonidæ. It is found in comparatively few rivers in England; in only one in Scotland, the Clyde, into which it was introduced some years ago; and not at all in Ireland. It is a useful fish for the angler, inasmuch as it comes into the best rivers just as the trout is going out. It is a handsome fish, of graceful shape, very silvery sides and belly, with small black spots. It supposed to smell of thyme when first caught, hence its name. It is seldom known to run much above 4 ℔ in weight, and even that size is not at all common,—from ½ or 1 ℔ to 1½ ℔ being the average takeable size. It rises very freely to the fly, and will take other bait; but is less carnivorous than the trout, so that minnow is rarely used as a lure for it,—small insects, as gentles, caddis, &c., may be used with advantage. The flies it prefers are usually small bright duns and spinners, such as are used for trout in clear waters. The longer dorsal fin of the greyling allows it to rise from greater depths more rapidly than the trout, and deep still reaches often hold the best fish. Unlike the trout, a greyling will often rise and refuse the fly four or five or more times in succession, and yet will perhaps take it after all. The mouth being tender, the fish must be treated more gently than the trout, or it may break away. There is one way of fishing for greyling practised in the midland rivers which is worth notice. It is called "grasshopper fishing," though the lure is totally unlike a grasshopper. A lump of lead of an elongated pear shape is welded or cast on to the shank of a No. 5 or 6 hook. This is covered with wool or worsted wound on to it in rings of different colours—green, yellow, and sometimes red. To make the bait more attractive, sometimes two or three gentles are put on the hook, and the bait is cast into a greyling eddy, and worked up and down smartly until taken by a fish. The angler strikes at every suspicion of a bite. Large baskets of greyling are taken thus.

Roach Fishing.

The roach (*Cyprinus rutilus*) is caught principally in bottom fishing with the float, as before described. The roach has been termed the river sheep, from his supposed unsuspiciousness of guile, but that can only be when he is never fished for. About London, where he forms a great attraction to a numerous body of anglers, he is particularly sharp; and nothing but the finest tackle, such as a single almost colourless horse hair, will take him, even gut being refused when he is much fished for. A very light quill float and a few sinkers are desirable. Roach weighing 2 ℔

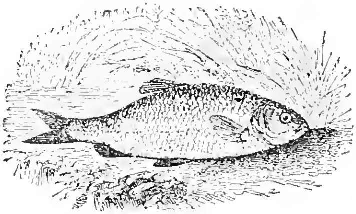


Fig. 23.—The Roach.

are not at all common, from 1 ℔ to 1½ ℔ being the usual limits. The best hook baits for roach are gentles, greaves, red worms, a plain paste made of flour and water or worked up bread crumb or pearl barley. Of course there are a multitude of other baits which are sometimes preferred, but these will rarely fail if the fish are at all inclined to feed. The best general ground-bait is that already mentioned in bottom fishing, though all sorts of other matters—as grains, barley-meal, pollard, boiled wheat, &c.—are sometimes used. Roach, when feeding near the surface, will sometimes take a fly, as indeed will most fish. Size of hooks required, 10, 11, and 12.

The Dace.

The dace (*Cyprinus leuciscus*) is frequently found in common with the roach, though often abounding in trout streams. Where there are no roach, it takes the same baits as the roach in all respects, save that it runs much more freely at the fly. In the months of July, August, and September on the Thames, large numbers of dace are taken with the fly from the water between Isleworth and Teddington with small black and red palmer and other flies tipped with a gentle or a piece of wash leather in imitation, and it is not uncommon for an angler to take ten dozen of them in a tide. The dace runs quickly, and requires very quick striking. The Jews are very fond of dace for their feasts, and pay a high price for them. Size of hooks required, 10, 11, and 12.

The Chub.

The chub (*Cyprinus cephalus*) is perhaps the least valuable fresh-water fish for table purposes, though probably the barbel may almost be put on a level with him, albeit Izaak Walton contrived to make a tasty dish of it; but at best the flesh is rather vapid, watery, and abounding in

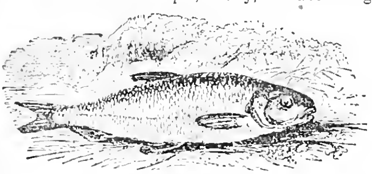


Fig. 24.—The Chub or Skelly.

bones. It is a fair sporting fish, however. In addition to his taking all kinds of baits in bottom fishing, he will take both natural and artificial insects on the surface boldly, and many are taken by dressing a cockchafer, humble bee, or small frog, or by casting imitations of the same, artificially prepared, under the boughs where the chub lies waiting. A big artificial humble bee or cockchafer, or a fly made of a silver tinsel body, coch-y-boudu hackle and turkey wing, with sprigs of green peacock in it, are about the three best lures for him, though many prefer red and black palmers. The chub often lies also in deep heavy streams, and will frequently in such cases take a live or a spinning minnow pretty freely. Among bottom baits cheese and greaves are special favourites. The chub rarely exceeds 6 or 7 ℔ in weight, though specimens have been known to attain 9 ℔. Size of hooks, 3, 4, and sometimes larger.

The Barbel.

The barbel (*Cyprinus barbus*), so termed from the wattles or beard depending from the sides of the mouth, is a very game fish for the angler, frequenting deep and rapid streams, and often turbulent and broken waters, as at the tail of mill wheels, weirs, &c. They go in large shoals, so that when the barbel are got upon the feed the angler often takes from 20 to 50 or more in a day. They require a good deal of ground-baiting, however,—worms, gentles, greaves, &c., being often used in large quantities two or three nights before fishing to induce them to feed freely, and even then the angler is as likely as not to be disappointed. A clean red lob-worm is, upon the whole, perhaps the best bait for a barbel, and next to that a bunch of gentles or greaves, though they will sometimes take freely a number of things, including fat bacon and raw beef. They are fished for in several ways by the ordinary and travelling float method, by the ledger and the clay-ball principally; and it often happens that they will take pretty well in one of these ways and refuse the others. The barbel nibbles a little at the still bait before biting, but when a good double tug is felt, the angler may strike firmly. Owing to its great expanse of fins, and its rounded body, the barbel is a very stout fighter, and makes a most prolonged resistance; and though it is not so active as either salmon or trout, it is more troublesome, and takes longer to subdue. In the spring months the large barbel will frequently take a spinning bait freely, and when spinning for large trout in a weir the angler frequently receives severe disappointment by hooking a big out-of-season barbel. They run up to 16 ℔ weight, but one of 12 ℔ is not caught every day. On the Thames the average is from 1 to 4 ℔. They are a very curious fish, some years biting freely, and during others hardly at all. Size of hooks for worms, 1, 2, 3; for other baits smaller.

The Bream.

The bream (*Cyprinus brama*). It is said that there are two kinds of bream,—the small white bream (flat) and the big olive-coloured bream. Much that applies to the barbel applies also to the bream. The same baits and the same

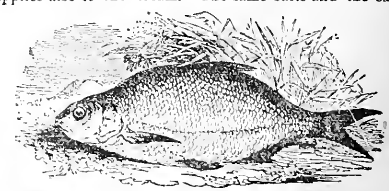


Fig. 25.—The Bream or Carp Bream.

methods of fishing must be adopted, but if possible finer tackle is required. Perhaps if there is one bait the bream likes better than another, it is two or three brandlings or red worms stuck on the hook. Otherwise his taste resembles the barbel's. Barbel and bream are commonly caught in the same swim, but bream like to have a deep quiet eddy to lie in. They are a curious fish, suddenly appearing in places where they have never been seen before, and after stopping for a year or two, as suddenly disappearing. They run up to 7 lb, and in the Thames average from 1 lb to 4 lb. They are a very fair fish for the table, and fry well. Size of hooks, 4, 5, 6.

The Carp.

The carp (*Cyprinus carpio*) is described by the Dame Juliana Berners as a "deyntous dish." Unfortunately the decline of knowledge in the matter of fish feeding and rearing in ponds, &c., renders it difficult to realise the dame's assertion, an ordinary carp from an ordinary pond being poor in flesh and muddy in flavour, but it is quite possible that the flesh, which is so susceptible of taking the nasty flavours exhaled around it, would, under better management, with better food and purer water, be both delicate and "deyntous." Of all fresh-water fish, the carp is one of the most cunning and difficult to catch where he is much fished for, though, singularly enough, they take much better in rivers than in still water. In still water, even if you can induce a good carp to pay attention to your bait (which you cannot always), he will nibble, and turn it about, until he either sucks it off the hook without touching the hook, or he discovers the hook on the line,

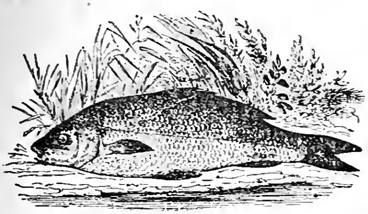


Fig. 26.—The Common Carp.

becomes alarmed, and swims away. Very fine tackle, therefore, is required in carp fishing; but as he is big and lusty, it should be round and strong. There are various baits which more or less attract him. Paste sweetened with sugar or honey is one of the best; but he will at times take gentles, greaves, and red worms. Some affect boiled green peas, some beans, and many are taken with parboiled potato, which is one of the best of baits in some places for large fish. The best ground-baits are those recommended already, of bran, rice, bread, &c. If the fish are very shy, float tackle is to be avoided, and a very light ledger on a pistol bullet used instead. As the line rests on the ground, the carp does not see it, and takes the bait without suspicion. A clear bottom, however, is desirable. Carp run up to a heavy weight, sometimes between 20 and 30 lb, and they live to a great age. Size of hooks, 5, 6, 7.

Tench.

The tench (*Cyprinus tinca*) very much resembles the carp in his habits, feeding on much the same matters, though neither paste nor any vegetable baits are to be recommended for tench. The best bait that can be put to him is a red worm, or two or three gentles; and for ground-baits, chopped worms and gentles are preferable. Tench bite best in the morning and evening, when there is hardly light enough to see the float; for float tackle is best for the tench, though he nibbles and mumbles at the bait exactly as the carp does and often, like him, leaves it after nibbling off all the tail of the worm that is beyond the point of the hook. When the tench is so shy his eagerness may be stimulated by very gently drawing the float and bait away a few inches, when he will often rush at the bait and seize it at once. Tench are a very quiet, unobtrusive fish, and may exist in a pond for a long time

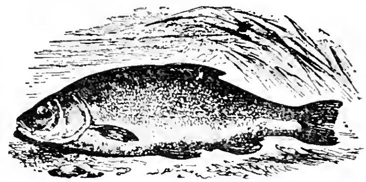


Fig. 27.—The Tench.

without being known to be there. They are very capricious in biting, sometimes biting well for a day or two, and again refusing all baits for weeks without any apparent reason. If taken from clear waters, the tench is a very good table fish—second only to the eel. Size of hooks, 6, 7, and 8.

The Eel.

The eel (*Anguilla acutirostris*). The eel is scarcely an angler's fish, but it is often taken in angling, and it is a most excellent and luscious table fish. It takes various baits, as worms, small dead fish, which are the best for it, and takes them better when they are still than when moving. Thus, night-lines are the best way of capturing the eel. Occasionally float tackle is used for the purpose, when the roughest tackle, with a float-hook and worm, suffices. Sniggling for eels is an amusing way of taking them. A stout needle, lashed to a long string, is concealed in a worm; the point of the needle is stuck lightly in the end of a long stick. This is then introduced into the mouth of a hole in which an eel is supposed to shelter. As soon as the eel sees it he secures it, pulls it from the stick, and devours it. The string is lashed to the middle of the needle, so that when the angler pulls at it the needle turns crosswise in his gullet. The angler pulls with a steady strain at the line, until at last the eel, unable to resist longer, comes out and is caught. Clotting for eels, by means of a big bunch of worms strung upon worsted and gathered up into festoons, is another way. The eels entangle their teeth in the worsted, and are lifted out and dropped into a pail. A hundredweight in a night has been caught in this way. They are chiefly caught, however, by baskets, nets, or traps set in mill-weirs, when they are migrating, and in some places, at such times, tons of eels are caught in a night. Fresh-water eels run up to a large size. They have been known to exceed 20 lb, but 4 or 5 lb are more common, and the average is from 1 to 2 lb. Hooks any size that is suitable—from 4 to 8.

The Gudgeon.

The gudgeon (*Cyprinus gobio*) frequently forms the young angler's first quarry. This little fish abounds in large shoals in the Thames and other rivers, six or seven dozen, or even more, frequently being taken at one pitch. No ground-bait is required to attract them, but the bottom being disturbed and harrowed by a heavy iron rake, the fish flock to the spot to search for food in the *débris*, and they will continue to bite for some time, when another rake renews their avidity. A light cork float and a small 10 or 11 hook, with a fragment of red worm, is all that is needed: for so eager are the little fellows, that they pull the float down with a dash, so that the angler rarely misses his prey. A dish of gudgeons, gently fried, crisp and brown, is by no means to be despised. With the gudgeon the pope, or ruffe (*Perca cernua*), is often found. It is little worth for the angler, and is not very abundant. All that applies to the capture of the gudgeon applies to the pope. The bleak also (*Cyprinus alburnus*), a lively little fish, but hardly worth the angler's notice; it may be taken either with bait or fly, as is the dace.

The Pike.

The various methods of fishing for the pike (*Esox lucius*) have already been detailed—spinning, live baiting, paternostering, the live and dead gorge, being the principal, though the pike will take a big fly at times made of peacock's feathers and other showy matters. Pike grow to a very large size, where the water is favourable even to 70 or 80 lb; but pike of half that weight are not common, and one of 20 lb is a prize to a London angler.

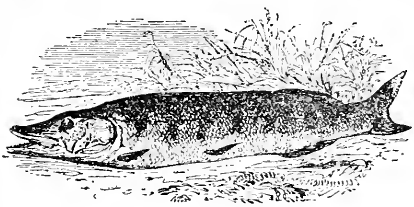


Fig. 28.—The Pike.

The Perch.

The perch (*Perca fluviatilis*) has also been partially dealt with, paternostering being about the best way of taking perch, though at times a float and worm will take better still, and even the ledger will take them. In big rivers perch in the winter get into the eddies and stiller waters, out of the floods, in shoals, and here, as the water begins to clear, they may be taken to the number of several dozen; often two or three at a time. They are excellent fish for the table. They run up to 4 lb weight, though heavier ones are sometimes taken. Hooks, 4, 5, and 6.

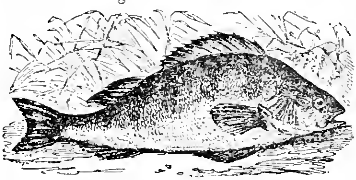


Fig. 29.—The Perch.

On Tackle and Fly-Making.

It is exceedingly desirable that the angler should be able to make and repair his own tackle. This will probably save him quite one-half of his outlay, and has the satisfaction of knowing that he can trust to the tackle, which he cannot always when he buys it; while, in case of accident, he can repair without delay, when the impossibility of doing so might peril his day's sport. The art of tying strands of gut together and of whipping on a hook may be learnt in a minute; and there is scarcely a book on angling that does not thoroughly explain it. Fly-tying, however, requires more notice.

The simplest form of trout-fly is the hackle, or palmer-fly. Having whipped the gut on to the hook with strong but fine silk, finishing at the bend of the hook, take two or three strands from the peacock's tail, known as harls, lay the ends together at the bend of the hook and whip them on with the silk, wind the silk on two-thirds up the hook, and then tie on the tip of a cock's hackle. Fig. 13 (page 38) shows the position. Should it be desired, however, to run the hackle all over the body, it may be tied on along with the peacock's harls. In that case, first wind on the harls round the hook side by side, avoiding the hackle, until they reach the head of the hook, when they must be tied down and cut off; then wind the hackle on likewise up to the head, pressing it down so as to make the fibres point all towards the tail; and having reached the head, tie that down too and snip off the waste, when fig. 14 is finished, and the hackle or palmer-fly complete (see fig. 14). If it be required to produce a winged fly, a little less hackle must be employed, and two slips of some suitable feather placed together as a pair of wings, and whipped on as in fig. 15 (see fig. 15). Should a tail be desired, two or three wisps of some suitable feather are whipped on at the bend of the hook before tying on the harls, and if tinsel be needed, that is tied on with the harl, and wound on over the body. Fig. 16 shows the complete fly, with tail, tinsel, and all complete. Various matters are used for bodies, as silk, wool, fur, &c. How to put on fur will be told in tying the salmon-fly.

The method of tying a salmon-fly is rather more complicated than that used in the trout-fly. Take a short piece of twisted gut or gimp, double it and lash it on so as to leave an eye at the head, as in fig. 17 (see fig. 17); then take a short fragment of tinsel or twist, and tie it on as shown; wind this round the bend of the hook two or three times; this forms the tag, and may be seen complete in fig. 18 (see fig. 18); over this tie on the tail, composed of fibres or a topping, &c., also shown in fig. 18[1] (see fig. 18); then tie in the silk or wool, or whatever the body is made with, also the tinsel, if needed; having tied it in, carry the silk on until the spot where the hackle is to commence is reached, then tie that in, and work the silk on to the shoulder. The result of these preparations is shown in fig. 18 (see fig. 18). Then wind on the silk or wool body evenly until it reaches the shoulder, when fasten it off; next, wind on the tinsel in even spirals, and fasten that off in the same way; next, the hackle, which may be stripped on one side, if it be required, thinly, or prepared by pressing the fibres together, so as to make them point as far as possible in the same direction. Having fastened off the hackle, the fly appears as in fig. 19 (see fig. 19). Then having carefully left a bit of the hook for the purpose, tie on the wing, which is composed of fibres or strips of feathers laid together. This is a nice operation, and requires a delicate but firm hand. After this, if it be needed, a head can be wound on over the stump of the wing, and for that purpose a fragment of chenille is the best substance. A few turns of the silk fixes the loop and finishes off, and a touch of varnish secures it. The complete fly is shown in fig. 20. In using fur or pig's wool for a body, the long coarse fibres should be picked out and rejected; the rest should be pulled into fragments, and then laid in a small ridge along the palm of the hand and rolled over and over, as cigarette makers do their tobacco; and having obtained sufficient coherence, it should be laid along the silk, and the silk being twirled round rapidly, is incorporated with the fur, which can then be wound on the hook to form the body of the fly. Various colours may thus be employed in the same fly. (F. F.)

[1] Some flies have over this a couple of turns of ostrich harl or other feather, which is called the but. It is not necessary, and serves no purpose, but it is shown in the complete fly in fig. 20.

ANGLO-SAXON LITERATURE. See ENGLISH LITERATURE.

ANGLO-SAXONS. See ENGLAND.

ANGOLA, a name that is employed to designate at least three different, although partly coincident, portions of the west coast of Africa. It is often applied to the whole coast-line, from Cape Lopez de Gonsalvo, in lat. 0° 44′ S., to St Felipe de Benguela, in 12° 24′ S.; the Portuguese consider that the entire country lying between the Zaire or Congo and lat. 18° S., and stretching for a considerable but somewhat indefinite distance into the interior, over which they assert that their authority extends, ought to be called Angola; lastly, the name is by most British geographers and travellers applied to that part of the preceding territory which lies between 8° 20′ and 9° 30′ S., and which nearly corresponds to the Portuguese sub-government of Angola. The natives, whose practice seems to harmonise with the third of these applications of the word, also call the country Dongo. With the exception of a flat, sandy, barren plain, that extends from the coast for a considerable distance inland, Angola, using the word in its most restricted sense, is mountainous and well-watered. Its chief rivers are the Coanza, which bounds it on the north, the Danda, which bounds it on the south, and the Benga. Most of the country is very fertile, producing palms, citrons, oranges, lemons, bananas, tamarinds, mangroves, and sugar canes in great abundance. Nor is the fauna less extensive; all the animals common in inter-tropical Africa are found in Angola, as well as some peculiar to the district; while the sheep, the cow, and the horse have been imported from Europe. Of its mineral productions, lead, sulphur, petroleum, and iron are plentiful; and gold, silver, and copper are said to exist in the interior. Gum, wax, and ivory are now the most important articles of trade; but formerly the principal traffic was in slaves. The heat is usually moderate, and the climate comparatively mild and salubrious. The religion of the natives of Angola is Fetichism; they believe implicitly in their priests, who pretend to bestow rain, favourable winds, and other blessings upon those who have propitiated them by liberal gifts. In criminal cases much use is made of what our ancestors called "the judgments of God." The accused is made to swallow poison, to take in his hand burning coals, or to undergo tests of a similar nature, and, unless he escapes unhurt from these trials, is pronounced guilty; of course the priests contrive that those whom they wish to absolve should suffer no harm. The native huts are formed merely of straw or dried leafy plants, intertwisted upon a framework of stakes; containing no aperture for the admission of light, they form not so much dwelling-houses, as dens for sleeping in, while the tenants spend the day and receive company in an open space in front that is covered with a slight roof. The population of Angola is estimated at about 250,000, of whom about 2000 are Europeans. Angola was discovered by the Portuguese under Diego Cam in 1484; and since that time, with the exception of a short period, from 1640 to 1648, during which the Dutch attempted to expel them, they have maintained their possession of the country undisturbed by other European powers. It cannot be said, however, that they have done much during this long rule either to develop the resources of the country or to improve the condition of its people; and, while they permitted an active slave trade to be carried on, their influence must have been much more injurious than beneficial. St Paul de Loanda, at which the governor resides, is the chief town. They possess a few forts in the interior, but over the greater part of the country their authority is hardly felt.

ANGORA, or ENGURI, the ancient *Ancyra*, a city of Turkey in Asia, capital of the vilayet of the same name, situated upon a steep hill, near a small stream, which flows into the Angara, a tributary of the Sakaria or Sangarius, about 220 miles E.S.E. of Constantinople. The modern town is not well built, its streets being narrow and many of its houses of mud; but there are a great many fine remains of Greek, Roman, and Byzantine architecture, the most remarkable of which is a temple of white marble, erected by the inhabitants in honour of Augustus. On the walls of this temple is the famous *Monumentum Ancyranum*, an inscription in Greek and Latin, detailing the principal events in the life of the emperor, a great part of which is still legible. Angora has long been celebrated for its goats, whose soft silky hair, about 8 inches long, forms the chief article of export from the town. The fineness of the hair may perhaps be ascribed to some peculiarity in the atmosphere, for it is remarkable that the cats, dogs, and other animals of the country are to a certain extent affected in the same way as the goats, and that they all lose much of their distinctive beauty when taken from their native districts. The other exports are goat and cat skins, gum, wax, honey, yellow berries, and madder root, while the import of British and other European goods is considerable, although the trade is almost entirely in the hands of Armenians. The population is variously estimated at from 20,000 to 60,000. Ancyra originally belonged to Phrygia, and afterwards became the chief town of the Tectosages, one of the three Gallic tribes that settled in Galatia, about 277 B.C. In 189 B.C., Galatia was subdued by Manlius, and in 25 B.C. it was formally made a Roman province, of which Ancyra was the capital. Ancyra was the seat of one of the earliest Christian churches, founded probably by the apostle Paul, and councils were held in the town in 314 and 358 A.D. In 1402 a great battle was fought in the vicinity of Ancyra, in which the Turkish sultan Bajazet was defeated and made prisoner by Tamerlane, the Tartar conqueror. In 1415 it was recovered by the Turks under Mahomet I., and since that period has belonged to the Ottoman empire.

ANGORNO, or NGORNU, a town of Bornu, in Central Africa, near the south-west shore of Lake Chad, from which it is separated by a level plain that is often under water. It is said to have a population of 30,000, which is much increased during the markets, when a large traffic is carried on in cotton, amber, metals, corals, and slaves.

ANGOSTURA, also called CIUDAD BOLIVAR, and SAN TOMAS DE LA NUEVA GUAYANA, a town of Venezuela, capital of the province of Guayana, situated on the right bank of the Orinoco, about 240 miles from its mouths, and only 191 feet above the level of the sea. It is the seat of a bishop, and contains a cathedral, a college, and an hospital, while a fort stands on the opposite side of the river, at this point comparatively narrow. Being the centre of a rich and extensive territory, Angostura would before now have probably become a large and flourishing city, had it not been retarded by the war of independence, and by the unsettled state of the country; for a long period it retrograded rather than progressed, and although now in a more prosperous condition, it has not yet reached the position to which it is entitled. The Orinoco is navigable for vessels of 300 tons, and a considerable trade is carried on in cocoa, sugar, cotton, jerked meat, and hides, as well as in the bark that takes its name from the city. In 1819 a congress met at Angostura, which resulted in the union of Venezuela and New Granada into one government under the name of the republic of Columbia; and in the same year the town began to be called Ciudad Bolivar, in honour of Simon Bolivar, who freed the country from the yoke of Spain. Population, about 8000.

ANGOULÊME, a city of France, capital of the department of Charente, and formerly of the province of Angou mois, situated on the left bank of the Charente, upon an elevated plateau, 221 feet above the river, at the foot of which, in the suburb of Houmeau, there is a station of the Paris and Bordeaux railway, 66 miles north-east of the latter town. The situation of Angoulême is very delightful, and the city itself is in general well built, although in the old quarter many of the streets are narrow and irregular. The chief public buildings are the cathedral of St Peter, rebuilt in 1120, but founded at a much earlier period; the remains of the old castle in the centre of the town, the birth-place of the celebrated Margaret of Valois, sister of Francis I.; the courthouse, and the town-hall. The town is the seat of a bishop, and has a court of primary jurisdiction, a lyceum, two normal, and several ordinary schools, an hospital, a theatre, and a public library. Angoulême is an important manufacturing city; its paper-mills produce large quantities of paper that is highly esteemed throughout France; and there are also distilleries, potteries, a cannon foundry, a powder mill, linen and serge factories, as well as a considerable trade in grain, fruit, and salt. Angoulême, the ancient *Iculisma*, was taken by Clovis from the Visigoths in 507; it was repeatedly plundered by the Normans in the 9th century, and was long subject to the counts of Angoulême, and also for a considerable period to the kings of England; but in 1303 Philip the Fair added it to the royal domain of France. In 1360 it was again surrendered to the English, who were, however, finally expelled in 1369. During the war of the Huguenots it was twice taken by the Protestants, in 1562 and 1568. Population (1872), 25,928.

ANGOULEME, Charles de Valois, Duke of, the natural son of Charles IX. of France and Marie Touchet, was born 28th April 1573, at the castle of Fayet in Dauphiné. His father, dying in the following year, commended him to the care and favour of his brother and successor, Henri III., who faithfully fulfilled the charge. His mother married Francois de Balzac, marquis d'Entragues, and one of her daughters, Henriette, marchioness of Verneuil, afterwards became the mistress of Henri IV. Charles of Valois was carefully educated, and was destined for the order of Malta. At the early age of sixteen he attained one of the highest dignities of the order, being made grand prior of France. Shortly after he came into possession of large estates left by Catherine de Medicis, from one of which he took his title of count of Auvergne. In 1591 he obtained a dispensation from the vows of the order of Malta, and married Charlotte, daughter of Henri, marshal d'Amville, afterwards duke of Montmorenci. In 1589 Henri III. was assassinated, but on his death-bed he commended Charles to the good-will of his successor Henri IV. By that monarch he was made colonel of horse, and in that capacity served in the campaigns during the early part of the reign. But the connection between the king and the marchioness of Verneuil appears to have been very displeasing to Auvergne, and in 1601 he engaged in the conspiracy formed by the dukes of Savoy, Biron, and Bouillon, one of the objects of which was to force Henri to repudiate his wife and marry the marchioness. The conspiracy was discovered; Biron and Auvergne were arrested, and Biron was executed. Auvergne after a few months' imprisonment was released, chiefly through the influence of his half-sister, his aunt, the duchess d'Angoulême, and his father-in-law. He then entered into fresh intrigues with the court of Spain, acting in concert with the marchioness of Verneuil and her father d'Entragues. In 1604 d'Entragues and he were arrested and condemned to death; at the same time the marchioness was condemned to perpetual imprisonment in a convent. She easily obtained pardon, and the sentence of death against the other two was commuted into perpetual imprisonment. Auvergne remained in the Bastile for eleven years from 1605 to 1616. In 1606 a decree of Parliament, obtained by Marguerite de Valois, deprived him of nearly all his possessions, including Auvergne, though he still retained the title. In 1616 he was released, was restored to his rank of colonel-general of horse, and despatched against one of the disaffected nobles, the duke of Longueville, who had taken Peronne. Next year he commanded the forces collected in the Isle de France, and obtained some successes. In 1619 he received by bequest, ratified in 1620 by royal grant, the duchy of Angoulême. Soon after he was engaged on an important embassy to Germany, the result of which was the treaty of Ulm, signed July 1620. In 1627 he commanded the large forces assembled at the siege of La Rochelle; and some years after, in 1635, during the Thirty Years' War, he was general of the French army in Lorraine. In 1636 he was made lieutenant-general of the army. He appears to have retired from public life shortly after the death of Richelieu in 1643. His first wife died in 1636, and in 1644 he married Francoise de Nargonne, daughter of Charles, baron of Mareuil. She had no children, and survived her husband many years. Angoulême himself died in 1650, in his seventy-sixth year. By his first wife he had three children: Henri, who became insane; Louis Emmanuel, who succeeded his father as duc d'Angoulême; and Francois, who died 1622.

The duke was the author of the following works:—(1.) *Mémoires, from the Assassination of Henri III. to the Battle of Arques*, published at Paris by Boneau, and reprinted by Buchon in his *Choix de Chroniques*, 1836, and by Petitot in his *Mémoires*, 1st series, vol. xliv.; (2.) *Les Harangues, prononcés en Assemblee de MM. les Princes Protestants d'Allemagne*, par Monseigneur le duc d'Angoulême, 1620; (3.) A translation of a Spanish work by Diego de Torres. To him has also been ascribed the work, *La générale et fidèle Relation de tout ce qui s'est passé en l'Isle de Ré, envoyée par le Roi a la Royne sa mère*, Paris, 1627.

ANGOUMOIS, an old province of France, nearly corresponding to the department of Charente. Its capital was Angoulême.

ANGRA, a city on the south coast of Terceira, one of the Azores, the capital of the island and of one of the three civil districts into which the Azores are divided, as well as the residence of the military governor of the whole group, and of the Roman Catholic bishops. It is a well-built, strongly fortified town, containing an arsenal for the Portuguese royal navy, a cathedral, and several churches, monasteries, and nunneries. The harbour is sheltered on the west and south-west by the promontory of Mount Brazil, and if this natural protection were supplemented by a breakwater on the south-east, the town would possess a secure and commodious anchorage; as it is, vessels during certain seasons are safer in the open sea. The chief exports are wine and grain; but foreign trade is not largo. Population, 11,281.

ANGRI, a town of Italy, in the province of Salerno, situated $11\frac{1}{2}$ miles N.W. of the town of Salerno, in a country which produces large quantities of grapes, cotton, and tobacco. Narses defeated Teias, the last king of the Goths, not far from Angri in 553 A.D. Population, 10,332.

ANGUIER, Francois (born 1604, died 1669), and Michael (born 1612, died 1686), two brothers, natives of Normandy, were distinguished sculptors in the time of Louis XIV. The chief works of Francis are the monument to Cardinal de Bérulle, in the chapel of the oratory at Paris, and the mausoleum of the last duc de Montmorency at Moulins. Michael executed the sculptures of the triumphal arch at the Porte St Denis. A marble group of the *Nativity* in the church of Val de Grâce, was reckoned his masterpiece.

ANGUILLA, or Snake Island, a small British West Indian island, one of the Lesser Antilles, situated 8 miles north of the island of St Martin, in lat. 18° 12′ N., and long. 63° 8′ W. Its chief products are salt, which is manufactured from a lake in the interior, sugar, cotton, maize, and tobacco, but the soil is comparatively barren, and there is a great deficiency of water in the island. Population, 3000.

ANGUSSOLA, or ANGOSCIOLA, SOPHONISBA, one of the best portrait painters of the latter half of the 16th century, was born at Cremona in 1533, and died at Genoa in 1620. In 1560, at the invitation of Philip II., she visited the court of Madrid, where her portraits elicited great commendation. Vandyck is said to have declared that he had derived more knowledge of the true principles of his art from her conversation than from any other source. She painted several fine portraits of herself, one of which is now at Althorp. A few specimens of her painting are to be seen at Florence and Madrid. She had three sisters, who were also celebrated artists.

ANHALT, a duchy of Germany, lying between lat. 51° 33′ and 52° 7′ N., and long. 11° and 12° 36′ E., and comprising an area of about 896 square miles. Except for a short distance on the west, and for a longer distance on the north-east, where it is bounded respectively by Brunswick and the Prussian province of Brandenburg, Anhalt is entirely surrounded by Prussian Saxony, which also intersects it, breaking it up into two large and several small portions. The Hartz mountains extend into the western of the large divisions, but the rest of the country is very flat, and even in the mountainous part no elevations rise to any great height. Most of the plain, which is watered by the Elbe and its tributaries, the Mulde and the Saale, is very fertile, producing large quantities of grain, tobacco, flax, hops, and fruits, especially grapes; cattle and sheep are reared in considerable numbers on the rich pasture lands; game and fish are abundant; while the mines in the Hartz mountains yield iron, lead, silver, and other minerals. The chief manufactures of Anhalt are linen, cotton, and woollen goods, metallic and earthen wares, beer, brandy, and sugar; but the principal export trade is in the raw products. Internally, Anhalt is governed by a constitutional and hereditary monarchy, the legislative body being a diet of 36 members, of whom 10 represent the nobility; 14, the principal towns; 10, the rural districts; and 2 are nominated by the duke, who has the entire executive power in his own hands; while, as a member of the German empire, the duchy has one vote in the Bundesrath, or Federal Council, and two in the Reichstag. Its income and expenditure for the year 1872 exactly balanced, being each 2,231,000 thalers, or £334,650; the public debt at the end of 1871 was 4,073,026 thalers, or £610,954. Anhalt contained 203,354 inhabitants in 1871, most of whom are Protestants. Its capital is Dessau, and the other chief towns are Bernburg, Köthen, and Zerbst. Railways connect these towns with one another, and also with Berlin and the principal cities of Germany. Bernard, son of Albert the Bear, margrave of Brandenburg, was the first upon whom the title of count of Anhalt was conferred. He died in 1212, and was succeeded in the principality of Anhalt by his son Henry I.; while Albert, a younger son, received his large possessions in Saxony. On the death of Henry in 1252, Anhalt was divided among his family into three parts,—Ascania, Bernburg, and Zerbst,—which were afterwards united under Joachim Ernest, who reigned from about 1570 to 1586. In 1603, however, the territory was again broken up, on this occasion into four parts, Dessau, Bernburg, Köthen, and Zerbst, four of Joachim Ernest's sons inheriting one of these divisions each, while the fifth, Augustus, who was the third in point of age, received a considerable sum of money, and the promise that, in the event of any one of the other lines becoming extinct, he or his descendants should succeed to the principality; his brother Christian, of Anhalt Bernburg, also gave him the small property of Plötzkau, from which he took his title. This promise was fulfilled in 1665, when William Louis of Anhalt Kothen died without direct heirs, and was succeeded by Lebrecht of Anhalt Plotzkau, who thereafter laid aside his own title. The Zerbst line becoming extinct in 1793, the principality, in accordance with a compact made in 1665, was divided among the three remaining families; next, by the death of Henry duke of Anhalt Kothen in 1847, that duchy was a second time left without direct heirs, but was ultimately incorporated with Dessau; and lastly, the Anhalt Bernburg family died out in 1863, leaving the whole of Anhalt under a single ruler. The present duke,—the title of duke was conferred upon the counts of Anhalt in 1807,—Frederick, succeeded his father Leopold in 1871, being at that time about forty years old. Several of the rulers of Anhalt have borne a conspicuous part in the affairs of Europe, and not a few of them have been noted for their zeal in the cause of Protestantism. Wolfgang, a prince of the earlier Zerbst line, was present at the diet of Augsburg in 1530, and was one of those who presented the confession to the emperor. Leopold I., of Anhalt Dessau, was one of the most distinguished soldiers of his time.

ANICHINI, LUIGI, an engraver of seals and medals, a native of Ferrara, lived at Venice about 1550. Michel Angelo pronounced his "Interview of Alexander the Great with the high-priest at Jerusalem," "the perfection of the art." His medals of Henry II. of France and Pope Paul III. are greatly valued.

ANIELLO, TOMMASO. See MASANIELLO.

ANILINE, or PHENYLAMINE (C_6H_7N), is one of the very numerous products of the distillation of coal tar. The substance has been known to chemists since the year 1826, when M. Unverdorben, by the destructive distillation of indigo, produced a liquid of an oily consistence, which he termed *crystalline*. In the year 1835, Runge, a German chemist, isolated from the oil of coal tar a substance which, having the property of producing a beautiful blue colour on treatment with chloride of lime, he named *kyanol*. In 1840, another investigator showed that by treating indigo with caustic potash it yields an oil, and he gave to his product the name *Aniline*, from the specific name of one of the indigo yielding plants, *Indigofera anil*. About the same time it was discovered that on treating nitrobenzol with a reducing agent, an organic base is formed, to which the observer of this reaction gave the name *benzidam*. Professor Hofmann, while a student in the laboratory of Baron Liebig, investigated these variously prepared substances, and found them to be identical in composition and action, and thenceforth they took their place as one body, under the name *Aniline* or *Phenylamine*. Pure aniline is a basic substance of an oily consistence, colourless, boiling at a temperature of 182° C. Dropped on paper aniline produces a greasy stain, which, owing to its volatilising at an ordinary atmospheric temperature, quickly disappears. On exposure to air it absorbs oxygen rapidly, and becomes of a deep brown colour; and it ignites readily, burning with a large smoky flame. It is possessed of a somewhat pleasant vinous odour, and a burning aromatic taste. It is a highly acrid poison, and Dr Letheby has pointed out that the poisonous action of nitrobenzol is due to a change of that substance into aniline taking place within the stomach.

The readiness with which aniline, in certain of its reactions, produces very brilliant colours, was of course known to chemists from the time Runge produced it from coal tar and gave it the name kyanol. Up to year 1858 it, however, possessed nothing beyond a scientific interest. On the 26th of August 1858, Mr W. H. Perkin obtained a patent for the production of a dye-stuff derived from aniline, which soon became well known as mauve, or Perkin's purple, as well as by various other names. The discovery of Mr Perkin formed the turning-point in the history of aniline, and was indeed the beginning of a great revolution in the arts and manufactures connected with the dyeing of textile fabrics. The manufacture of aniline dyes was really first begun in France, the French manufacturers acting on the information supplied by Mr Perkin's patent specification. It immediately spread to all industrial centres, and became one of the most eagerly investigated of all commercial undertakings. A rapid succession of patents were applied for and obtained; new processes and combinations were continually being projected, and a great variety of colours were tried with more or less success as commercial substances. The activity of scientific research kept pace with the energy of manufacturing enterprise, resulting in a rapid improvement of processes, decrease in the cost of the manufacture, and a great increase in the beauty and tinctorial effect of the dyes produced. At the present time every colour, and all tints and shades of colours, are produced from aniline; and, while the processes employed and the combinations formed are very numerous, the names under which the dye-stuffs are sold must be said to be endless.

Of the processes by which aniline may be prepared, that only is available in manufacturing which was devised by Zinin, when he prepared it, under the name of benzidam, from nitrobenzol. Aniline is only found in very small quantities as a direct product of the distillation of coal tar, but a large proportion of light hydrocarbons are among the products when the temperature ranges between 80° C. and 130° C. The chief of these is benzol, with smaller quantities of toluol and other closely allied substances. These hydrocarbons, when acted upon by strong nitric acid, give up an atom of hydrogen, the place of which is taken by one of nitroxyl (NO_2), and benzol is thus transformed into nitrobenzol: *i.e.*, benzol (C_6H_6) + nitric acid (HNO_3) = nitrobenzol ($C_6H_5NO_2$) + water (H_2O). Nitrobenzol is a yellow oily liquid, with the exact flavour of bitter almonds, for which it has long been used as a substitute in fancy soap-making, under the name of essence of mirbane. Its transformation into aniline is now practically effected by submitting it to the reducing influence of nascent hydrogen, by the action of iron and acetic acid. To a mixture of nitrobenzol and strong acetic acid a certain proportion of iron filings is gradually added. Very energetic chemical action is set up with great disengagement of heat. When the reaction is complete the aniline is distilled over by superheated steam. The aniline of commerce thus prepared is not a chemically pure product, but a mixture of aniline and toluidine, just as the commercial benzol operated on is a mixture of benzol with toluol. In the manufacture of dyes it is found essential that certain proportions of both aniline and toluidine should be present in the aniline oil operated on.

The method by which Mr Perkin obtains from aniline the violet colour known as mauve, is by mixing a solution of sulphate of aniline and of potassic dichromate in equivalent proportions, and leaving them for several hours till the resulting reaction is complete. A black precipitate is formed, which is washed free from the potassic sulphate it contains, and then treated with naphtha to dissolve out the resinous matter contained in the mass. The residue consists of the mauve dye, and may be dissolved in alcohol. It has been found to be the sulphate of a base, to which the name mauveine has been given.

The greater proportion of aniline dyes manufactured are now produced directly or indirectly from another basic body, termed rosaniline. About the time of the French-Austrian war in 1859, a second coal-tar dye was introduced into commerce, which became popularly known as aniline red or Magenta, from the battle fought at the period of its introduction. Dr Hofmann's investigations into the nature and composition of this dye have done more to place the entire industry on a satisfactory basis than any other undertaking. He found that it consisted of a salt of a basic substance, to which he gave the name rosaniline ($C_{20}H_{19}N_3H_2O$). For the preparation of rosaniline, Hofmann found that a certain proportion of toluidine must be present in the commercial aniline employed. Rosaniline is now entirely manufactured by treating aniline of a known composition with a strong solution of arsenic acid in an iron retort, heated to a temperature of not more than 180° C. The reaction occupies about eight hours; and at the conclusion of the operation a crude mass, consisting of rosaniline arsenite and arseniate, is found, which is next dissolved in water acidulated with hydrochloric acid. Common salt is added to this solution, when a double decomposition takes place. Rosaniline hydrochlorate is formed on the one hand, and sodium arseniate and arsenite on the other. For the preparation of the salts of rosaniline, the base is treated directly with acids.

Rosaniline blues are prepared by acting upon commercial aniline with a salt of rosaniline, such as the acetate, under the influence of a heat of about 190° C., kept up for two hours. The reaction which takes place is the substitution of three atoms of phenyl for three of hydrogen, and hence these blues are chemically salts of triphenylrosaniline. Violet colours, such as Hofmann's violet, are prepared by an analogous process to that employed for the blues, by treating rosaniline with the iodides of methyl or ethyl, atoms of these radicals taking the place of hydrogen, and forming ethylic or methylic rosaniline. Aniline green is formed by the action of aldehyd on a solution of aniline red in sulphuric acid, and subsequent boiling in a solution of hyposulphite of soda. Aniline yellow, or yellow fuchsine, is formed from a base named chrysaniline, a minor product of the formation of rosaniline; but most of what is termed aniline yellow is prepared from picric acid, a different product of the distillation of coal tar. Various shades of brown and maroon, as well as black colours, are regular commercial products; but they are neither so well understood, nor of such consequence as the reds, blues, and greens.

Aniline colours are employed in the industrial arts for numerous other purposes besides their great use as dyeing materials. Violet ink and other fancy coloured inks are prepared from them. They are used by paper manufacturers for tinting pulps, and for the superficial staining of finished paper. They are likewise used by paper stainers in the printing of wall papers, in the preparation of lithographic inks, and to some extent for water colours. They are largely employed as colouring materials in perfumery, fancy soaps, and cosmetics, besides having many other minor applications.

Concerning these dyes, Dr Hofmann, to whom the industry is so much indebted, wrote, in 1862, while it was yet in its infancy, "Instead of disbursing her annual millions for these substances, England will, beyond question, at no distant day become herself the greatest colour-producing country in the world; nay, by the very strangest of revolutions, she may erelong send her coal-derived blues to indigo-growing India, her distilled crimson to cochineal-producing Mexico, and her fossil substitutes for quercitron and safflower to China, Japan, and the other countries whence these articles are now derived." It is scarcely needful to say that these bold anticipations have already been fully realised.

ANIMAL KINGDOM

ANIMALS, CLASSIFICATION OF. The object of classification is to bring together those things which are like, and to separate those which are unlike. Each science has its own classification of the objects with which it deals, the kinds of likeness and unlikeness according to which these objects are grouped varying in relation to the special qualities or properties of matter with which the science is concerned. Thus, the physicist classifies bodies according to their mechanical, electrical, thermic, or other physical properties; the chemist, regards their composition; while the zoologist and the botanist group them according to their likenesses and unlikenesses of structure, function, and distribution.

As soon as the labours of anatomists had extended over a sufficiently great variety of animals, it was found that they could be grouped into separate assemblages, the members of each of which, while varying more or less in minor respects, had certain structural features in common, and these common morphological characters became the definition of the group thus formed. The smallest group thus constituted is a MORPHOLOGICAL SPECIES. A certain number of species having characters in common, by which they resemble one another and differ from all other species, constitutes a GENUS; a group of genera, similarly associated, constitutes a FAMILY; a group of families, an ORDER; a group of orders, a CLASS; a group of classes, a SUB-KINGDOM; while the latter, agreeing with one another only in the characters in which all animals agree, and in which they differ from all plants, make up the ANIMAL KINGDOM.

The formation of a morphological classification is therefore a logical process, the purpose of which is to throw the facts of structure into the smallest possible number of general propositions, which propositions constitute the definitions of the respective groups. A perfect classification will fulfil this end, and, in order to form it, two conditions are necessary: Firstly, we must have a full knowledge of the adult structure of every animal, recent and extinct; secondly, we must know all the modifications of structure through which it has passed, in order to attain the adult condition, or in other words, the mode of development of the animal. For it is the sum of all the structural conditions of an animal which constitutes the totality of its structure; and if two animals, similar in their adult state, were unlike in their development, it is clear that the latter circumstance would have to be taken into account in determining their position in a classification.

Linnæus, living at a time when neither comparative anatomy nor embryology can be said to have existed, based his classification of animals upon such broad resemblances of adult structure and habit as his remarkable sagacity and wide knowledge enabled him to detect. Cuvier and his school devoted themselves to the working out of adult structure, and the *Leçons d'Anatomie Comparée* and the *Règne Animal* are wonderful embodiments of the results of such investigations. But the Cuvierian system ignores development; and it was reserved for Von Baer to show the importance of developmental studies, and to inaugurate the marvellous series of researches which, in the course of the last fifty years, have made us acquainted with the manner of development of every important group of animals. The splendid researches of Cuvier gave birth to scientific palæontology, and demonstrated that, in some cases, at any rate, extinct forms of life present characters intermediate between those of groups which are at present widely different. The investigations of Agassiz upon fossil fishes tended in the same direction, and further showed that, in some cases, the older forms preserve, as permanent features, structural characters which are embryonic and transitory in their living congeners. Moreover, Darwin, Owen, and Wallace proved that, in any great area of geographical distribution, the later tertiary extinct forms are clearly related to those which now exist in the area. As Taxonomic investigations increased in accuracy and in extent, the careful examination of large suites of specimens revealed an unexpected amount of variability in species; and Darwin's investigation of the phenomena presented by animals under domestication proved that forms, morphologically as distinct as admitted natural genera, could be produced by selective breeding from a common stock.

Upon the foundation thus furnished, the doctrine of Evolution, first scientifically formulated by Lamarck, has been solidly built up by Darwin, and is now, with various modifications and qualifications, widely accepted. But the acceptance of this doctrine introduced a new element into Taxonomy. If all existing animals are the last terms of a long series of developmental stages, represented by the animals of earlier ages of the earth's history, the starting point of which has been a primordial form of the extremest simplicity consistent with animal life, then every animal has an "ancestral" as well as what may be termed a "personal" embryology; and the same considerations which oblige the Taxonomist to take account of the latter phenomena, compel his attention to the former stages of development. Two animals belong to the same group, when they are similar in structure, personal development, and ancestral development, and not otherwise. Hence it follows that a perfect and final zoological classification cannot be made until we know all that is important concerning—1, the adult structure; 2, the personal development; and 3, the ancestral development of animals. It is hardly necessary to observe that our present knowledge, as regards even the first and second heads, is very imperfect; while, as respects the third, it is utterly fragmentary.

The only genus of animals of which we possess a satisfactory, though still not quite complete, ancestral history, is the genus *Equus*, the development of which in the course of the Tertiary epoch from an Anchitherioid ancestor, through the form of *Hipparion*, appears to admit of no doubt. And all the facts of geology and palæontology not only tend to show that the knowledge of ancestral development is likely long to remain fragmentary, but lead us to doubt, whether even such fragments as may be vouchsafed to us by the extension of geological inquiry will ever be sufficiently old, in relation to the whole duration of life on the earth, to give us positive evidence of the nature of the earliest forms of animals.

While holding the doctrine of evolution to its fullest extent, and having no doubt that Taxonomy ought to be the expression of ancestral development, or *phylogeny*, as well as of embryogeny and adult structure, and while conceiving that the attempts at founding a scientific phylogeny, which have been made by Haeckel and others, are of much interest and importance as guides to and suggestors of investigation, the present writer looks upon all such attempts as provisional hypotheses; and he conceives that, at any rate for the present, it is a mistake to introduce considerations of this purely hypothetical kind into classification, which should be based on verifiable data.

In the case of an existing animal, it is possible to determine its adult structure and its development, and therefore to assign its place relatively to other animals, the structure and development of which are also known; and, in the case of an extinct animal, it is possible to ascertain certain facts of its structure, and sometimes certain facts of its development, which will justify a more or less positive assignment of its place relatively to existing animals. So far, Taxonomy is objective, capable of proof and disproof, and it should leave speculation aside, until speculation has converted itself into demonstration.

In the present rapidly shifting condition of our knowledge of the facts of animal structure and development, however, it is no easy matter to group these facts into general propositions which shall express neither more nor less than is contained in the facts; and no one can be more conscious of the manifold imperfections of the following attempt at such a classification than the author of it.

In certain of the lower animals, the substance of the body is not differentiated into histogenetic elements; that is, into cells[1] which, by their metamorphoses, give rise to tissues. In all other animals, on the other hand, the protoplasmic mass, which constitutes the primitive body, is converted into a multitude of cells, which become metamorphosed into the tissues of the body.

For the first of these divisions the old name of PROTOZOA may be retained; for the second, the title of METAZOA, recently proposed by Haeckel, may be conveniently employed.

I. THE PROTOZOA.

Haeckel has shown that, among the *Protozoa*, there are some which are simpler than the rest, inasmuch as they are devoid of both nuclei and contractile vesicles. To these he applies the name of—

1. *Monera.*—Among the members of this group, which are at present known, three series are distinguishable, in all of which multiplication is effected by division, preceded, or not preceded, by the assumption of an encysted condition. In one state, each of these *Monera* is a *myxopod*,[2] that is, is provided with longer or shorter pseudopodia as locomotive organs, and, in *Protamœba* and *Protogenes*, the result of the process of division is also two or more myxopods. But, in *Protomonas*, the myxopod, after becoming encysted, gives rise by division to bodies provided with long flagelliform cilia, by which they are propelled, and which may be termed *mastigopods;* and in *Myxastrum*, the encysted body divides into a multitude of oval particles, each enclosed in its own coat. These are set free, and each gives rise to a new myxopod of the same character as the parent.

In *Protomyxa*, the myxopods coalesce into a reticulated plasmodium; and *Vampyrella* is parasitic, devouring stalked diatoms, and encysting itself upon the ends of their stalks, the encysted form dividing into new *Vampyrellæ*. Most of these interesting *Monera* have been made known by Haeckel, so that in all probability, many others remain to be discovered. It is probable that the *Foraminifera*, notwithstanding the complexity of the skeletons, belong to this group, but too little is known of the structure of their soft parts to enable any certain conclusion to be drawn respecting them, and the analogy of *Gromia* leads to the suspicion that they may belong to the next division.

2. *Endoplastica.*—In these *Protozoa* a portion of the interior protoplasmic body is separated from the rest as a distinct, more or less rounded, body, which may be termed the *endoplast*, as a term suggestive of its similarity to the nucleus of a histogenetic cell, without implying its identity therewith. Of such endoplasts there may be one or many, but the protoplasm in which they lie does not give rise to cells, which become metamorphosed into elements of the tissues. Very often they possess one or more vacuoles, which rhythmically dilate and contract, in accordance with the changes in the protoplasm in which they lie, and which are termed *contractile vesicles.*

In this division of the *Protozoa*, three groups—the *Amœbidæ*, the *Flagellata* (or flagellate *Infusoria*), and the *Gregarinidæ*—closely repeat the forms and mode of reproduction of the *Protamœbidæ*, *Protomonadidæ*, and *Myxastridæ* among the *Monera.* Among the rest, the *Acinetidæ* are distinguished by their pseudopodia being converted into suckers, through which they draw the juices of their prey. In all these, and in the preceding forms, there is a more or less marked distinction of the protoplasm constituting the body into a firmer and denser outer layer, the *ectosarc*, and a more fluid inner substance, the *endosarc;* and, in some of the *Gregarinidæ*, the ectosarc becomes differentiated into muscular fibres. In the *Flagellata* there is a permanent oral aperture; and in one member of this group, *Noctiluca*, additional complications of structure, in the form of a ridge-like tooth and a tentacle, occur. In the *Radiolaria*, the body is still more clearly differentiated into an inner substance, surrounded by a capsule, and containing nuclei and even cells, and a vacuolated ectosarc, whence the radiating pseudopodia proceed. Coloured corpuscles, usually yellow, appear in the ectosarc, and have been shown by Haeckel to contain starch and to multiply independently. In the *Ciliata* (ciliated *Infusoria*), with which the *Catallacta* of Haeckel may be included, the differentiation of the protoplasm of the body, without any development of histogenetic cells, goes still further. A permanent mouth and anus may appear, connected by a permanently softer and more fluid region of the protoplasm (as is plainly to be seen, for example, in *Nyctotherus*) foreshadowing an intestinal cavity. The ectosarc may be differentiated into a specially modified cortical layer, and well-marked muscular fibres may be developed. Moreover, the endoplast, or "nucleus," becomes an organ of reproduction, the germs of the young being given off by division from it. Very generally, a small body—the so-called "nucleolus," but which has, admittedly, nothing to do with the structure so named in a true cell, and may be termed the "endoplastula"—is to be found close to the nucleus, and there is some ground for supposing it to be a testis. The *Infusoria* frequently multiply by fission, which may, or may not, be preceded by encystment; and in many of them, as in the *Gregarinidæ*, *Acinetidæ*, and some *Flagellata*, conjugation has been observed. It is yet disputed how far the conjugation is a necessary antecedent of the process of endogenous germ formation.

Ehrenberg concluded, from those remarkable researches which first gave a clear insight into the structure of the ciliated *Infusoria*, that they were animals of complex structure, possessing, on a minute scale, all the organs characteristic of the higher forms of animal life. In opposition to this view, Dujardin started the conception that they are little more than masses of sarcode (=protoplasm); and Von Siebold, modifying this view in accordance with the cell theory, regards them as the equivalents of single cells of the tissues of the higher animals. The result of the long controversy which has been carried on on this subject seems to be, on the one hand, that Ehrenberg was quite right in vindicating for the *Infusoria* a far greater complexity of structure than they had been supposed to possess. It is certain that an Infusorium may possess a distinct integumentary layer, muscles, a permanent œsophagus, a permanent anal area, and, in some cases, a persistent tract

[1] The term "cell" is used here in its broadest sense, as equivalent to a nucleated mass of protoplasm.

[2] The term "Rhizopod" is already employed in a limited and special sense.

of the body substance, more permeable to alimentary matters than the rest, which might be fairly termed a permanent alimentary tract. Moreover, there is much reason for regarding the endoplast and endoplastula as generative organs, while there is, sometimes, a rather complex persistent system of water vessels. But, on the other hand, this complexity of organisation is different from that observed in the higher animals, inasmuch as the various structures enumerated do not result from the metamorphosis of histogenetic cells, but arise by immediate differentiation of the finely granular protoplasm of which the body is composed. And, so far, Von Siebold appears to have been fully justified in regarding a ciliated Infusorium as the homologue of a single cell. This is a view which will present no difficulty to those who are familiar with the morphology of the lower plants. The complicated mycelium of *Mucor Mucedo*, for example, is, while young, nothing but a single cell; and, in *Caulerpa*, a single undivided cell grows, without division, into an organism which simulates one of the higher Algæ in the diversity of its parts.

II. The Metazoa.

The germ becomes differentiated into histogenetic cells, and these cells become arranged into two sets, the one constituting the outer wall of the body, or *ectoderm*, while the other, or *endoderm*, lies internal to the foregoing, and constitutes the lining of the alimentary cavity, when, as is usually the case, a distinct alimentary cavity exists. In the embryo, the representatives of these two layers are the *epiblast* and *hypoblast*.

All the *Metazoa*, in fact, commence their existence in the form of an ovum, which is essentially a nucleated cell, supplemented by more or less nutritive material, or *food yelk*. The ovum, after impregnation, divides into cleavage masses, or *blastomeres*, giving rise to a *Morula*, in the midst of which arises a cavity, the *blastocœle* (*cleavage cavity*, "*Furchungshöhle*" of the Germans), which may be larger or smaller, filled only with fluid, or occupied by food yelk. When it is largest, the blastomeres, disposed in a single layer, form a spheroidal vesicle, enclosing a correspondingly shaped blastocœle. When it is reduced to a minimum, the *Morula* is an almost solid aggregation of blastomeres, which may be nearly equal in size, or some may be much larger than others, in consequence of having undergone less rapid division. The next stage in the development of the embryo of a *Metazoon* consists (in all cases except a few parasitic auenterous forms) in the conversion of the *Morula* into a body having a digestive cavity, or a *Gastrula*. The animals in which the embryo takes on the form of a *Gastrula*, may be termed, as Haeckel has proposed, *Gastrææ*.

The conversion of the *Morula* into the *Gastrula* may take place in several ways.

In the simplest, the *Morula* being composed of equal or nearly equal blastomeres, more or less completely converted into cells, these differentiate themselves into an outer layer, the epiblast, investing the remaining cells, which constitute the hypoblast. The central cells of the hypoblast next diverge and give rise to a space filled with fluid, the alimentary cavity, which opens at one end, and thus gives rise to the *Gastrula*. This is the process generally observed in *Porifera*, *Cœlenterata*, *Turbellaria*, *Trematoda*, and *Nematoidea*.

In a second class of cases, the *Morula* becomes converted into blastomeres of unequal sizes, a small and a large set. The smaller rapidly become converted into cells, and invest the larger and any remains of the food yelk, as a blastoderm, which at first represents only the epiblast of the former case. The hypoblast arises either from the epiblast thus formed, or from the included larger blastomeres. This is the process observed in certain *Turbellaria*, in the *Ctenophora*, in the *Oligochæta* and *Hirudinea*, in the *Arthropoda*, and in most *Vertebrata*.

In a third group of instances, the *Morula*, whether consisting of equal or unequal blastomeres, becomes spheroidal, and encloses a correspondingly shaped blastocœle. One part of the wall of this vesicular *Morula* then becomes invaginated, and gives rise to the alimentary cavity, with the hypoblast which limits it. This process has been observed in the *Chætognatha*, *Echinodermata*, *Gephyrea*, polychætous *Annelida*, *Enteropneusta*, *Brachiopoda*; in most *Mollusca*; in *Amphioxus*; and, slightly modified, in *Petromyzon* and in the *Amphibia*. These various modes in which the two primary layers of the germ may be developed shade off into one another, and do not affect the essence of the process, which is the segregation of one set of cells to form the external covering of the body, and of another set to constitute the lining of the alimentary canal.

In whatever manner the *Gastrula* is formed, and whatever be its shape when its alimentary cavity is complete, one of two things happens to it. It becomes provided with many ingestive apertures, distinct from that first formed; or with only one, which may or may not be distinct from the first aperture. The former division comprises only the Sponges (*Porifera* or *Spongida*) in which, as the remarkable researches of Haeckel have shown, the walls of the deeply cup-shaped *Gastrula* become perforated by the numerous inhalent ostioles, while the primitive opening serves as the exhalent aperture. These may be termed the *Metazoa polystomata*.

The latter division includes all the remaining forms, which may be grouped together as *Metazoa monostomata*. Among these, two primary groups are distinguishable, of which the second exhibits an advance in organisation upon the first. In the first, the aperture of the *Gastrula* becomes the permanent mouth (*Archæostomata*). In the second, the permanent mouth is a secondary perforation of the body wall (*Deuterostomata*).

1. It is now well established that the aperture of the *Gastrula* becomes the oral aperture of the adult in the *Cœlenterata*, which group includes animals differing much in grade of organisation, from the simple *Hydra* to the complex *Ctenophore*, but all manifestly exhibiting variations of one fundamental type. Parallel with these may be ranged an assemblage composed of the *Turbellaria*, *Rotifera*, and *Trematoda*, which are associated together by the closest resemblances of structure, and which present an even greater range in grade of organisation than the *Cœlenterata*. The lower *Rhabdocœla* come very close to the *Infusoria* (as close as the multicellular to the unicellular Algæ), and are but little superior to *Hydra* in the degree of their organic differentiation; while, in the *Trematoda*, the land *Planariæ*, and the *Nemertidæ*, we have animals which attain a considerable complexity, and in the case of many *Trematoda* and of *Lineus* (*Pilidium*) undergo remarkable metamorphoses. As a cognate group, the *Nematoidea* may be enumerated, extremely simple in their lowest forms, considerably differentiated in the higher, and connected with the *Turbellaria* by such forms as *Polygordius*. The *Oligochæta* and the *Hirudinea* also belong to this division of *Scolecimorpha*, but they differ from the foregoing in the development of a segmented mesoblast.

In the *Cœlenterata*, *Nematoidea*, *Turbellaria*, *Trematoda*, and *Rotifera*, the mode of origin of the cells which lie between the epiblast and the hypoblast, constitute the mesoblast, and give rise to the connective tissue and muscles of the body wall and of that of the intestine is not precisely known. They may take their origin in the epiblast, or in the hypoblast, or in both. But in the *Oligochæta* and the *Hirudinea*, after the epiblast and hypoblast are differentiated the cells of the latter give rise by division to two bands of cells, which lie, one on each side of the long axis of the ventral face of the worm, and constitute the mesoblast. This becomes marked out by transverse constriction into segments, and, in each segment, gives rise to all the tissues which lie between the epiblast (epidermis) and hypoblast (epithelium of the alimentary canal). The mouth corresponds with the primitive involution of the *Morula;* the anal aperture is a new formation. In the *Nematoidea* and in the lower Rhabdocœle *Turbellaria*, the intestinal canal is a simple tube or sac. But in some *Turbellaria* and *Trematoda*, the alimentary canal gives off diverticula, which ramify through the mesoblast and even unite together. The like takes place in a great many *Cœlenterata*, and the "gastrovascular apparatus," as it has been well termed, which is thus formed, is highly characteristic of them. The animals just referred to, therefore, have an "enterocœle" more or less distinct from the proper digestive cavity, but connected with it, and ramifying through the mesoblast.

2. In the remaining members of the animal kingdom, the embryo develops a secondary mouth as a perforation of the body wall, the primary aperture sometimes becoming the anus, and sometimes disappearing. Of these *Metazoa deuterostomata*, there are some which follow the mode of development of the *Oligochæta* and *Hirudinea* very closely, so far as the formation and segmentation of the mesoblast is concerned, though the question, whether this segmented mesoblast arises from the epiblast or the hypoblast, has not been exhaustively worked out. These are the *Annelida polychæta;* and there is the closest resemblance in development between them and the lower *Arthropoda* (*Crustacea*, *Arachnida*, lower *Insecta*), while, in the higher Arthropods, the process is complicated by the development of an amnion, and by some other special peculiarities which need not be considered in detail. In all these *Metazoa*, whatever cavities are developed in the mesoblast, whether a wide perivisceral cavity, or vascular canals, or both combined, they arise from the splitting or excavation of the mesoblast itself, and are not prolongations of the alimentary cavity. Hence they may be termed *Schizocœla.*

But, in certain other deuterostomatous *Metazoa*, the mesoblast becomes excavated, and a "perivisceral cavity" and vessels are formed in quite another fashion.

Thus in the *Chætognatha*, represented by the strange and apparently anomalous *Sagitta*, Kowalewsky's researches show, that the vitellus undergoes complete segmentation, and is converted into a vesicular *Morula*, on one side of which involution takes place, and gives rise to the primitive alimentary canal, of which the opening of involution becomes the permanent anus, the mouth being formed by perforation at the opposite end of the body. Before the mouth is formed, however, the primitive alimentary cavity throws out, on each side, a cæcal pouch, which extends as far forwards as its central continuation does, and grows backwards behind the anus. The two sacs, thus prolonged posteriorly, meet, but remain divided from one another by their applied walls in the median line. These lateral sacs now become shut off from the median portion of the primitive alimentary cavity (which opens at its anterior end, and becomes the permanent alimentary canal), and are converted into shut sacs, the cavity of each of which forms one-half of the perivisceral cavity. The inner wall of each sac, applied to the hypoblast, gives rise to the muscular wall of the intestine; and the outer wall, applied to the epiblast, becomes the muscular wall of the body, and from it the generative organs are evolved. The great ganglia and nerves are developed from the cells of the epiblast. Thus *Sagitta* is temporarily cœlenterate, but the two gastrovascular sacs, each enclosing an enterocœle, become shut off from the alimentary canal and metamorphosed into the walls of the perivisceral cavity. But it is not altogether clear whether the cells of the enterocœle give rise only to the lining of the perivisceral cavity, and whether the muscles and connective tissue are otherwise derived or not. Kowalewsky's evidence, however, is in favour of the origin of the muscles directly from the cells of the mesoblastic diverticula.

In the *Echinodermata*, the brilliant investigations of Johannes Müller, confirmed in their general features by all subsequent observers, proved, firstly, that the ciliated embryonic *Gastrula* (the primitive alimentary canal of which is formed by involution of a vesicular blastoderm), to which the egg of all ordinary Echinoderms gives rise, acquires a mouth, by the formation of an aperture in the body wall, distinct from the primitive aperture of the *Gastrula*, so that, in this respect, it differs from the embryo of all *Cœlenterata;* secondly, that the embryo thus provided with mouth, stomach, intestine, and anus acquires a complete bilateral symmetry; thirdly, that the cilia, with which it is primitively covered, are ultimately restricted to one or more series, some of which encircle the axis of the body, or a line drawn from the oral to the anal apertures; and fourthly, that, within this bilaterally symmetrical larva or *Echinopædium*, as it may be called, the more or less completely radiate Echinoderm is developed by a process of internal modification.

Müller believed that the first step in this process was the ingrowth of a diverticulum of the integument, as a hollow process, which became converted into the ambulacral vascular system of the Echinoderm. He did not attempt to explain the origin of the so-called blood-vascular system, or pseudhæmal vessels, nor of the perivisceral cavity. Müller's conclusions remained unchallenged until 1864, when Prof. Alexander Agassiz took up the question afresh, and, in a remarkable paper on the development of the genus *Asteracanthion*, detailed the observations which led him to believe that the ambulacral vessels do not arise by involution of the external integument, but that they commence as two primitively symmetrical diverticula of the stomach (the "würstformige Körper" of Müller), one of which becomes connected with the exterior by an opening (the dorsal pore observed by Müller, and considered by him to be the origin of the ambulacral vessels), and gives rise to the ambulacral vessels, the ambulacral region of the body of the Echinoderm being modelled upon it; while upon the other gastric sac, the antambulacral wall of the starfish body is similarly modelled. Both gastric sacs early become completely separated from the stomach of the *Echinopædium*, and open into one another, so as to form a single horseshoe-shaped sac, connected with the exterior by a tube which is converted into the madreporic canal. Agassiz does not explain the mode of formation of the perivisceral cavity of the starfish, and has nothing to say respecting the origin of the pseudhæmal vessels.

Recently, Metschnikoff has confirmed the observations of Agassiz, so far as the development of the ambulacral system from one of the diverticula of the alimentary canal of the starfish larva is concerned, and he has added the important discovery that the perivisceral cavity of the Echinoderm is the product of what remains of these diverticula. Moreover, his observations on other *Echinodermata* show that essentially the same process of development of the peritoneal cavity occurs in *Ophiuridæ*, *Echinidæ*, and *Holothuridæ.*

The precise mode of origin of the pseudhæmal system, or so-called blood-vessels, of the Echinoderms is not yet made out. But it is known that the cavity of these vessels contains corpuscles similar to those which are found in the perivisceral cavity and in the ambulacral vessels, and that all three communicate.

Both Agassiz and Metschnikoff justly insist upon the correspondence in development of the lateral gastric diverticula of the *Echinopædium* with the gastrovascular canal system of the *Ctenophora;* and, on the ground of this resemblance, the former refers the Echinoderms to the *Radiata*, retaining under that Cuvierian denomination the *Acalephæ* (*Cœlenterata*) and the *Echinodermata*. But this arrangement ignores the real value of his own discovery, which shows that the Echinoderms have made a great and remarkable step, in passing from their primarily cœlenterate stage of organisation to their adult condition. And it further ignores the unquestionable fact, admirably brought out by the same excellent observer's recent investigations into the development of *Balanoglossus*, that the *Echinopædium* is almost identical in structure with the young of animals, such as the *Gephyrea* and *Enteropneusta*, which are in no sense radiate, but are, eminently, bilaterally symmetrical. In fact, the larva of *Balanoglossus* (the sole representative of the *Enteropneusta*), was originally described by Müller, under the name of *Tornaria*, as an Echinoderm larva; and was subsequently more fully examined by Prof. Alex. Agassiz, who also regarded it as an unquestionable Echinoderm larva; and it is only recently that it has been proved, partly by Metschnikoff and partly by Agassiz himself, to be the larval form of *Balanoglossus*. In *Balanoglossus*, as in the Echinoderms, it appears that saccular outgrowths of the intestine give rise to the perivisceral cavity and its walls; and, if such be the case, the mesoblast will be chiefly, if not wholly, represented by diverticula of the alimentary canal. Thus in the *Chætognatha* and *Echinodermata*, and possibly in the *Enteropneusta*, the perivisceral cavity is a portion of the alimentary cavity shut off from the rest; and, in contradistinction to the *Schizocœla*, in which the perivisceral cavity is produced by a splitting of the mesoblast, they may be said to be *Enterocœla*.

If we endeavour to determine the place of the three remaining great groups of animals, the *Mollusca*, the *Tunicata*, and the *Vertebrata*, obstacles arise,—firstly, from a want of sufficiently exact knowledge respecting the *Mollusca;* and secondly, from the difficulty of interpreting certain well-ascertained facts in the *Vertebrata*.

That the *Mollusca*, including under that name the *Polyzoa* and *Brachiopoda*, as well as the higher Mollusks, are closely allied to the *Annelida*, is readily demonstrated. The known forms of Brachiopod, Lamellibranch, Pteropod, and Gasteropod larvæ all have their parallels among Annelidan larvæ. The *Polyzoa* are closely allied with the *Gephyrea* and *Rotifera;* and a Mollusk may be said to be a few-segmented annelid with a mantle. But whether the perivisceral cavity is developed in the annelidan or in the echinoderm fashion is not yet clear. In the *Polyzoa*, the evidence is at present insufficient to justify any conclusion. In the *Brachiopoda*, there is some ground for thinking that the perivisceral cavity is formed in the same way as in *Sagitta* and the *Echinodermata*; while, in the *Lamellibranchiata* and *Odontophora*, there is every reason to believe that the perivisceral cavity is formed by splitting of the mesoblast, or that they are schizocœlous.

In the lowest *Tunicata*, represented by *Appendicularia*, the recent investigations of Fol have shown, that, in the adult, the body proper is formed almost exclusively by an ectoderm and endoderm, which proceed directly from the epiblast and hypoblast of the embryo. It is only in the caudal appendage that a distinct mesoblast is represented by the notochord and the muscles. The blood channels correspond with the blastocœle, and the "house" in which these singular animals shelter themselves is a cuticular secretion, representing the cellulose coat of the higher ascidians. The *Appendicularia* have no *atrium*, or at most only rudiments of it, hence the branchial clefts open directly on the hæmal aspect of the body, which corresponds with the ventral face of a vertebrate animal. In all other *Tunicata*, an atrial cavity is formed by involution of the ectoderm, which thus gives rise to a cavity on each side of the branchial sac, into which the branchial clefts of the adult open; and a thick cellulose *cuticula*, into which cells from the ectoderm usually wander, invests the exterior of the body. The "atrial tunic," or invaginated layer of the ectoderm, is reflected, as a visceral layer, over more or less of the outer surface of the alimentary canal, and, as a parietal layer, over more or less of the inner surface of the body wall; and the space between the two (the blastocœle) becomes converted into the blood passages. Thus, such an ascidian resembles a vertebrated animal, not only in the manner in which its nervous centre is developed, but in the fact that it possesses an atrial cavity, which singularly resembles the pleuroperitoneal chamber of a vertebrate. For this cavity is bounded externally by the atrial tunic and the integument, which correspond with the somatopleural layer of the mesoblast and the epiblast of a vertebrate embryo; and it is bounded, internally, by the atrial tunic and the epithelium of the alimentary canal, which, to the same extent, correspond with the splanchnopleure and the hypoblast. The primitively double atrial aperture has its parallel in the peritoneal openings which persist in many *Vertebrata*.

Thus the ascidian has no "perivisceral cavity" formed by splitting of the mesoblast, nor has it any "perivisceral cavity" formed by diverticula from the alimentary canal. It is neither enterocœlous nor schizocœlous, but what, at first sight, resembles a perivisceral cavity is formed within the body by involution, and the ascidian may therefore be said to be *epicœlous*. If the alate prolongations of the body which lie at the sides of the branchial apertures, in *Balanoglossus*, were to enlarge and unite round the anus so as to leave but a relatively small opening between their edges, the cavity so formed would answer to the atrial chamber of an ascidian.

In the higher *Vertebrata*, the pleuroperitoneal[1] cavity appears to be formed by the splitting of the mesoblast into two layers, a splanchnopleure and a somatopleure, and, therefore, seems at first to correspond with the perivisceral cavity of the Annelids and Arthropods. But what is now known of the structure and development of the lowest and most embryonic of known *Vertebrata*, *Amphioxus*, throws very great doubt upon this interpretation of the facts. One of the most singular of the many peculiarities of *Amphioxus* is the fact that the branchial clefts open, not on the exterior of the body, as in all other *Vertebrata*, but into a chamber with a single external aperture, which, on the one hand, curiously resembles the atrium of an ascidian; while, on the other, it is undoubtedly homologous with the pleuroperitoneal cavity of the higher *Vertebrata*. Now Kowalewsky's investigations have shown, that, at first, the branchial apertures of the embryo *Amphioxus* open upon the exterior of the body, but that, after a time, a process of the wall of the body, on the dorsal side of the branchial apertures, grows down over them, and, uniting with its fellow in the median ventral line of the body at all points, except at the abdominal pore, gives rise to the outer wall of the pleuroperitoneal cavity. Thus the lining of that cavity, like the atrial tunic of the ascidian, is a derivative of the epiblast; and *Amphioxus* is epicœlous. As it can hardly be doubted that the somatopleure of *Amphioxus* is the homologue of the somatopleure in the higher *Vertebrata*, it becomes

[1] It must be recollected that the pericardium is also originally a part of this cavity, and that in some fishes, *e.g.*, the Rays, it never becomes completely shut off from it.

highly probable that the apparent splitting of the mesoblast in the latter, after all, represents the mode of development of the pleuroperitoneal cavity which obtains in the former, and, thus; that the *Vertebrata* are not schizocœlous, but epicœlous. Whether this suggestion will turn out to be well based or not, must be decided by the embryological investigations specially directed to this point: but that there should be any essential difference between *Amphioxus* and other *Vertebrata*, in the manner in which the pleuroperitoneal cavity is formed, is highly improbable.

The distance between *Amphioxus* and other vertebrate animals, which has hitherto been generally supposed to exist, has been greatly diminished by recent investigations. So far from being devoid of a brain and of a skull, the regions of the cerebro-spinal axis and of the neural canal, which answer to those organs in the higher *Vertebrata*, are, in proportion, extremely long in *Amphioxus*, as they are in all vertebrate embryos. But, in *Amphioxus*, the head retains throughout life a segmentation comparable to that of the rest of the body, while, in the higher *Vertebrata*, almost all traces of these distinct segments are very early lost. Moreover, in *Amphioxus*, the renal apparatus, so far from being absent, is represented by a comparatively large structure, and nothing is wanted to equip it with all the organs found in a young Marsipobranch, but auditory sacs, which, however, it must be remembered, make their appearance late in the Lamprey. With all this, the gap between *Amphioxus* and the *Marsipobranchii* is undoubtedly more considerable than that between the *Marsipobranchii* and other fishes, and it may represent a primary division of the class *Pisces*,—which, from the segmentation of the skull, may be termed the *Entomocrania*,—as opposed to the rest, in which the primary segmentation of the skull is almost completely effaced, and which may therefore be designated *Holocrania*.

It has been stated above that the great majority of the *Metazoa* pass through the *Gastrula* condition, and belong to the division of the *Gastrææ*. In some members of this division, however, the alimentary canal may be rudimentary, as in sundry male *Rotifera* and in the *Gordiacei* among the *Nematoidea*, and yet these are so closely allied to other forms possessing fully developed digestive canals, that it is reasonable to regard their rudimentary alimentary apparatus as absorbed. In two groups, however, the *Cestoidea* and the *Acanthocephala*, there is no trace of an alimentary canal either in the embryo or in the adult.

From the point of view of phylogeny, this fact may be interpreted in two ways. Either the alimentary canal which once existed has aborted, and the *Cestoidea* and *Acanthocephala* are modified *Scolecimorpha*, or these parasites have not descended from *Gastrææ*, but have passed into their present condition directly from a *Morula*-like form of *Metazoon*. In the latter case they will form a division of *Agastrææ*, apart from the other *Metazoa*.

The subjoined synopsis indicates the general relations of the different groups of the Animal kingdom, in accordance with the views which have been put forward in the preceding pages.

Those who are familiar with the existing condition of our knowledge of animal morphology, will be aware that any such scheme must needs, at present, be tentative and subject to extensive revision, in correspondence with the advance of knowledge. Nor will they regard it as any objection to the scheme of classification proposed, that the divisions sketched out may be incapable of sharp definition—the constant tendency of modern investigations being to break through all boundaries of groups, and to fill up the gaps between them by the discovery of transitional forms. In the place of assemblages of distinctly definable groups, which it has hitherto been the object of the Taxonomist to define and co-ordinate in precise logical categories, we are gradually learning to substitute series, in which all the modifications by which a fundamental form passes from lower to higher degrees of organic complication, are summed up. (T. H. H.)

ANIMALIA.

I.—PROTOZOA.

i. MONERA.
Protamœbidæ. Protomonadidæ. Myxastridæ, &c.

ii. ENDOPLASTICA.
Amœbidæ. Flagellata. Gregarinidæ. Acinetida. Ciliata. Radiolaria.

II.—METAZOA.

A. Gastrææ.

i. POLYSTOMATA.
Porifera (or Spongida).

ii. MONOSTOMATA.

1. ARCHÆOSTOMATA.

a. Scolecimorpha.

Rotifera. Turbellaria. Trematoda. Nematoidea. Hirudinea. Oligochæta

β. Cœlenterata.

Hydrozoa. Actinozoa.

2. DEUTEROSTOMATA.

a. Schizocœla.

Annelida (Polychæta). *Gephyrea.* *Brachiopoda* (?) *Polyzoa* (?) *Arthropoda.* *Mollusca.*

b. Enterocœla.

Enteropneusta. *Chætognatha.* *Echinodermata.*

c. Epicœla.

Tunicata. *Vertebrata.*

B. Agastrææ (provisional).
Acanthocephala. Cestoidea.

ANIME, a resinous exudation from the *courbaril* tree, which grows in the West Indies and in South America. When imported in the natural state it is infested with vast numbers of insects, and hence the name. It is of a pale brown colour, transparent, brittle, and in consequence of its agreeable odour is much used for fumigation and in perfumery. Its specific gravity varies from 1·028 to 1·054. It melts readily over the fire, and softens even with the heat of the mouth, but is insoluble in water. It is dissolved by alcohol, but not completely, unless the spirit be boiling. It is allied to copal in its nature and appearance, and is much used by varnish-makers.

ANIMISM, a term formerly employed in Biology to denote the theory of which Stahl is the chief expositor; the theory of the soul (*anima*) as the vital principle, cause of the normal phenomena of life, or of the abnormal phenomena of disease. It is now current in the wider anthropological sense given to it by Dr E. B. Tylor (*Primitive Culture*, chapters xi.–xvii.), as including the *general doctrine of souls and other spiritual beings.* This application is not only appropriate, but is even rendered indispensable by the absence of any other suitable word; for *spiritualism*, though occasionally used in a general sense, has become associated with a particular modern development of animistic doctrine; *anthropomorphism*, if less objectionable, is also to some degree inadequate; while the term *theology* cannot be extended to include the lower forms of the doctrine of spiritual beings, and indeed many of its higher developments, except by an ill-considered departure from ordinary usage, which raises in many minds a prejudice against the most reliable results of anthropological inquiry.

An animistic philosophy, explaining the more strange or striking phenomena of nature by the hypothesis of spiritual agency, is universally prevalent among savage races; and unless the wide-spread animistic beliefs of savages are to be regarded as but degenerate or corrupted relics of those possessed by more cultured peoples,—a theory which can scarcely be held to account for the essential and native appropriateness of animism as it flourishes among races of low culture, and its less appropriate and apparently derivative character as it survives in higher civilisations,—there seems tenable ground for the inference, that an animistic philosophy must have been that which was earliest developed among the prehistoric societies of mankind. In accordance with this view, animism may be described as the distinctive philosophy of primitive culture. It is manifestly the outcome and development of that earliest analogical reasoning, which concludes external objects to be animated with a life essentially similar to our own; it is the expression and application of our first general theory of natural causes,—a theory rude and inadequate, yet marvellously self-consistent and serviceable: and its history appears primarily to be that of a dominant and pervading philosophy, applied to explain all the phenomena of nature and life, save only those ordinary sequences which the uncivilised man regards as needing no explanation; afterwards, in the progress of culture, that of a system of thought always more or less modified and restricted by the increase of positive knowledge, and surviving only in greatly refined or greatly enfeebled forms, or only reviving at intervals of time.

Of the origin of animism perhaps no perfect account has yet been given. It can hardly be said to be obvious why, in uncultured races or individuals, there should arise that invariable tendency to represent natural forces as conscious and anthropomorphic. There is reason to believe, however, that the type of all the forms in which the tendency manifests itself, is to be discovered in the conception of the human soul. Evidently the notion of an animating, separable, and surviving soul commends itself as the ready explanation of many familiar phenomena, and the appropriate instrument of a philosophy which ascribes animation to nature at large; so that thus, according to the account given by Dr Tylor, primitive animism may be considered to have arisen simply from the evidence of men's senses, interpreted by the crude and childlike science of the prehistoric world. From the sight of life and death it was, he conceives, naturally inferred that every man has a life, or vital principle, the departure of which from his body causes death,—this idea being confirmed by apparent temporary departures, such as swoons and sleep. From the appearance of men seen in dreams and visions, it was not less cogently argued that every man has also a phantom likeness of his body, separable from it so as to appear to others at any distance, and continuing to exist and appear after the bodily death of its proper owner. Accordingly, the definition of the soul in primitive religion would, as in the lower existing religions it actually does, combine these leading qualities in the conception of an "apparitional soul," which is a thin, unsubstantial human image, the cause of life and thought in the individual it animates, capable of quitting his body for a time or altogether, and so leaving him insensible or dead, and when thus absent from the body appearing to other persons asleep or awake. From this conception, then, animism may reasonably be supposed to have had its origin, especially as other animistic doctrines exhibit such a distinct affinity and relationship to this of the apparitional soul, as almost amounts to a proof of direct derivation from it. The hypothesis being correct, it would, for instance, follow that the lower animals ought to be considered as having souls similar to human souls, inasmuch as they have life, and their phantoms are likewise seen. Moreover, though inert objects, such as clothes or weapons, have not life, yet their phantoms appear to men in dreams, and thus they must be considered as having something of the nature of souls, separable from their grosser part, and surviving its destruction. Now, in fact, both these ideas are recognised in the religions of the lower races. They come into special prominence in the savage and barbaric rite of sacrifice for the dead, where not only are wives and slaves slain to do service to their master's soul in the world of spirits, but horses and cattle are slaughtered to be spiritually transmitted thither, and clothes, ornaments, and other articles are destroyed, that he may wear and use the "object-souls" thus sent to him. The savage doctrine of a future state, presently to be referred to, also strikingly corroborates the theory of the phantom soul as the origin and centre of animistic thought.

There remains, however, the difficulty of understanding by what process this rudimentary doctrine of the soul has grown into the great system of developed animism: a system of thought so comprehensive as to hold all nature in a web of vital action and spontaneity; so multiform as to invent some new spirit-race for almost every fresh order of phenomena; so coherent as to create a perfect *plexus* of ideas that mutually support and interpret one another; finally, so persistent, that even its more extravagant developments can survive for ages in defiance of accurate knowledge. It is difficult to realise how exceedingly slow and gradual must have been that growth of positive science and its methods of verification, which has allowed a fanciful and little regulated philosophy to take root so firmly and cast its branches so far. Yet only by a great and connected development does it seem possible that animism could be so matured and extended. Regarding many, at least, of the varied forms of animistic belief, there is already sufficient evidence to make it probable that they have arisen by one continuous process of evolution, extending through the lower to the higher civilisation.

This evidence of continuity of development Dr Tylor represents as partly historical, and partly turning upon the principle of survival in culture. Thus, as among savage tribes, the soul is actually identified with the shadow or the breath, the use of such words as σκιά, πνεῦμα, *umbra*, *anima*, *shade*, and *spirit*, may be held to show the derivation of the civilised conception of the soul from the same primitive and savage idea. The primitive conception of the soul as consisting of a thin, vaporous, material substance, held its place in ancient philosophy and theology, being supported by such writers as Epicurus and Origen, and was only gradually superseded by the more modern belief of the soul's immateriality. The elves, fairies, goblins, &c., so well known in modern folk-lore, correspond to the nature-spirits and demons of the savage religions. In these cases there has been survival with considerable change; on the other hand, the continuity of animistic thought is likewise indicated by many instances in which an idea survives with little or no modification. Such instances are to be found in many old customs, and especially among peasants, whose notions of the spiritual world are often almost savage. Thus the ancient funeral sacrifice of the warrior's horse for him to ride into the other world, which was for the last time in Europe actually and officially done at Treves in 1781, is still kept up in form by leading the dead soldier's horse to his grave. The piece of money is still put in the hand of the corpse at an Irish wake; and in most countries of Europe may still be seen the pathetic custom of setting out offerings of food for the spirits of the departed. Sacrifices to the deities of wells and rivers, trees and rocks, have continued almost unchanged in the rudest districts of such countries as Russia. As a historical example, the primitive theory of convulsions, delirium, madness, &c., being caused by demoniacal possession lasted on among educated people through the Middle Ages, and has only been fairly suppressed by the modern medical schools.

Proceeding on the inference of continuous development, the same writer has attempted a classification of animistic doctrines as they appear in the religious philosophy of the lower and higher culture. The doctrine of souls, as distinguished from that of other spiritual beings, is first considered. It is found possible to trace the conception of the human apparitional soul in various beliefs concerning ghosts, wraiths, doubles, &c., which survive among civilised societies long after the soul has ceased to be conceived as material or ethereal. The notion of animal-souls, largely prevalent among savage tribes, still faintly survives in our own country. The doctrine of plant-souls seems long to have formed an important element in the religious philosophies of India; and even the doctrine of object-souls, which exercises unlimited dominion in savage religions, can still be traced as influencing some of the actions, though not, perhaps, the explicit opinions, of civilised men. Closely allied like these doctrines, to the primitive notion of the apparitional soul, is the belief in the soul's existence after death, which appears either as a doctrine of transmigration, describing the re-birth of souls in successive bodies, or in its more general and more important form as the doctrine of a future life. The latter, as commonly held by savage races, supposes the phantom souls of the departed either to remain here as hovering ghosts, or to be transported to some distant region, there to continue a life more or less similar to the present, but with little or no trace of moral retribution: in more advanced civilisations, however, this doctrine exercises the most powerful moral influence, by distinguishing the heaven of the good from the hell of the wicked. The primary doctrine of souls is next described as leading to the development of the doctrine of other spiritual beings, from the lowest ranks of demons and elves, up to the highest deities of the Pantheon. The life and action of the body being ascribed to a soul, all other phenomena of the universe were in like manner ascribed to soul-like beings or spirits, which are thus, in fact, personified causes. So disease among the lower races is accounted for by possession by demons, who are often themselves human souls, and who enter the bodies of their victims, causing all kinds of illness, and especially those phenomena of convulsion and delirium in which the patient seems actually animated by a spirit not his own. Other events and accidents of life are in the same way accounted for among savages as the acts of the demons, good or evil, whom they believe to pervade the universe; and as these beings are, more often than not, conceived to be souls of deceased men, the consequent worship of divine Manes is the principal religion of the lower state of civilisation. The doctrine of object-souls, expanding into the general doctrine of spirits conveying influence through material objects, becomes the origin of Fetichism and idolatry. Spiritual beings, under a thousand names, are multiplied upon the earth; not only those guardian spirits and hurtful demons directly influencing the lives of men, but others, far more numerous, with varied functions to discharge in the economy of the external world. To the lower races all nature being animated nature, every brook and well, every rock and glade, is peopled by nature-spirits; while Heaven and Earth, Sun and Moon, Rain and Wind and Thunder, are either themselves adored, or personified in the character of mighty nature-gods, such as Zeus, Apollo, or Poseidon,—spiritual beings who are, as it were, the great animating souls of their special phenomena. Among the lower races, also, there appears in a rudimentary form that antagonism between a good and evil deity, which forms the fundamental idea of Zoroastrism and Manichæism. Lastly, the conception of a Supreme Deity appears at a very early stage of civilisation, whether one of the great nature-deities, such as Heaven or Sun, is raised to this royal pre-eminence, or whether a being of the nature of a soul of the world, like the Great Spirit of the North American Indians, is venerated as Creator and Lord of the universe. Then, by a natural evolution, Monotheism is established.

Such, briefly sketched, is Dr Tylor's account of the development of animism, considered as the main principle of the philosophy of religion, throughout the various grades of civilisation. Whether, having shown many popular superstitions to be undoubted survivals from an ancient state of belief, he has been equally successful in proving a like derivation for doctrines recognised by modern religion, will be questioned by many who perceive the bearing of his conclusions upon the actual validity of theological tenets. It is proper to point out that he has noted one great distinction between the lower and higher animism, which consists in the absence of any distinctly ethical element in the spiritual philosophy of the less cultured races. Only at a comparatively late stage of their development do the moral feelings become associated with animistic beliefs.

The final decay of many forms of animistic belief, much more readily than the process of their development, admits of being traced with the aid of historical evidence. Indeed, the history of each of the sciences is a record of the progressive substitution of matter for spirit and law for spontaneity; and we can still witness the process of decay in various stages; for while certain sciences—like astronomy, since the time when Kepler imagined minds in the planets—have wholly exterminated the animism within their borders, there are others that have scarcely yet advanced so far—biology, for example, which is still familiar with "vital force" and final causes. Nor is the process commonly a rapid one: in many cases, as a world of illustration has been adduced to prove a declining spiritual conception may persist for a length of time, refined and modified into a "principle" or "essence," whose action, though still automatic like a spirit's, is also regular like that of a natural law. Among all civilised races, however, animism has long ceased to be known as the universal philosophy or explanation of nature, and its remaining manifestations are in great measure reduced to a secondary or rudimentary form. Thus animism survives in the imperfect theories of childhood; it survives also, as we have seen, in the superstitions of the uneducated; and as, in primitive societies, language and imagination fostered the development of spiritual myth, so animism, embodied in metaphor, remains in later civilisations as an important element, if not in truth the very substance of imaginative literature.

The process by which animism comes to be superseded by positive science is therefore familiar, both in its history and results. Regarding its real nature, however, the greatest difference of opinion exists, and there is raised one of the most interesting questions connected with animism—the question of its relation to metaphysics. According to the well-known doctrine of Comte, which, having since his time been expounded and illustrated by several of his followers, would now appear to be accepted by many even of those who do not profess themselves Positivists, animism passes into positive science *through* metaphysics. In support of this view there is pointed out, what has just been explained, that as knowledge progresses, anthropomorphic and animistic conceptions rarefy and sublimate into so-called essences or principles, with which conceptions metaphysical discussions are shown to be largely conversant. Systems of ontology betray their history by a hundred clinging vestiges of animism; and all the favourite ideas of the dialectician are to be traced in the symbolism of savage religions. The Platonic *ideas*, to take but a single instance, are closely represented by the *species-deities* of the North American Indians; while, even in the writings of the master himself, how animistic and mythical is the character they maintain. It is, therefore, concluded that metaphysics is little more than decaying animism, and that a large proportion of animistic theory, before being superseded by positive science, passes through the "metaphysical" stage. From this view of the nature of his science, and its relation to animism, the metaphysician, however, dissents. While admitting that degenerate "metaphysical" conceptions do exist, and that psychology and ontology, more perhaps than other sciences, are confused and retarded by their influence, he refuses to recognise these conceptions as metaphysical in any special or indeed admissible sense. The facts by which the Positivist seeks to prove that animism, as one inadequate explanation of nature, grows into metaphysics, another system of explanation almost equally unsatisfactory, the metaphysician rather regards as proving that metaphysics, a legitimate science, grows out of primitive animism by precisely the same process as other sciences. The discovery in savage or other religions, of dialectical ideas mythically expressed and explained, only confirms him in the belief that there does exist a class of phenomena which it is the business of the science of metaphysics to investigate, since even mythical explanations are seldom formed, unless in the presence of some real problem calling for solution; and he contends that in this way the subject matter of metaphysical science, though long overgrown and encrusted with animistic conceptions, does gradually shine through and assert itself in the light of positive knowledge. If these arguments then be allowed, metaphysics is no decaying animism, but rather a science in the act of struggling free from animism; and animism itself, though often passing in its decay through a phase misnamed metaphysical, is quite improperly represented as undergoing any transformation into metaphysics.

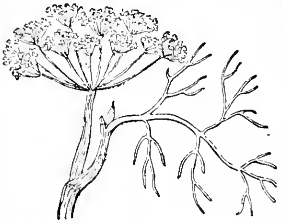
Reviewing the conclusions countenanced by what evidence we possess touching the nature and history of the doctrine of spiritual beings, we find that while it is possible, and even necessary, to regard animism as a system of primitive philosophy extending through various forms into the higher civilisations, yet this view being for the most part unsupported by direct historical evidence, and depending largely on the inference of a close analogy between primitive and savage thought, is in great measure confessedly theoretical, leaving much room for dispute, both as to the extent to which animistic beliefs have been transmitted and modified by a regular, continuous, and uninterrupted process, and as to the conditions which, in special instances, have led to their formation and development, or disappearance and decay. A theory that represents, not only the extravagances of mythology and superstition, but indeed all that we call spiritual, nay, all that we name divine, as but the fruit of a natural anthropomorphic tendency, much more appropriate to savage than to civilised life, is, it is manifest, in thorough inconsistency with many widely accepted doctrines of philosophy and theology. Regarding the importance of the inquiry there is, however, no dispute. Spiritual philosophy has influenced every province of human thought; and the history of animism, once clearly traced, would record the development, not of religion only, but of philosophy, science, and literature. (A. O. L.)

ANIMUCCIA, GIOVANNI, musical composer, was born at Florence in the last years of the 15th century. At the request of St Filippo Neri he composed a number of *Laudi*, or hymns of praise, to be sung after sermon, which are noteworthy as furnishing the rudimentary form out of which the Oratorio was developed. In 1555 he was appointed "maestro di capello" at St Peter's, an office which he held until his death in 1571. He was succeeded by the more celebrated Palestrina, who had been his friend and probably his pupil. It is impossible to say to what stage Animuccia brought the oratorio form, as no specimens of his *laudi* are now extant. The manuscript of many of his other compositions is still preserved in the Vatican Library. His chief published works were *Madrigali e Motetti a quattro e cinque voci* (Ven. 1548) and *Il primo Libro di Messe* (Rom. 1567). From the latter Padre Martini has taken two specimens for his *Saggio di Contrapunto*. Paolo Animuccia, a brother of Giovanni, was also celebrated as a composer.

ANIO, or ANIEN, the modern *Teverone*, a river of Italy which rises in the Apennines, and, flowing first N.W. and then S.W., joins the Tiber a little above Rome. It forms a beautiful cascade at Tivoli. The Anio supplied Rome with water by two aqueducts, the Anio Vetus, constructed about 270 B.C., and the Anio Novus, completed, 48 A.D., by Claudius. The Digentia of Horace is one of its tributaries. See AQUEDUCT and TIVOLI.

ANISE, *Pimpinella Anisum*, is an umbelliferous plant found in Egypt and the Levant, and cultivated on the Continent of Europe. It is used medicinally as an agreeable aromatic. The officinal part of the plant is the fruit which consists of two united carpels, called a cremocarp. It is known by the name of aniseed, and has a strong aromatic taste and a powerful odour. By distillation the fruit yields a volatile, oily matter known as oil of anise. It is used as a carminative, and is also employed in the manufacture of liqueurs. The anise of the Bible (Matt. xxiii. 23) is *Anethum graveolens*, or dill (see fig.), a native of the south of Europe and of Egypt, and also found near Astracan, at Buenos Ayres, and at the Cape of Good Hope The name Dill is derived from an old

Norse word meaning to soothe, referring to its carminative qualities in allaying pain. It is one of the garden plants of which the Pharisees were wont to pay tithes. It is used in pickles and soups. The star-anise of liqueur-makers is the produce of a totally different plant, *Illicium anisatum*, belonging to the Natural Order Magnoliaceæ, sub-order Wintereæ. It receives its name from its flavour, and from its fruit spreading out like a star.



ANJÁR, a fortified town of Hindustán, and the capital of a district of the same name in the native state of Cutch, lies in 23° 6′ N. lat., 70° 3′ E. long. The country is dry and sandy, and entirely depends on well irrigation for its water supply. The town is situated nearly 10 miles from the Gulf of Cutch. It suffered severely from an earthquake in 1819, which destroyed a large number of houses, and occasioned the loss of several lives. In 1820 the population was estimated at 10,000. The town and district of Anjar were both ceded to the British in 1816, but in 1822 they were again transferred to the Cutch Government in consideration of an annual money payment. Subsequently it was discovered that this obligation pressed heavily upon the resources of the native state, and in 1832 the pecuniary equivalent for Anjár, both prospectively and inclusive of the arrears which had accrued to that date, were wholly remitted by the British Government.

ANJENGO, once a British factory and fortress, now a small sea-port town of India, in Travancore, nearly encircled by a deep and broad river, at the mouth of which it is situated. It lies in 8° 40′ N. lat., 76° 49′ E. long. The fort was built by the English in 1684, and retained till 1813, when the factory was abolished on account of the useless expense attending it. Anjengo is infested with snakes, scorpions, and centipedes, those animals finding shelter in the matted leaves of the cocoa-tree with which the houses are mostly thatched. Anjengo is celebrated for the best coir cables on the Malabar coast, manufactured from the fibre of the Laccadive cocoa-nut. It also exports pepper, cotton cloths, and drugs.

ANJER, a sea-port town of the Dutch East Indian island of Java, situated on the Strait of Sunda, 18 miles W. of Batavia. It is protected by a fort, and besides carrying on a considerable trade in Eastern curiosities, supplies passing vessels with fresh water and provisions. The population is considerable, but its amount is not known.

ANJOU, one of the thirty-six ancient provinces of France, approximately equivalent to the modern department of Maine and Loire. It was bounded on the N. by Maine, which separated it from Normandy; E. by Touraine; S. by Poitou; and W. by Brittany. It was, as Mr Freeman has remarked, altogether lacking in geographical individuality, and owed its somewhat prominent position in history to the character and fortunes of its counts and dukes. By the ancient chronicler of Anjou the origin of the countship is referred to a certain Tertullus, who owed his elevation from an humble rank to Charles the Bald; but the first person history lays hold of is Ingelgar, who lived about 870, and obtained possession of that portion of the subsequent province which lies between the Maine and the Mayenne. He was followed in succession by Fulk the Red (888); Fulk the Good (938), author of the proverb that an unlettered king is a crowned ass; Geoffrey Grisegonelle, or Grey-Tunic (958); Fulk Nerra, or the Black, famous as a warrior, and on account of his pilgrimages, by way of penance, to the Holy Sepulchre; Geoffrey Martel, a vigorous but unsuccessful opponent of William the Conqueror; his nephews, Geoffrey the Bearded and Fulk Rechin, from the latter of whom we have an interesting historical fragment, giving an account of his ancestors and defending his own conduct (D'Achery, *Spicilegium*, folio edition, vol. iii.); Fulk Nerra II.; and Geoffrey Plantagenet, who united Anjou and Maine, and —by his marriage with Matilda of England—Normandy also into one dominion. When his son became (1154) king of England, as Henry II., these various provinces passed into the power of the English crown, but were forfeited by King John (1204) to Philip Augustus of France. Henry III. demanded restitution, but did little in support of his demand; and Anjou soon passed into the hands of Philip, son of Louis VIII., and from him to Charles, the brother of Louis, who by his exploits in Italy made the name of Charles of Anjou famous, and established the house of Anjou on the throne of Naples (1266–1285). His son, Charles II., king of Naples, nicknamed *il Zoppo*, or the Lame, gave the investiture of Anjou and Maine to his son-in-law, Charles of Valois, younger son of Philip the Bold; and from 1290 the counts of Valois took the title of dukes of Anjou and counts of Maine. In 1328 the son of Charles of Valois became king of France, as Philip VI., and united the duchy of Anjou to the crown. King John in 1356 bestowed it on his son Louis. The Anjou line ended in the unfortunate René (noticed below), who was deprived of his duchy by Louis XI. of France, or, more strictly, in his brother Charles, who died in 1481. Meanwhile old René's daughter Margaret, who was made of sterner stuff than her father, was battling with more than a woman's valour for the rights of her son in England. From this time onward the title of duke of Anjou has been borne, without implying any territorial sovereignty, by Charles VIII. of France, by each of the four sons of Henry II., by the second son of Henry IV., by the two sons of Louis XIV., by his grandson (Philip V. of Spain), and by his great-grandson (Louis XV.) Charles, a nephew of Charles of Naples, obtained the throne of Hungary in 1308, and was succeeded by his son Louis the Great, who also became king of Poland; but the same fatality of failure in the male line also befell this branch of the house of Anjou. (See Freeman's *Norman Conquest*, vol. ii. p. 267; D'Achery, *Spicilegium*, vol. iii.)

ANJOU, René, Duke of, was the second son of Duke Louis II., and succeeded his brother Duke Louis III. He was born at Angers in 1408, and brought up by his uncle, Louis of Bar, who, in 1419, contracted a marriage between him and Isabella, heiress of Lorraine, and, in 1430, left him in possession of his duchy. On the death of Charles of Lorraine in 1431, René was acknowledged as his successor, but he had soon to defend himself against the claims of the count of Vandemont, who was supported by Philip of Burgundy. The battle of Bouligneville decided in favour of the count, and René was taken prisoner to Dijon by Philip. In 1432, however, he was conditionally released, and in the following year was confirmed in the duchy of Lorraine by the Emperor Sigismund. In 1435, while again, according to the conditions of his release, in the custody of Philip, he became, by the death of his brother, duke of Anjou and count of Maine, and a little later, received the offer of the inheritance of the queen of Naples. His endeavours to enforce his claims on the Neapolitan kingdom were ultimately futile, and he quitted Italy in 1442. Three years afterwards he married his daughter Margaret to Henry VI. of England, and thus increased the influence, though hardly the prosperity of his house. On the death of his wife in 1453, he bestowed the duchy of Lorraine on John of Calabria, his only surviving son. He himself retired to Provence, where henceforth, with but occasional interruption, he led a simple quiet life, amusing himself with the writing of verses and the painting of miniatures, the cultivation of flowers, and the keeping of wild animals. Thus occupied, he exhibited a philosophical submission to the changes brought about by the artful schemes of his less pacific neighbours, until he was at last reduced to an ignoble dependency on the good-will and pleasure of Louis of France, without the liberty of even bequeathing his possessions to any one but the king He died at Aix in 1480, followed by the regret of his subjects, who afterwards held him in remembrance as "The Good King René."

ANKARSTRÖM, Johan Jakob, the assassin of Gustavus III, king of Sweden, was descended from an honourable family, and was born in 1759. After having been for some time at court as a page, he entered the army, but left after a few years with the honorary rank of captain. He is said to have been concerned in some treasonable projects, and to have been pardoned by the king, but the story has not sufficient authority. The Swedish nobles were about this time violently opposed to the king, who, by the aid of the other orders of the state, had wrested their power from them, and was now ruling despotically. This dislike was increased by the *coup d'état* of 1789, and by the king's known desire to interfere in favour of Louis XVIII. of France. Ankarström, a man of strong passions and violent temper, resolved upon the assassination of Gustavus, and communicated his intention to the disaffected nobles, and among others, to Counts Horn and Ribbing, who would willingly have undertaken the deed themselves. After some ineffectual attempts to seize the king's person, a favourable opportunity offered itself. A masked ball was held at Stockholm on the 16th March 1792, which the king attended, though he had been warned against doing so by an anonymous letter. By a preconcerted signal, Count Horn indicated his victim to Ankarström, who fired and inflicted a mortal wound. The murderer was identified by the discharged pistol, thrown down in the ball-room, and was arrested. He did not attempt to deny his crime, but declared that he had no accomplices. After a long trial he was condemned, was publicly beaten on three successive days, had his right hand cut off, and was finally beheaded and quartered. He endured his sufferings with the greatest fortitude, and seemed to rejoice in having rid his country of a tyrant. His principal accomplices were imprisoned for life.

ANKLAM, or Anclam, a town of Prussia, in the province of Pomerania, situated on the Peene, 6 miles from its mouth in the Kleine Haff, and 47 N.W. of Stettin, with which it is connected by railway. The fortifications of Anklam were dismantled in 1762, and have not since been restored, although the old walls are still standing; formerly, however, it was a town of considerable military importance, which suffered severely during the Thirty Years' and the Seven Years' Wars; and this fact, together with the repeated ravages of fire and of the plague, has made its history more eventful than is usually the case with towns of the same size. It does not possess any remarkable buildings, although it contains several, private as well as public, that are of a quaint and picturesque style of architecture. The Peene is navigable up to the town, which has a considerable trade in its own manufactures, as well as in the produce of the surrounding country, while some shipbuilding is carried on in wharves on the river. The chief manufactures are linen and woollen goods, leather, beer, and soap. Anklam formerly bore the names Wendeuburg and Tanglim. Population in 1871, 10,739.

ANKOBAR, or Ankober, the capital of the kingdom of Shoa in Abyssinia, situated in lat. 9° 34′ N. and long. 39° 35′ E., on a mountain about 8200 feet above the level of the sea. The appearance of Ankobar is somewhat peculiar; its houses, ill-built wooden structures, with conical thatched roofs, are irregularly dotted over the side of the hill; a rude fortification of stakes and branches protects the upper portion of the town, while the palace, a more pretentious, but very ugly stone building, crowns the summit. Ankobar enjoys many natural advantages, its climate especially being remarkable for mildness and salubrity. Its population is about 5000, but during the residence of the court it rises to 15,000.

ANNA, Ana, or Anah, a town of Turkey in Asia, situated on the right bank of the Euphrates, about 160 miles N.W. of Baghdad. It is an open, defenceless place, consisting chiefly of a single street, which extends for several miles along a narrow strip of land that lies between the river and a ridge of rocky hills. The houses are separated from each other by beautiful and fertile gardens filled with fruit trees, and in the river, facing the town, is a succession of equally productive islands. The most easterly of these islands contains the ruins of the old castle, while the remains of the ancient *Anatho* extend from this island for about two miles down the left bank of the Euphrates. Coarse cloth is almost the only manufacture at Anna.

ANNA CARLOVNA, who for a few months held the position of regent in Russia, during the minority of her son Ivan, was the daughter of Catherine, sister of the Empress Anna Ivanovna, and was born in 1718. In 1739 she married the duke of Brunswick Wolfenbüttel, and their son Ivan was, in 1740, adopted by the empress and proclaimed heir to the throne. A few days after this proclamation the empress died, leaving directions regarding the succession, and appointing her favourite Biron as regent. Biron, however, had made himself an object of detestation to the Russian people, and Anna Carlovna, with the assistance principally of the able but intractable Munich, had little difficulty in overthrowing his power. She then assumed the regency, and took the title of grandduchess; but she knew little of the character of the people with whom she had to deal, was utterly ignorant of the approved Russian mode of government, and speedily quarrelled with her principal supporters. In December 1741, Elizabeth, daughter of Peter the Great, who, from her habits, was a favourite with the soldiers, excited the guards to revolt, overcame the slight opposition that was offered, and was proclaimed empress. Ivan was thrown into prison, where he soon afterwards perished. Anna and her husband were banished to a small island in the River Dwina, where, in 1745, she died in childbed. Her husband survived her for many years.

ANNA COMNENA, daughter of the Emperor Alexius Comnenus I., was born 1st December 1083. She was her father's favourite, and was carefully trained in the study of poetry, science, and Greek philosophy. With a mind superior to the effeminacy and voluptuousness of the court in which she was educated, she cultivated literature and sought the acquaintance of the more eminent philosophers of the period. But wise and studious as she was, she was also intriguing and ambitious. Having married an accomplished young nobleman, Nicephorus Bryennius, she united with the Empress Irene in attempting to prevail upon her father during his last illness to disinherit his son, and give the crown to her husband. The affectionate virtue of the father prevailed over female address and intrigue; but this only stimulated the ambition of Anna. She entered into a conspiracy to depose her brother; and when her husband displayed timidity in the enterprise, she exclaimed that "nature had mistaken their sexes, for he ought to have been the woman." The plot being discovered, Anna forfeited her property and her fortune, though, by the clemency of her brother, she escaped with her life. Excluded by her base conduct from the enjoyments of court, she employed her solitude in writing the *Alexiad*—a history, in Greek, of her father's life and reign. The production is still extant, and forms part of the celebrated collection of the *Byzantine Historians*. Her style is extravagantly rhetorical, diffuse, and panegyrical. In her account of the first Crusade she is often at variance with the Latin authorities. The *Alexiad*, in fifteen books, was first published at Augsburg in 1610; but the best edition is that of Schopen, with a Latin translation (Bonn, 1839, 2 vols. 8vo), and Schiller in his *Historic Memoirs* gives a German translation.

ANNA IVANOVNA, Empress of Russia, daughter of Ivan, brother of Peter the Great, was born in 1693, and married in 1710 to the duke of Courland, who died the following year. After the death of Peter II., in 1730, the imperial council offered the vacant throne to Anna on the following conditions:—She was to govern according to the decisions of the supreme council, and she was not allowed, without its consent, either to declare war or to conclude peace, to impose new taxes, to grant any important office of the state, to dispose of crown lands, to contract a matrimonial alliance, or to nominate a successor to the throne. She was also not to punish any noble, or to confiscate any one's property without a legal sentence. Anna signed these conditions without any demur; but after her arrival at Moscow, a numerous party, jealous of the authority which this constitution, imitated from that of Sweden, gave to the supreme council, or rather to the families of the Princes Dolgorouki and Galitzin, of whose members it was chiefly composed, petitioned the empress to assume the autocracy of her predecessors. Anna immediately complied with this request, and the framers of the constitution either were banished to Siberia, or perished on the scaffold. Russia was governed in a most tyrannical and oppressive manner during the whole reign of Anna by her favourite Biren, who was made by her influence duke of Courland. According to Russian authorities, 20,000 victims of Biren's tyranny perished during Anna's reign of six years, and amongst them persons belonging to the highest ranks in the country. The principal events of Anna's reign were the voluntary restoration, in 1732, to Shah Nadir of the Russian provinces, Shirvan, Ghilan, and Mazanderan, acquired by Peter the Great, but which caused more expense than they yielded revenue to Russia; a Chinese embassy at St Petersburg, the only one that was ever sent to Europe; the assistance given to the elector of Saxony and king of Poland, Augustus III., against his competitor Stanislaus Leszczinski, supported by France; a Russian army sent to the assistance of the Emperor Charles VI. against France; a war with Turkey from 1736 to 1739, which, notwithstanding several successful campaigns, gave no advantage to Russia at the conclusion of peace; and an advance made into Central Asia by the establishment of the Russian protectorate over the khan of the Kirghises, who, with the assistance of Russian officers, conquered Khiva, but failed to maintain himself there. Anna died in 1740. Her reign is considered as a period of transition from the old Muscovite semi-barbarian manners to the polish, though not the civilisation, of the West.

ANNA, Baldasarre d', a painter of some repute, who flourished during part of the 16th and 17th centuries. He was born at Venice, probably about 1560, and is said to have been of Flemish descent. The date of his death is uncertain, but he seems to have been alive in 1639. For a number of years he studied under Leonardo Corona, and on the death of that painter completed several works left unfinished by him. In the opinion of many judges he surpassed his master in richness and mellowness of colour, though he was inferior to him in design. His own activity seems to have been confined to the production of pieces for several of the churches and a few of the private houses in Venice; and though there exists no accurate list of his works, the old guide-books and descriptions of the city notice a considerable number of paintings by him. Scarcely any of these, however, have survived to the present time.

ANNABERG, a town of Saxony, situated in the Erzgebirge, about 1830 feet above the level of the sea, and at a distance of 18 miles south from Chemnitz, with which it is connected by railway. The chief importance of Annaberg is derived from its large lace and ribbon manufactories, the latter of which were first established in the town by Belgian Protestants, who were driven from their country by the tyranny of the duke of Alva. There are also extensive and valuable silver, tin, and cobalt mines in the neighbourhood. Population, 11,693.

ANNALS (*Annales*, from *annus*, a year), a concise historical record in which events are arranged chronologically, year by year. The chief source of information in regard to the annals of ancient Rome is a passage in Cicero (*De Oratore*, ii. 12, 52), which has been the subject of much discussion. He states that from the earliest period down to the pontificate of Publius Mucius Scævola (*circa* 131 B.C.), it was usual for the Pontifex Maximus to record the events of each year on a white tablet (*album*), which was exhibited in an open place at his house, so that the people might read it. These records were called in Cicero's time the *Annales Maximi*. After the pontificate of Publius, the practice of compiling annals was carried on by various unofficial writers, of whom Cicero names Cato, Pictor, and Piso. The *Annales* have been generally regarded as the same with the *Commentarii Pontificum* cited by Livy, but there seems reason to believe that the two were distinct, the *Commentarii* being fuller and more circumstantial. The nature of the distinction between annals and history is a subject that has received more attention from critics than its intrinsic importance deserves. The basis of discussion is furnished chiefly by the above quoted passage from Cicero, and by the common division of the work of Tacitus into *Annales* and *Historiæ*. Aulus Gellius, in the *Noctes Atticæ* (v. 18), quotes the grammarian Verrius Flaccus, to the effect that history, according to its etymology (ἱστορεῖν, *inspicere*, to inquire in person), is a record of events that have come under the author's own observation, while annals are a record of the events of earlier times arranged according to years. This view of the distinction seems to be borne out by the division of the work of Tacitus into the *Historiæ*, relating the events of his own time, and the *Annales*, containing the history of earlier periods. It is more than questionable, however, whether Tacitus himself divided his work under these titles. The probability is, either that he called the whole *Annales*, or that he used neither designation. (See Tacitus.) So far as the distinction between annals and history is real, it seems to arise out of the more restricted conditions imposed upon the annalist as compared with the historian. A narrative strictly annalistic must necessarily be a mere register of isolated facts, and not a record of historical processes. Confined at each stage within the narrow limit of a single year, it cannot trace the progress of events or exhibit their connection and interdependence, as is done in history. (See on this subject an ingenious though somewhat fanciful paper by Niebuhr contributed to the *Rheinisches Museum*, and translated by Thirlwall in the Cambridge *Philological Museum*, vol. ii.) In modern literature the title annals has been given to a large number of standard works which adhere more or less strictly to the order of years. The best known are Grotius's *Annales et Historia de Rebus Belgicis* (Amst. 1557), written in imitation of Tacitus; Baronius's *Annales Ecclesiastici*, comprising the first twelve centuries of the Christian era; Hailes's *Annals of Scotland from the Accession of Malcolm III. to the Accession of the House of Stuart;* Chambers's *Domestic Annals of Scotland;* and the *Annales de Chimie*, founded in 1789 by Lavoisier and others, and continued, with two interruptions, down to the present time.

ANNAMABOE, or ANAMABOE, a British fort and town on the Gold Coast of Africa, about 10 miles E.N.E. of Cape Coast Castle. It exports palm oil, ivory, gold dust, pea nuts, and Guinea grains; and in return its imports of manufactured goods are considerable. The town suffered severely during the invasion of the Ashantees in 1807, but the fort, although garrisoned only by a few soldiers, resisted the whole Ashantee host. Population about 4500.

ANNAN, a royal and parliamentary burgh of Scotland, in the county of Dumfries, situated on the river Annan, nearly two miles from the Solway Firth, and about fifteen from Dumfries. It is a well-built town, containing a town hall, a parish church, several dissenting chapels, and an excellent academy. The river Annan which has been embanked, is navigable for vessels of 300 tons up to within half a mile of the town, and for vessels of 60 tons to the bridge, a fine structure of three arches built in 1824. Annan is a station on the G. and S.-W. Railway, and is connected with the main line of the Caledonian Railway, and also with England, by the Solway Junction branch which crosses the firth by means of a very strong viaduct. The principal manufactures are cotton, ropes, and cured hams; shipbuilding and salmon fishing are also carried on, while there is a considerable trade with England, the chief exports being cured hams, cattle, sheep, and grain. The town, which is governed by a provost and fourteen councillors, including three bailies, unites with Dumfries, Kirkcudbright, Lochmaben, and Sanquhar, in returning one member to parliament. In 1871 the population of the royal burgh was 4174, of the parliamentary, 3172.

ANNAN, a river rising near the source of the Tweed, in the range of hills that lies on the confines of the counties of Dumfries, Lanark, Peebles, and Selkirk. About two miles beyond Moffat it receives two large tributaries,—the Moffat Water, which flows westward from Loch Skene, a mountain lake in the north-eastern corner of Dumfriesshire, and the Evan Water, which flows eastward from the upper part of Lanarkshire. The Annan has a total length of about 40 miles, and below its junction with the Moffat and the Evan it is joined by the Kennel Water from the west and the Dryfe Water from the east. Annandale was once the name of a stewartry which comprehended a large portion of Dumfriesshire.

ANNAPOLIS, a seaport town of the United States, the capital of Maryland, situated on the Severn, about 2 miles from its mouth in Chesapeake Bay, and about 25 in a direct line from Washington, with which it is connected by railway. It is a neat, regularly-built place, but the trade which at one time seemed likely to enrich it has been transferred almost entirely to Baltimore, and Annapolis is now little more than the political capital of the state. It contains handsome Government buildings, a college, and the United States Naval Academy, which was established at Annapolis in 1845, and was for a time removed to Newport, Rhode Island. Providence, as Annapolis was first called, was founded in 1649, but it did not get a charter until 1708, when it also received its present name in honour of Queen Anne. It has been the seat of government since 1689. Population in 1870, 5744.

ANNAPOLIS, a town of Nova Scotia, capital of Annapolis county, and up to 1750 of the whole peninsula, situated on an arm of the Bay of Fundy, at the mouth of a river also called Annapolis, 95 miles west of Halifax. Annapolis is one of the oldest settlements in North America, having been founded in 1604 by the French, who called it Port Royal; it was finally captured by the British in 1710, and was ceded to them by the treaty of 1713. It possesses a good harbour, but its trade at present is small. Apples of a very fine quality are grown in the surrounding country. Population, 1500.

ANN ARBOR, a town of the United States, the capital of Washtenaw county, Michigan, situated upon the Huron, about 40 miles west of Detroit, with which it is connected by the Michigan Central Railway. The town, which is healthy and well built, is a place of considerable commercial importance, its chief manufactures being iron, wool, and flour, while the trade in the produce of the surrounding district is large and valuable. It is the seat of the university of Michigan, a liberally-endowed institution, founded in 1837, and at present containing three subsidiary colleges devoted to legal, medical, and literary studies respectively, with a total attendance, in 1870, of 1072 students. The college buildings are large and pleasantly situated, and the university possesses a library, an observatory, and a chemical laboratory. The population of Ann Arbor in 1870 was 7363.

ANNATES. As early as the 6th century it began to be customary for those who were ordained to ecclesiastical offices to pay a fee or tax to the ordaining authorities; and this tax at length amounted to a half or the whole of a year's income. When, in course of time, the Roman See had appropriated the right of consecration, the money was paid into the Papal treasury, not, according to the defenders of the system, as a remuneration for the benefice conferred, but as a natural contribution to the maintenance of the Pope and his ecclesiastical government. These *annates*, or first-fruits, were of different kinds, though the chief features were the same in all. *First*, When a bishop, archbishop, or abbot received his investiture, he paid to the Pope a year's revenue of his new benefice (*servitia communia*); *Secondly*, If his benefice was one of those "reserved" by the Pope, he handed over to the Papal treasury the annates paid to him by those whom he at any time collated to livings in his diocese (*annalia, medii fructus, jus deportuum*); *Thirdly*, According to a bull of Paul II. in 1469, if benefices were united to certain communities, the annates were only to be paid every fifteen years, and not at every presentation (*quindenia*); and, *Fourthly*, A small addition was made to the *servitia communia* as a kind of notarial fee (*servitia minuta*). It must not be supposed that this system ever was worked with absolute uniformity and completeness throughout the various parts of the Papal domain. There were continual disagreements and disputes: the central authorities endeavouring to maintain and extend this most important of their financial schemes, and the subordinate ecclesiastics doing their best to get rid of the impost altogether, or to transmute it into some less objectionable form. The subject frequently became one of national interest, on account of the alarming amount of specie which was thus drained away, and hence numerous enactments exist in regard to it by the various national governments. In England the annates, which had previously been paid for the most part to the archbishop of Canterbury, were claimed by John XXII. (1316–1334) for three years, and permanently usurped by his successors till the time of Henry VIII., when, in 1531, their collection was prohibited. At that time the sum amounted to about £3000 a year. On the completion of the Reformation, the annates were, along with the supremacy, bestowed on the crown; but in February 1704 they were appropriated by Queen Anne to the assistance of the poorer clergy, and thus form what has since been known as "*Queen Anne's bounty.*" The amount to be paid was originally regulated by a valuation by the bishop of Norwich in 1254, later by one instituted in 1292, which in turn was superseded by the *Liber Regis* of 1535. In France, in spite of royal edicts,—like those of Charles VI., Charles VII., Louis XI., and Henry II.,—and even denunciations of the Sorbonne, the custom held its ground till the famous decree of the 4th of August during the Revolution of 1789. In Germany it was decided by the concordat of Constance, in 1418, that bishoprics and abbacies should pay the *servitia* according to the valuation of the Roman chancery in two half-yearly instalments. Those benefices only were to pay the *annalia* which were rated above 24 gold florins; and as none were so rated, the annalia fell into disuse. The Basle Council (1431–1443) wished to abolish the *servitia*, but the concordat of Vienna (1448) confirmed the Constance decision. The Congress of Ems (1786) also declared against them; but they continued to be paid till 1803, when, to indemnify the powers that had sustained territorial loss through the recent wars, a very great amount of ecclesiastical property was secularised. In some parts of Germany, the payment of annates is still made under particular concordats. In Scotland *annat* or *ann* is half a year's stipend allowed by the Act 1672, c. 13, to the executors of a minister of the Church of Scotland above what was due to him at the time of his death. This is neither assignable by the clergyman during his life, nor can it be seized by his creditors.

ANNE, Queen of Great Britain and Ireland, was born on the 6th of February 1664. She was the second daughter of James Duke of York, afterwards James II. She was only seven years old when her mother, Anne Hyde, died, having previously professed adherence to the Church of Rome, a step which was immediately imitated by her husband. The duke, however, had to allow his daughters, the princesses Mary and Anne, to be brought up as Protestants; and Anne always continued to be attached, zealously and even bigotedly, to the Church of England. In her twentieth year she was married to Prince George, the brother of the King of Denmark. In the establishment then formed for her, a place was given, on her own earnest desire, to her early playfellow Lady Churchill, afterwards Duchess of Marlborough; and this ambitious and imperious woman, acquiring rapidly an irresistible authority over the feeble mind of the princess, thenceforth ruled her absolutely for more than twenty years. Not long afterwards, when the Duke of York had become king, he made repeated attempts to convert the princess Anne to his own creed; he engaged that, if she would become a Roman Catholic, she should be placed in the line of succession to the throne before her elder sister Mary. Prince George appears to have received those overtures favourably; but he, an indolent and goodnatured man, who cared for nothing but good eating and field-sports, never had any influence over his wife. She remained firm in her Protestantism, lived in retirement during the whole of her father's reign, and did not allow her opinions or feelings any further vent than that which they found in her private correspondence with the Princess of Orange. When, in 1688, James's queen gave birth to a son, the sisters took a lively interest in the suspicions and inquiries that arose; and Anne was easily led to believe that the child was supposititious; though later in her life she must have been convinced that he was really her brother. Before the landing of the Prince of Orange Prince George was pledged to join him; and his wife and Lady Churchill abandoned King James on the first opportunity.

From the Revolution till the death of William III., Anne's way of life was as quiet and obscure as it had been during the reign of her father. She did, indeed, on the prompting of her favourite, acquiesce in the act of the convention-parliament, which, postponing her place in the succession, gave the throne to William in case he should survive Mary. But the sisters soon quarrelled, and never were reconciled. The misunderstanding began in trifling questions of etiquette, quite fitted to the calibre of both of the royal minds; but considerations of real importance soon compelled the king himself to interfere. The Churchills, traitorous to their new sovereign, as they had been to the old, were known to be intriguing for the restoration of James; and they induced Anne to write secretly to her father, and declare repentance for her desertion of him. Even when William dismissed Marlborough from all his places, the princess obstinately persisted in retaining his wife in her household. After Queen Mary's death the king and his sister-in-law went through the forms of a reconciliation; but there was no confidence on either side; and indeed the secret correspondence with Saint Germains was still carried on. The state of the succession to the crown threatened new difficulties. Anne had seventeen children, but most of them were still-born; and the Duke of Gloucester, the only one who survived infancy, died in 1700 at the age of eleven. The Jacobites, however, were unable to prevent the passing of the Act of Settlement, which placed the Electress of Hanover after Anne in the succession to the crown.

On the 8th of March 1702, Anne became queen of England by the death of William, being then thirty-eight years of age. Into her short reign there were crowded events possessing vast importance, both for the British Empire and for the whole of Europe; and her name is customarily associated with one of the most characteristic epochs in the history of English literature. Marlborough and Peterborough commanded her armies; her councils were directed in succession by Godolphin and Somers, by Harley and St John; Berkeley and Newton speculated and experimented; and the "wits of Queen Anne's time" were mustered, in poetry and in prose, under such chiefs as Prior and Pope, Swift, Addison, and Steele, Arbuthnot and Defoe. But no sovereign could have exerted less of real and personal influence than Queen Anne did, either on the national polity or on the national enlightenment. A blessed thing it was that she should have been thus powerless. For, beyond her own epicurean comforts, and the petty ceremonial of her court, there were just three ideas which her narrow and uninstructed intellect admitted: each of these ideas was full of danger to the peace and happiness of the state; and each of them was cherished by her with the hereditary stubbornness of a Stuart. She was as eager as any one of her race to enlarge the prerogatives of the crown: her father's devotion to the Church of Rome was not stronger than was her desire to increase the power of the Church of England; and she never ceased to wish earnestly that her exiled brother should be her successor on the throne. In no stage of Anne's reign was even the last of these designs impracticable: there were always able statesmen inclined to lead the way; and more than once the tide of public opinion set towards absolutism, both political and ecclesiastical. The queen, however, was not only dull and ignorant, but also indolent, fond of flattery, and accustomed from her youth to let herself be guided by stronger and more active minds than her own. Whatever her wishes might be, her actions were ruled by her female favourites. Fortunately the earlier of her two directresses, a woman of extraordinary force of character, was both willing and able to keep in check the queen's private inclinations: not less fortunate was it that the sway exercised by the next possessor of the royal favour was speedily cut short by her mistress's death. The course of English history might have flowed less smoothly if the Duchess of Marlborough and her husband had not become convinced that their own interest lay in supporting the principles of the Revolution; and those principles might have sustained a rude shock, if Mrs Masham and her Jacobite allies had been allowed a few months longer to mature the queen's plans and their own.

The reign of Queen Anne, lasting for twelve years, falls naturally into two unequal periods.

During the first of these, the Duke of Marlborough was paramount in the houses of parliament, and his wife in the royal closet. A ministry of Tories was formed on the queen's accession; but the leaders of it were Marlborough and Godolphin, who immediately began to edge off from their party. The principal measures were, from the beginning, in substantial conformity to the policy of King William: the war with France, hardly resisted then by any part of the nation, was prosecuted with ardour and success; and the victories of Oudenarde, Ramillies, and Blenheim, gained by the consummate generalship of Marlborough, made England formidable and illustrious throughout Europe. In the internal affairs of the kingdom, Whig principles for a time prevailed more and more; the party acquired a decided majority in the House of Commons; and the ministry came to be composed almost entirely of Whigs, some of the Tories being dismissed, and others, like the two leaders, showing the accommodating flexibility of opinion which was so rife among the statesmen of that slippery age. The union of England and Scotland was carried through in the face of many difficulties; and, while the proceedings of the ministry in the matter were by no means perfectly pure, the measure owed its success mainly to the independent and honourable assistance of the best man among the Whigs, the accomplished and patriotic Lord Somers. During several years, in short, barriers were gradually and firmly built up against the old system and the old parties. But other days were at hand. The domineering favourite of the queen presumed rashly on her power, and offended the self-esteem of her mistress. Mrs Masham, a poor relation of the duchess, whom she had introduced into the royal household, soothed Anne's fretful temper, gratified her vanity, and quickly, though secretly, acquired her confidence and affection; and, under the guidance of the new favourite, and her prompter Harley, the queen was encouraged to hope for the attainment of all her most cherished aims. The state of public opinion underwent a corresponding change. Even under the masterly government of William, disappointments had been felt by those who expected impossibilities from the Revolution; discontent now diffused itself very widely, the main cause being the increase of taxation which had been rendered necessary by the Continental war. The Tories and Jacobites, led by some of the ablest of the statesmen, and assisted by some of the most skilful and energetic of the political writers, dexterously used the combustible materials that were accumulating, and made the church also an active engine of mischief. The ministry saw their parliamentary majorities wasting away; they were personally treated at court with open contumely; and their ruin was completed when, still relying too boldly on their supposed strength, they impeached Sacheverell for publicly preaching in favour of Jacobitism and the divine right of kings. In August 1710 the Whig administration was ignominiously discarded.

The second period of the queen's reign began at this point. She was thenceforth governed by Mrs Masham; Mrs Masham was governed by Harley and St John, the chiefs of the new ministry; and these able and unscrupulous men exerted themselves to the utmost of their power in undoing all that had been done by their predecessors. The fruits of the war were immediately abandoned, and the allies of England shamefully betrayed, by the treaty of Utrecht. If open attacks were not made on the constitution, it was only because the Parliament could not be trusted in such a case, and because, also, the two ministerial leaders became jealous of each other, and formed separate intrigues. Harley, the Sinon of the time, corresponded both with St Germains and with Hanover; St John, more decidedly Jacobite, plotted with Mrs Masham and the queen to procure the crown for the Pretender, on the ostensible condition of his professing Protestantism. But these cabals oozed out sufficiently to alarm the honourable Tories, and to array them and the bishops against the ministry in Parliament. The time, likewise, during which the danger was growing, proved too short to allow it to become ripe. Harley and Mrs Masham came to an open quarrel one evening in Anne's presence; after they had squabbled for hours, the poor queen just retained strength enough to insist that the minister should resign on the spot; she then retired at two in the morning, and lay down on her deathbed. She was seized with apoplexy, and died on the 1st of August 1714. St John's schemes were not ready for execution; and, by the prompt activity of a few patriotic statesmen, the accession of George I. was immediately and peaceably secured. (W. S.)

(See Earl Stanhope's *History of England, comprising the Reign of Queen Anne until the Peace of Utrecht*, Lond. 1870.)

ANNEALING is the process of removing the brittleness peculiar to glass vessels and metal castings immediately after manufacture. Newly-blown glass is so fragile as to be altogether unfit for use, and the common occurrence of the breaking of a lamp-glass on lighting the lamp, or of a tumbler on pouring in hot water, shows the want of proper annealing.

The process consists generally in heating the vessels up to a red or white heat in a close oven, and allowing them to cool gradually over a space of several hours or even days. The brittleness of rapidly-cooled glass is exhibited by the philosophical toy known as *Rupert's drops* or *glass tears*, said to have been first brought over to England by Prince Rupert and exhibited at the court of Charles I. They are small tadpole-shaped pieces of glass, which have been formed by allowing fused glass to drop into water. A pretty hard blow may be given with impunity to the thick part or head of the glass tadpole; but the mere breaking off of the tail causes the whole to fly to pieces, or rather to dust, with a sharp explosion. An illustration of the same kind is given by what are known as *Bologna phials*. These are vessels of thickish glass about half the size of a common Florence oil-flask, with no apparent flaw or cause of weakness. Though they will stand the shaking of a small bullet within them, yet the shaking of a few particles of sharp sand hardly visible will cause the bottom to fly to pieces. It is the mere scratching of the skin that is fatal; and the explanation is easily found. The particles of the glass have a cohesive polarity which dictates a certain regularity in their arrangement, but which requires some time for its development. When the vessels are suddenly cooled, the surface molecules only can have had time to dispose themselves duly, while those within are kept by this properly formed skin in a highly constrained situation; and it is only so long as the surface film keeps sound that this constraint can be resisted. In the Rupert's drops it is plainly visible that the interior substance is cracked in every direction, and ready to fly to pieces.

In the process of annealing the glass is kept for some time in a state approaching fluidity, and admitting of a uniform molecular arrangement throughout. Of course the thicker the glass the more careful must be the annealing and the longer the process; very thin glass requires little or no annealing, because it is, so to speak, all skin; and glass thread requires no such treatment to make it possess the exquisite flexibility of silk.

The large sheets of plate glass, now used for shop windows require to be very carefully annealed before being ground and polished, otherwise they would be unable to stand the scratching of the surface. Imperfection in this respect is often revealed by the spreading in every direction of a crack once begun. These plates require as long as a fortnight to complete the annealing; and smaller articles from six to sixty hours, according to their thickness and weight

In the manufacture and working of the various metals, annealing is frequently employed to reduce the brittleness usually resulting from a rapid or important change of molecular structure, such as is produced by hammering, long-continued vibration, rolling, and sudden cooling. The coppersmith who hammers a flat sheet of copper into a vessel of any description he pleases, must leave off hammering at intervals, and anneal the piece of metal to prevent it going to pieces under his blows. The extreme degree of tenuity to which gold is reduced by heating, is attainable only by very frequent and careful heating and slow cooling at each stage of the processes of forging, rolling, and beating

Perhaps no better example can be given of the importance of annealing in metals th t have to be subjected to frequent concussion than the art of die-forging. The matrix, from which the die-punches are impressed, is the product of many months' labour, and the subject of tender care in its manufacture. Being a mass of steel of considerable dimensions, it is extremely liable to fracture after the operation of hardening, so much so that it will not bear even sudden changes of atmospheric temperature. This brittleness is removed by putting it in water, gradually raised to the boiling-point, and then allowed slowly to cool. The matrix is used, not so often for the stamping of medals and coins directly, as for the manufacture of die-punches, which shall be used to produce any required number of dies exactly like the original matrix. For this purpose a conical plug of fine soft steel is compressed by powerful machinery against the matrix, but in receiving the impression its texture is condensed and hardened, so that the annealing process has to be repeated after every few blows in the die-press, to prevent cracking of the surface Coins, whether gold, silver or copper, are usually impressed by a single blow, and in their case the blank metal is annealed before coining But in medals, where the design is in bolder relief, a number of blows,—sometimes as many as thirty, is required; and in this case it is necessary to anneal after every third blow

Wheels and axles of railway carriages, from the constant vibration to which they are subjected, become, in course of time, dangerously brittle; and they require to be re-worked and annealed anew to restore the requisite toughness to the material. So also in the processes of metal rolling and wire-drawing, frequent annealing is necessary to allow the cohesive force to produce the most stable arrangement of the particles. The soft metals, such as lead, tin, and zinc, are annealed by immersion in water, which is made to boil and then to cool slowly. Sudden changes of temperature have the effect, almost invariably, of rendering metals brittle. And, as sudden cooling is required to give to steel its peculiar and invaluable hardness, so unfortunately it renders it at the same time brittle as unannealed glass, from the unnatural strain which the inner substance of the metal possesses. Annealing must, therefore, be employed to reduce this molecular strain, and to give the steel a workable flexibility. This is done by raising it to a red heat within a close vessel, and then allowing it gradually to cool. Heating in an *open* fire is very injudicious, because the carbon which enters the steel as an element combines with the oxygen of the air to the detriment of the quality of the steel. Usually steel goods are heated in an iron oven with charcoal powder, or placed in the heart of hot cinders, so as to exclude all air and oxygen. Large castings, such as are used in the manufacture of cannon, are kept covered with hot cinders and allowed to cool down sometimes over a space of about three months.

In proportion as this brittleness and hardness are reduced by annealing, the flexibility is increased, which allows of the employment of steel for an infinite variety of purposes. A bath of oil, which boils at about 600° Fahr., is often used for the annealing of steel tools, when a temperature between the boiling-point of water and 500° or 600° Fahr. is required. Annealing is also employed to render cast-iron malleable or less brittle than it is naturally, so that a dozen of small articles—such as buckles and knife-blades—can be manufactured at less cost than a single article can be otherwise.

Annealing may be said to be the inverse process of *tempering*, which is the fixing of the molecular condition of steel by more or less sudden cooling from a particular temperature.

The real nature of the change which metals undergo by annealing is not thoroughly understood. Most of the malleable metals are susceptible of two distinct forms: one, called the crystalline form, which they assume by slow cooling; and the other, the fibrous, which is acquired by hammering or rolling. When this, however, is carried beyond a certain point, the metal becomes so hard that it is not capable of being bent far without breaking, and recourse must be had to annealing or slow cooling.

On the other hand, if the annealing be long continued the malleability diminishes, and the metal again has a crystalline fracture. Zinc by wire-drawing becomes very flexible, and possesses a degree of tenacity not inferior to that of copper; but, if it be kept in boiling water for a length of time, it will resume its original brittleness, and show a crystalline appearance when broken. Thus it appears that little can be said of the theory of the subject; little more, indeed, can be attempted than the enumeration and classification of the facts.

ANNECY, a town of France, in the deparment of Haute Savoie, situated at the foot of the lake of Annecy, 22 miles south of Geneva. The surrounding country presents many scenes of beauty, and the town itself is a pleasant residence, containing a cathedral, a bishop's palace, a church (in which the relics of St Francis de Sales are preserved), and an old castle, formerly the residence of the counts of Geneva. It is the seat of several important manufactures, the chief being linen and cotton goods, glass, cutlery, earthenware, and leather; linen bleaching is also carried on to a considerable extent, and in the neighbourhood there are some iron mines. There are traces of the Roman origin of the place; at all events Annecy le Vieux, a village a little to the N.E., existed in the time of the Romans. Annecy was once the capital of the counts of Geneva; from them it passed to the counts of Savoy, or, as they ultimately became, kings of Sardinia, by whom it was ceded to the French in 1860. Population, 11,581. The lake of Annecy is about 9 miles in length by 2 in breadth, and its surface is more than 1400 feet above the sea. It discharges its waters by means of a canal into the Fier, a tributary of the Rhone.

ANNELIDA

ANNELIDA, a class of the sub-kingdom Annulosa, the title being derived from Lamarck's term Annélides (*Annellus*, a little ring), given to Cuvier's red-blooded worms. The latter were included by Linnæus under his *Vermes*, along with intestinal worms, molluscs, zoophytes, and sponges. The labours of Pallas, Baster, Otho Fabricius, and especially O. F. Müller, enabled Gmelin, in the 13th edition of the *Systema Naturæ* of the great Swede, to make some improvements and many additions. Cuvier ranged the Annelida under his Articulata, giving them the chief position on account of their red blood; but they are now generally classified as a separate type below the latter. It would be out of place to enumerate all the advances that have occurred since Cuvier's time, but among those whose names stand prominently forward in this respect are Lamarck, De Blainville, Bosc, Audouin, Milne-Edwards, Dugès, Moquin-Tandon, and De Quatrefages in France; Van Beneden, Morren, and D'Udekem in Belgium; Gruithuisen, Oken, H. Rathke, Grube, Max Schultze, Hoffmeister, Hering, Kölliker, Schmarda, Keferstein, Ehlers, and Ratzel in Germany; Claparède in Switzerland; Malmgren, Metschnikoff, and Kowalevsky in Russia; Sars in Norway; Kinberg and Lovén in Sweden; Delle Chiaje in Italy; Stimpson, Leidy, A. Agassiz, and Verrill in North America; and Montagu, Dalyell, G. Johnston, J. R. Johnson, Williams, Huxley, Baird, and Ray Lankester in our own country.

FIG. 1.—*Nereis pelagica*. L. (*After Œrsted.*)

The Annelida may be described as bilaterally symmetrical animals, with flattened or cylindrical bodies, composed of numerous soft rings, or without such. The locomotive appendages (generally furnished with bristles) are not articulated. Nervous system consisting of a cephalic ganglion or pair of ganglia, connected on each side of the œsophagus with a chain of ganglia running along the ventral aspect. Mouth ventral; alimentary canal with an anus. Circulatory system with distinct vessels. The majority are small animals, but some reach the length of 6 feet and upwards, and are as thick as a finger.

In the present article the Annelida will be understood as comprehending the A. POLYCHÆTA, A. OLIGOCHÆTA, A. ONYCOPHORA, A. DISCOPHORA, and A. GEPHYREA, the first two being often placed together in the subclass Chætopoda.

I. In the first order, A. POLYCHÆTA, the body (fig. 1) is elongated, segmented, more or less cylindrical (certain tubicolous forms having two well-marked regions), and almost universally furnished with uniramous or biramous bristle-bearing feet (parapodia, Huxley). The first segment is modified, so as to form a head or snout, and has the eyes, tentacles, &c. The second or buccal segment bears the mouth and certain processes. The other segments have foot-tubercles, bearing bristles developed in special sacs (*e*, fig. 4), and various appendages, such as elytra, dorsal and ventral cirri, &c. The structure of the bristles (*e.g.* fig. 2) holds a prominent part in the discrimination of species and even genera, and the same may be said of the hooks of many of the Tubicola (fig. 3). A curious example of the Opheliidæ has no bristles, and *Tomopteris* has only one at the base of each tentacle. Posteriorly, the diminished body generally terminates in two elongated cirri in the free forms, while in the sedentary such processes are often absent. In *Polydora* (fig. 21) a curious funnel-like structure exists.

FIG. 2.—Bristle of *Pionosyllis Malmgreni*.

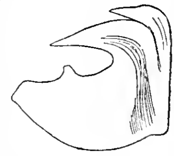


FIG. 3.—Hook of *Terebella*.

The body in the Polychæta (*e.g.* fig. 4) is invested by a

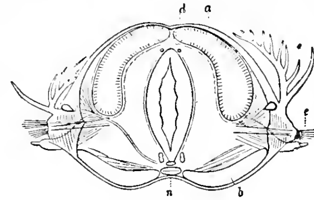


FIG. 4.—Transverse section of *Eunice*. (*After Ehlers*)

finely fibrous, cuticular, or chitinous layer (*d*), to which the iridescence in many forms is due. This is perforated at somewhat regular intervals by two series of pores, and cilia are generally present at certain points. In the sedentary annelids the cuticle is thinner, a feature probably in connection with their protective tubes. Beneath the cuticle is a cellulo-granular hypoderm, with tubular glands, bacilliparous and glandular follicles in certain cases, as well as the deposits of pigment. The muscular system is well developed, and the bands variously arranged in the body-wall. A well-marked circular layer is generally present externally, while in others it would seem to be represented only by oblique bands. The longitudinal bundles follow different plans, such as forming an almost continuous coat, or split up into various distinct ribands (*a* and *b*, fig. 4, the former representing one of the dorsal bands, the latter one of the ventral). Schneider thought that the arrangement of the muscular system might form the basis of a classification of this and allied groups; but for sound reasons it has not been adopted. There is no tendinous raphe at each segment, though fibres from the dissepiments pass through

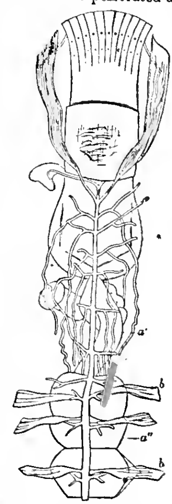


FIG. 5.—Ventral vascular system of *Nereis cultrifera*, Grube (*After Ehlers*). *a*, proboscis; *a'*, œsophagus; *a''*, intestine; *b*, dissepiments; *v*, ventral blood-vessel.

the longitudinal layer, in some cases even to the hypoderm. The muscular fibres have a hyaline connective tissue. In *Myxicola* and *Protula* the fibres of the longitudinal coat have a dendritic appearance in transverse section. Besides the foregoing, many have a powerful oblique band on each side, passing down to be inserted near the nerve-cord, or elsewhere; and the proboscis (*a*, fig. 5), bristles, branchiæ, alimentary canal, and other organs, have a series of special muscles. By the muscles of the body-wall the Polychæta execute all their movements in the water and on land, the feet-papillæ with their bristles playing quite a subordinate part. A few progress in addition by special organs, such as the tentacles of the Terebellæ.

The cutaneous and muscular tissues enclose a space termed the perivisceral cavity, which stretches from the anterior to the posterior extremity. This chamber is lined by a special membrane, which likewise envelops the alimentary canal, vessels, and other organs. It is generally divided into various transverse spaces by muscular dissepiments or screens (which permit communication), and occasionally there are longitudinal partitions. In this cavity the highly organised perivisceral corpuscles float in a coagulable lymph, which has no relation with sea-water. The lining membrane is ciliated in *Aphrodita*, *Glycera*, *Polycirrus*, *Tomopteris*, and *Terebella*; and it is curious that in these the blood-vessels proper are absent, with the exception of the first and last. Ray Lankester has found that hæmoglobin occurs in the perivisceral corpuscles of *Glycera* and *Capitella*. Professor Huxley, after M. de Quatrefages, is inclined to think the perivisceral fluid the true blood of the group, but this is doubtful.

The circulation of the blood is effected by a system of closed vessels with muscular walls (fig. 5) the funda-

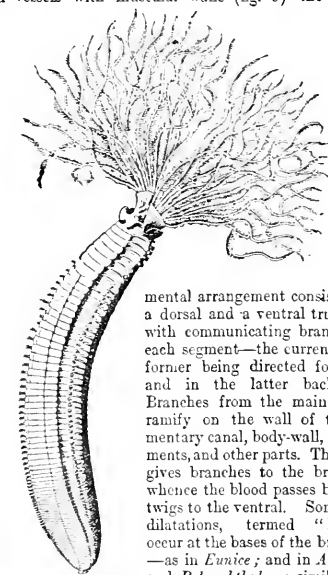


Fig 6.—*Dasychone infracta*, Kr (After Malmgren.)

mental arrangement consisting of a dorsal and a ventral trunk (*v*), with communicating branches in each segment—the current in the former being directed forwards, and in the latter backwards. Branches from the main trunks ramify on the wall of the alimentary canal, body-wall, dissepiments, and other parts. The dorsal gives branches to the branchiæ, whence the blood passes by other twigs to the ventral. Sometimes dilatations, termed "hearts," occur at the bases of the branchiæ —as in *Eunice*; and in *Arenicola* and *Polyophthalmus* similar dilatations exist in other parts. Various modifications of the system take place, such as the bifurcation of the dorsal vessel anteriorly or posteriorly, the presence of blood-sinuses or lacunæ round the intestine in certain sedentary forms, and great diversity in regard to capillary distribution. The blood is usually reddish in colour, and devoid of corpuscles—the latter, however, being present in *Syllida*, some of the Opheliidæ, Cirratulidæ, and in *Staurocephalus*. It is colourless in *Aphrodita*, greenish in *Stylaroides* and certain Sabellidæ. Finally, *Glycera* and *Polycirrus* are devoid of a true circulatory apparatus. This system is compared by Professor Huxley to the water-vascular system of the Echinoderms, Trematoda, and other groups; but, as formerly mentioned, this is doubtful. Hæmoglobin has been found by Ray Lankester in the blood of many of the Polychæta.

The Annelida composing this group generally possess a special branchial apparatus, and where this is absent (*e.g. Lumbriconereis*), the skin and ciliated digestive chamber seem to carry on the function. So characteristic are the branchiæ, that the term Dorsibranchs was aptly bestowed on one section (see fig. 4), and Cephalobranchs on the other (see fig. 6). The branchiæ have the form of simple filiform organs, or they are pinnate, bipinnate, pectinate (*e*, fig. 4), flabelliform, or arbuscular processes. To each the blood is carried by a branch of the dorsal vessel, which traverses the organ to its extremity, and, looping, carries the aerated fluid to the ventral vessel. Vascular loops pass between the two branches in the branchiæ, and only very thin cuticular tissues covered with cilia intervene between the water and the blood, so that due oxygenation occurs. In the Serpulidæ the branch from the dorsal vessel is continued directly into the twig going to the ventral, and from their point of union a single vessel traverses the branchia and sends processes into the pinnæ, the blood, moreover, in these presenting undulatory movements. A cartilaginous framework exists in the branchial processes of the latter group and the Sabellidæ (fig. 6). According to Fritz Müller the opercular plug in certain forms is developed by a gradual metamorphosis of the branchia.

The digestive system consists of a rounded alimentary canal, commencing at the second and terminating in an anus at the last or the penultimate segment. The mouth opens in the form of a simple slit or grooved dimple on the under surface of the second segment. In many the first region is a complex muscular and protrusible proboscis (fig. 5, *a*, pharynx and œsophagus of some, and the œsophagus of others), with papillæ, horny or dense calcareous teeth (fig. 7), with a narrow œsophageal region (*a'*) behind. Certain glandular organs in the œsophageal region of certain forms are termed salivary. The walls of the succeeding portion (*a''*) are often marked by numerous sacculations from constrictions at the dissepiments; and in some (*e.g.*, *Aphrodita*) large diverticula occur. The inner surface bears vibratile cilia, the walls are glandular, and there are also circular and longitudinal muscular fibres. The gland-cells contain numerous refracting granules, and the tissue is by some held to be homologous with the liver of the higher forms. Many modifications of this system exist: thus, for example, there is in *Syllis* a firm, smooth anterior region (*pharynx*), often armed, then a region provided with glands (*proventriculus* or gizzard), a stomach with a glandular sac on each side, and lastly the intestine. The food of the group consists of both animal and vegetable substances, and sandy mud is swallowed by others for the nutrient particles it contains.

Fig 7.—Tip of proboscis and horny teeth of *Polynoe impatiens*. (After Savigny.)

The nervous system has the form of a pair of cephalic ganglia, and a chain of ganglia placed along the ventral aspect of the body (*n*, fig. 4). The former lie over the œsophagus, and send branches to the eyes, tentacles, and other organs. A cord (buccal) joins them on each side to the ventral chain, and thus the œsophagus is encircled by a nervous collar. In each segment the ventral ganglia give out branches for the supply of the neighbouring organs and feet. The nerve-cells chiefly occur on the ventral surface and sides of the ganglia. In some (*e.g.*, *Terebella*), while the nerve cords are united in the anterior region, they are separate posteriorly. The eyes are much developed in *Alciope*, certain Syllidæ, and others; but, on the other hand, many are eyeless. Most of the eyes are mere masses of black pigment (sometimes capsulated) situated on the head, destitute of means of accommodation, with certain nerve-threads going to them. In *Alciope*, sclerotic, lens, retina, and other parts exist. In *Branchiomma* the eyes occupy the branchiæ, and in *Fabricia* the posterior end of the body. Otolithes are stated to be present in a few (*e.g. Arenicola*), but on these and other minute points further investigation is required. The sense of touch is extremely delicate in the group; on the surface at large, as well as in the tentacles and cirriform processes. *Evarne, Nephthys, Ophiodromus*, and others, exhibit remarkable irritability.

The Polychæta are for the most part diœcious, the sexual glands being variously developed on the inner surface of the body-wall or on the dissepiments, and developing in the forms of ruffs round the vascular axes. The products are detached into the perivisceral cavity. The ciliated and looped segmental organs of Dr Williams occur very generally, and may conduct outwards the sexual elements, but they have also been supposed to be excrementitious. In *Tomopteris* their ciliary current carries spermatozoa inwards, and the same may occur in other forms. The structure and deposition of the egg, and the changes in its development, agree with those in other classes. Certain Eunicidæ are ovo-viviparous. Occasionally the ova are borne on the back (*Polynoë*), or in a ventral pouch (*Autolytus cornutus*), until hatched, while in *Spirorbis* a modification of the operculum acts as an ovisac. The young escape as ciliated organisms with a long whip anteriorly; but, as development progresses, the cilia are confined to certain zones. A few immature forms, again, such as the young of *Nerine*, carry remarkable bristles, which are shed before the adult form is reached. Some have arranged the larval forms according to the zones of cilia and the temporary bristles. In the growth of the young animal the development of the new segments takes place between the first and last. In certain Nereidæ, *e.g. Nereis Dumerilii*, at least two sexual forms exist,—viz., a small adult which develops either ova or spermatozoa in the usual way (except that in the male the elements occur in two testicles placed in one segment), and, secondly, another which becomes transformed into a *Heteronereis* before the sexual elements are developed. Metschnikoff has further found another *Nereis* which is hermaphrodite. The phenomena of alternate generations is also observed in *Autolytus*, and fissiparity in *Filigrana*,—the latter, with *Spirorbis* and *Amphiglena*, being also hermaphrodite. The female *Autolytus* quite differs from the male, and has its body loaded with ova, which pass into a pouch in *A. cornutus*, Agass., and the products by-and-by get exit as free-swimming embryos. The male is wide in front, and has large tentacles, the sperm-sacs occupying the first five bristled segments. From the young of the foregoing is developed—so as to complete the series—the third kind, viz., the "parent-stock" of A. Agassiz, which differs from both the previous forms. No sexual elements occur in the parent-stock, but the males and females are produced from the body by transverse fission (fig. 8).

Regeneration of mutilated parts is common in the Polychæta, even to the reproduction of a head.

The tubes formed by many exhibit an amount of precision and skill not far removed from the powers of the most ingenious insects. In common with the Nemerteans, their skin exudes a tenacious secretion which coheres under water, and this alone forms the protective tube in some, while in others it is strengthened with mud (fig. 9), sand, gravel, shells, and stones. The secretion varies from the most delicate film in the Syllidæ, to the tough parchment-tubes of *Chætopterus*, or the rigid crow-quills of *Hyalinœcia* (fig. 10). The eyeless *Pectinaria belgica* (fig. 11), again, fashions a tube like a straight horn (fig. 12) of minute pebbles or large grains of sand, carefully selected and admirably fixed to each other by a whitish secretion. In placing the grains together in the wall there is no haphazard, but angle fits angle as in a skilfully built wall. Beautiful semi-transparent tubes are constructed by an allied species in the deep sea from the siliceous spicules of sponges. The remarkable arborescent or pectinate processes which ornament the free ends of the tubes of certain *Terebellæ* are also noteworthy. The calcareous tubes of the fixed Serpulidæ, or the free (*e.g. Ditrypa*), differ from those of the molluscs in the absence of organic connection between the animal and its protective sheath. Lastly, large coherent masses of coarse gravel and sand-tubes are formed on various beaches by *Sabellaria*.

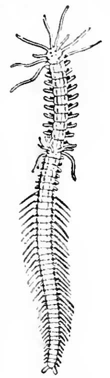


Fig. 8.—Parent-stock of *Autolytus cornutus*. (*After A. Agassiz.*)

Fig. 9.—*Clymene amphistoma*, Sav., with a fragment of tube on the right. (*After Savigny.*)

The annelids are subject to many parasitic inroads, as by *Gregarinæ*, *Opalinæ*, and *Nematoids*, internally; various vegetable growths, zoophytes, *Loxosomæ*, and the crustaceans *Selius, Selenium, Nereicola, Terebellicola, Sabelliphilus, Chonephilus*, and *Sabellacheres*, externally. Commensalism is likewise not uncommon; thus *Polynoë scolopendrina* haunts the tubes of *Terebella nebulosa*, and it also alternates with *Harmothoë marphysæ* in the tunnels of *Marphysa sanguinea*; *Acholoë astericola* frequents the ambulacral rows of *Astropecten*, *Malmgrenia castanea*, the peri-oral region of *Spatangus purpureus*, and *Nereilepas fucata* associates itself with the hermit-crab in Buccinum; while *Alciopina parasitica* lives in the interior of Pleurobrachia, and one of the Amphinomidæ in the respiratory cavity of Lepas.

The Polychæta are all marine, and distributed over the whole surface of the globe,—often at very great depths,—as early shown by General Sabine, and recently by the Norwegian dredgings, and those of the celebrated "Porcupine" and "Challenger" expeditions. Many species are common to the entire North Sea, and extend to the south as far as Gibraltar, while some northern forms enter the Mediterranean in considerable numbers. The British species are common to the North Sea, and many range to the shores of North America. The size of some of the

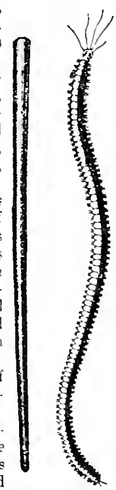


Fig. 10.—*Hyalinœcia tubicola*, O. F. Müller, and tube.

forms greatly increases in the Arctic Sea. The tropical waters abound with lustrous and splendidly tinted speci-

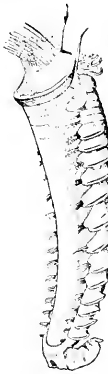


Fig. 11.—*Pectinaria belgica*, Pall. (*After Malmgren.*)

Fig. 12.—Tube of fig. 11, partially shaded.

mens, especially amongst the Amphinomidæ. The borers in shell, limestone, coral, and Melobesia, seem cosmopolitan, and the swimming *Tomopteris* is likewise widely distributed. The forms frequenting the bottom of the sea live in mud or sand, or lurk under stones, in chinks of rocks, shells, and seaweeds. Many specially affect mud or muddy sand, *e.g.*, the Lumbriconereidæ, Nephthydidræ, Glyceridæ, and the Terebellidæ; while some prefer hard or stony ground, *e.g.*, the Polynoidæ and Sigalionidæ. Between tide-marks they abound in fissures of rocks, under stones in pools, under tangle-roots, and in sand or sandy mud. Many live in captivity several years, but the duration of their existence generally is unknown.

Tubicolar Polychæta occur in various strata, from the Lower Silurian upwards, and *Serpulites* even appear in the

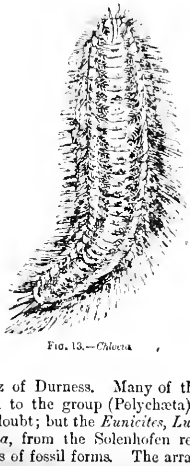


Fig. 13.—*Chloeia.*

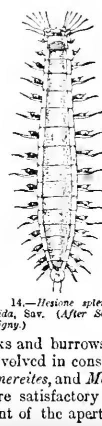


Fig. 14.—*Hesione splendida*, Sav. (*After Savigny.*)

quartz of Durness. Many of the tracks and burrows referred to the group (Polychæta) are involved in considerable doubt; but the *Eunicites*, *Lumbriconereites*, and *Meringosoma*, from the Solenhofen rocks, are satisfactory evidences of fossil forms. The arrangement of the apertures of *Arenicola didyma*, from the Longmynd, in pairs is peculiar.

In regard to beauty of form and colour, complex structure and wonderful habits, the Polychæta are not surpassed by any invertebrate class. The splendid bristles of the Aphroditidæ, constantly glistening with all the hues of a permanent rainbow, the brilliant tints of the Phyllodocidæ, Hesionidæ, and Nereidæ, and the gorgeous branchial plumes of the Terebellidæ, Sabellidæ, and Serpulidæ, can only be compared with the most beautiful types of butterflies and birds.

The class Annelida has been divided into the sections *Branchiata* and *Abranchiata*, the former comprehending the Polychæta, the latter the other groups; but this does not always hold good, since many Polychæta have no branchiæ. The latter, again, have been separated into the Dorsibranchs and Cephalobranchs, the former corresponding to the Maricola, Errantia, or Nereidæ of others, the latter to the Tubicola or Sedentaria. Grube's divisions, Rapacia and Limivora, are based on the nature of their food. In the present state of the department it will suffice to indicate the following families (chiefly after Malmgren) under which the Annelida Polychæta have been ranged, and to refer for further information to the *Annélides* of De Quatrefages, the *Familien* of Grube, the *Chætopoda* of Ehlers, the *Annélides Chétopodes* of Claparède, the *British Museum Catalogue* by Johnston and Baird, and the various works of Kinberg and Malmgren:—Euphrosynidæ, Amphinomidæ (fig. 13), Aphroditidæ, Polynoidæ, Acœtidæ, Sigalionidæ, Nephthydidæ, Phyllodocidæ, Hesionidæ (fig. 14), Alciopidæ, Tomopteridæ (provisionally), Syllidæ, Nereidæ (fig. 1), Staurocephalidæ, Lumbriconereidæ, Eunicidæ (fig. 4), Onuphididæ (fig. 10), Goniadidæ, Glyceridæ, Ariciidæ, Opheliidæ, Scalibregmidæ, Telethusidæ (fig. 20), Sphærodoridæ, Chloræmidæ, Sternaspidæ, Chætopteridæ, Spionidæ (fig. 21), Cirratulidæ, Capitellidæ, Maldanidæ (fig. 9), Ammocharidæ, Hermellidæ, Amphictenidæ (figs. 11 and 12), Ampharetidæ, Terebellidæ, Sabellidæ (fig. 16), Eriographidæ, and Serpulidæ (fig. 15).

Fig. 15.—*Spirorbis nautiloides*, Lamarck.

Fig. 16.—*Sabella vesiculosa*, Mont. (*After Montagu.*)

II. The A. Oligochæta are annelids without tentacles, cirri, or specialised branchial processes. Bristles, variously grouped, from two to eight and upwards in each transverse series. They are hermaphrodite, and the young undergo no metamorphosis.

The body is enveloped in a delicate cuticle resembling that of the Polychæta, and pierced by many pores. Underneath is a cellulo-granular hypoderm, with numerous glands. The setæ are simple, bifid, or hair-like. The muscular layers are an external circular, and an internal longitudinal, marked by the bristle sacs. The foregoing tissues enclose a perivisceral space, with the usual septa and the characteristic corpuscles in a coagulable lymph, which performs important functions in the economy.

The circulatory system consists essentially of a dorsal trunk situated over the digestive chamber, carrying the blood from behind forwards, and a ventral or sub-intestinal conveying the fluid in the opposite direction. The former is broken up into a plexus of vessels in the anterior segments, and generally gives off a large branch (perivisceral) on each side in the others. The perivisceerals in certain segments behind the anterior plexus are enlarged, and so evidently contractile as to have received the name of "hearts," and propel the blood into the ventral vessel. In the other segments the perivisceerals pass to the latter, either with or without division into branches—in the form of cutaneous plexuses, which are greatly developed in this group. Branches pass from the ventral to the intestinal wall, inosculating with others from the dorsal, and forming a rich capillary network. In the *Lumbrici* there is also a third longitudinal vessel underneath the nerve-cord, and it is in communication with both dorsal and ventral, especially by the cutaneous system. The blood is generally reddish, devoid of corpuscles, and coagulable. Respiration seems to be effected by the cutaneous and special plexuses, aided, probably, in some by the currents of water in the ciliated digestive canal.

The digestive system is in the form of a simple straight, more or less muscular tube, differentiated into œsophagus, crop, gizzard, and sacculated intestine in *Lumbricus*, and coated internally with the usual glandular elements (certain glands anteriorly being supposed to be salivary), and lined internally with cilia. In the same group a peculiar closed fold of the chamber constitutes the *typhlosolis* of authors. The anus is situated at the posterior end of the body. In the Limicolous group the structure is less complex—pharynx, œsophagus, and intestine only being present. The nervous system consists of a pair of cephalic ganglia, from each of which a trunk passes by the side of the œsophagus to join the ventral chain, which gives off branches in each segment to the surrounding parts. In *Lumbricus* another small gangliated chain lies over the commencement of the alimentary tract. The nervous system agrees in intimate structure with that of the Polychæta. Besides touch, and in some sight, the special senses are not much developed. Several have epidermal papillæ connected with cutaneous nerves, which probably aid tactile sensibility.

The Oligochæta are hermaphrodite, the sexual elements being developed in certain anterior segments in the form of testicles, deferent canals, receptacles, copulatory papillæ in some males, and ovaries and accessories in the female. In each segment, with a few exceptions (while there are two in each in *Lumbricus*), the segmental organs occur. Claparède thought that in the Limicola the latter are absent from the segments bearing the oviducts and seminal receptacles, but present in those having male organs; while in *Lumbricus* they are present in all the segments except the four last. In some, special glands exist for secreting the egg-capsules. A cincture or clitellum occurs in certain segments anteriorly (in *Lumbricus* from the eighteenth to the twenty-ninth or thirtieth, and in the others from the tenth to the fifteenth segment). The ova are deposited in chitinous capsules (containing one or more), and the young issue therefrom in a tolerably complete condition. Besides the ordinary development by ova, it has long been known that *Nais* and *Chætogaster* exhibit fissiparous reproduction. In *Nais*, after a certain degree of growth has been reached, budding takes place, so that several tolerably complete young forms may be found attached to the adult. The process goes on until the *Nais* has been reduced to twelve or fourteen rings; then a pause occurs, and the animal increases in length to forty or fifty rings, when a new cycle commences by division in the middle of the body. *Chætogaster* shows similar features, the budding taking place between the third and fourth segments in the androgynous form—many zoids or buds being attached in line; but while the second in position is one of the newest, the second in age is near the middle of the series.

Reproduction of lost parts readily takes place in this group. Parasites, such as *Gregarinæ*, *Opalinæ*, Nematoids, and larval cestodes, are met with internally, and *Vorticellæ* are common externally. Commensalism is seen in *Chætogaster*, which lives on the pond-snails (*Limnæus* and *Planorbis*), and *Stylaria* is stated also to be ectoparasitic.

They are distributed over the land and fresh waters (in sand and mud) of the whole world: very few are marine.

Two of the most important classifications are those of D'Udekem and Claparède. The former arranges the suborders according to the gemmiparous, or non-gemmiparous condition of the constituents. The latter group live in earth or mud, are unable to swim or follow their prey, and have always their organs of generation. The former are elegant little worms, living in stagnant or running water, able to swim, and their generative organs are developed only at certain periods. Claparède divides them into two families, viz., the *O. Terricola* (including the earthworm and its allies), and the *O. Limicola*, an arrangement much resembling Grube's *Lumbricina* and *Naidea*.

III. The A. Onychophora are represented by a single aberrant family, *Peripatus*. They are hermaphrodite forms (with claws instead of bristles) approaching the Arthropods, and inhabiting land and moist places in Chili, the West Indies, and other parts. The ventral nerve-cords remain separate.

IV. The A. Discophora (leeches) are ringed forms (fig 17), without lateral appendages (except in *Branchellion*), but possessing an anterior and posterior sucker. There is no specialised respiratory system. They are generally hermaphrodite, and often ectoparasitic.


Fig. 17.—*Hirudo medicinalis*, L.

Externally there is a delicate porous cuticle; beneath lies a thick glandular cutis, which pours out an abundant secretion of mucus, as in the Nemerteans. The muscular system consists of an external circular coat of considerable strength, from which various vertical or decussating bands pass at intervals, powerful longitudinal bundles being held in the intermediate spaces, especially laterally. There are also special muscles connected with the pharynx and other parts. Each end of the body is generally formed into a flattened muscular sucker, consisting apparently of several amalgamated segments. By aid of the latter organs they move from point to point, and they can also progress rapidly by swimming like the Nemerteans. The perivisceral space is quite absent. The circulatory system shows a main dorsal, a ventral, and two lateral trunks, all communicating by branches in each ring. In *Branchiobdella* the blood is corpusculated. The blood is probably aerated on the cutaneous, and perhaps, in some cases, on the digestive surface. The digestive system consists of a mouth opening into the anterior sucker, a muscular pharynx, œsophagus, a large stomach with various cæcal diverticula, and an anus which opens in front of the posterior sucker, though sometimes into it. In some (*e.g.* the common leech), the mouth is furnished with three horny serrated teeth. The nervous system is composed of two cephalic ganglia, which supply branches to the eyes when present, and the usual gangliated ventral cord—giving off branches to the surrounding parts. The gullet passes through the connecting trunks as in the former groups. The last ganglion in the ventral cord of *Clepsine* is larger than the others; and, as in the Polychæta, the ganglia do not always correspond in number with the rings. Other nerves occur in several, *e.g.*, the leech, which has a trunk running along the dorsal surface of the digestive canal. Eye-specks are present in some, and touch is generally much developed. The cupuliform organs in the cutaneous tissues of the head and anterior region in certain leeches are supposed to be connected with the latter sense.

The Discophora are hermaphrodite (with the exception of the *Malacobdellidæ* and *Histriobdellidæ*), with the male organs ranged along the ventral surface in the form of a series of testes, which are connected with a common vas deferens leading into a vesicula seminalis on each side. The latter conveys the fluid into the intromittent organ, and its secretion agglutinates the spermatozoa into a seminal rope or spermatophore. The female organs consist of two ovaries leading to a common duct, opening into the vagina, which receives the spermatophore. The segmental organs are present, but not in direct communication with the reproductive structures, nor do they carry the products to the exterior, since they are often cæcal. The foregoing diverges from the arrangement in the other Annelida, since the generative products are not extruded into a perivisceral cavity, but pass outwards by a particular apparatus. The ova are deposited in capsules formed by special secretions, those of the leech being called cocoons. No metamorphosis occurs in the development of the young, which by-and-by, in some cases, attach themselves in crowds to the abdominal surface of the parent.

The Discophora do not possess much power of regenerating lost parts. They are distributed everywhere, chiefly

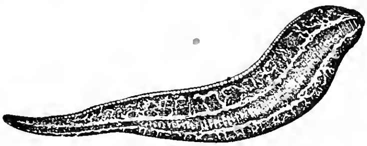


Fig. 18.—*Hirudo medicinalis*, L., var. *officinalis*. The green leech.

in fresh water and moist places; some are marine. A few attain a large size, *e.g.*, a species from Valdivia is described as being two and a half feet long. Many are ectoparasitic, living on fishes, crabs, and even in jelly-fishes (Bolinidæ). In swampy ground in tropical countries certain leeches are often troublesome to travellers. Fossil leeches have been found in the lithographic stones of Germany They have been grouped into five families, viz., Malacobdellidæ, Histriobdellidæ, Acanthobdellidæ, Branchiobdellidæ, and Rhynchobdellidæ—the latter including the medicinal leech of Europe, the green leech (fig. 18), the *Bdella nilotica* of Savigny (fig. 19), the horse-leech, skate-leech, pond-leech, which is devoid of an anterior sucker, and other well-known forms.

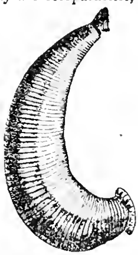


Fig. 19.—*Bdella nilotica*, Sav. (*After Savigny.*)

V. The A. Gephyrea seem to approach the Echinoderms through the Holothuroidea. The body is more or less cylindrical, and, though corrugated, is not definitely segmented. There is generally a protrusible proboscis, having the mouth at the end or at its base; and the anus is terminal or dorsal.

The cuticle is chitinous, has numerous processes of similar composition, longitudinal and transverse rugæ, and many pores. Beneath is a hypoderm containing certain glandular organs or sacs, and, in some, bodies like tricho-cysts. Bristles occur in *Echiurus* and *Bonellia*. The muscular system consists of external circular and internal longitudinal fibres, and special groups of retractor and other muscles of the proboscis. In some the longitudinal layer is arranged in separate bands, stretching from one end of the body to the other. The circulatory system shows a dorsal and ventral vessel, both in the Sipunculidæ communicating with a circular vessel (ciliated internally) surrounding the œsophagus, and sending prolongations into the ciliated tentacles. The latter contains a corpusculated fluid. Certain ciliated infundibuliform organs also occur on the intestinal mesentery of *Sipunculus*, and are thought to be connected with the so-called water-vascular system. In *Echiurus* there is a more distinct circulation, consisting, according to De Quatrefages, of three longitudinal trunks—a dorsal, ventral, and intestinal. The perivisceral cavity is large, with rudimentary dissepiments in some, and contains a corpusculated fluid, which in the living animal shows very lively currents—most marked posteriorly, and generally in a longitudinal direction. In *Bonellia* the respiratory structures open into the latter chamber. Two kinds of excretory organs occur—in some opening into the rectum, and in others into the alimentary cavity anteriorly. The protrusible proboscis is often armed with chitinous processes. The mouth opens at the base of the proboscis in the Echiuridæ, but at its tip in the Sipunculidæ, the latter also having short ciliated tentacles surrounding the aperture. It is followed by a pharynx and much-convoluted alimentary canal lined with cilia. The anus is either terminal, or situated dorsally at a point near the anterior third of the body. The walls of the alimentary canal are glandular, and there are also muscular fibres. The nervous system consists of a ventral cord giving off various branches, but showing no distinct ganglionic enlargements, nor indication of a fusion of two cords. There is an œsophageal collar, but the cephalic ganglia do not seem to be always distinct. There are no organs of the special senses except those of touch, which is fairly developed, and in a few eye-specks, especially in young forms.

The A. Gephyrea are diœcious, and have structures homologous with the segmental organs of the other groups, in the form of a series of tubes or cæca. In the *Sipunculi*, according to Keferstein and Ehlers, there are two testicles, and the ova are developed in ovaries attached to the wall of the body, but they vary in situation in other families. The products fall into the perivisceral cavity. In some the young undergo certain metamorphoses (*Actinotrocha*-form), but in others the larval condition differs from the adult chiefly in the possession of ciliated zones.

The Gephyrea are widely distributed on the surface of the globe, generally in muddy regions, and some are common in empty univalves. They are all marine. They have been grouped in three families: (1.) *Echiuridæ*, containing forms with bristles, such as the common spoon-worm (Echiurus vulgaris) and *Bonellia;* (2.) *Sipunculidæ*, with a dorsal anus, *e.g.*, *Phascolosoma Bernhardi* of the univalve shells; (3.) *Priapulidæ*, with a terminal anus, *e.g.*, *Priapulus caudatus*. *Sternaspis* has lately been removed to the Polychæta, and *Phoronis* has been included in the group as a tubicolar Gephyrean.

The Chætognatha and the higher Turbellaria approach the Annelida proper very closely, though from different points of view, and may be regarded as intermediate between them and the Nematodes, Tematodes, and Cestodes. The Nemerteans (the highest group of the Turbellaria) especially come near the Annelida, notwithstanding the condition of the nervous system. They have cilia externally, and a cutis which secretes similar hyaline tubes to those of many Annelida. The muscular system is greatly developed, and in definite layers, and many swim as freely as the most active leeches. The digestive system intimately agrees, having cilia on the inner surface of the canal, a muscular œsophageal region, and a sacculated intestine, while the glandular and other elements in the wall are very similar; it differs in not passing through a buccal nervous collar, although it lies beneath the nervous system in this region. The circulatory apparatus is fairly developed, and in some corpusculated. The special plexus, in certain forms, in the œsophageal part of the digestive tract points out not only the true function of the vessels (which have been considered a water-vascular system without reference to the cephalic sacs and their ciliated vessels in the Enopla), but shows a close analogy with the anterior plexuses of many Annelida proper and *Balanoglossus*, and even foreshadows the branchial system of certain vertebrates, as seen, for instance, in the young *Petromyzon*. The appending of the branchial system to the anterior end of the digestive is characteristic. Though it is quite inaccurate to say that the Nemerteans have a corpusculated fluid in the general cavity of their bodies, yet a highly organised corpusculated fluid exists in their muscular proboscidian chamber, and evidently performs important functions in their economy Moreover, the remarkable proboscis and its sheath pass through a ring of nervous tissue consisting of the superior and inferior commissures and their connections with the ganglia. The cephalic ganglia are large, and lie over the digestive system, but the nerve-cords are separated throughout. The Nemerteans are chiefly diœcious, and the products of their sexual organs, which are developed in the form of a series of sacs on each side between the muscular wall of the body and the digestive canal, find exit by lateral pores, the contents of the male organs being often vented in clouds, as in *Hermella*. The young sometimes undergo a metamorphosis, *e.g.*, the *Pylidium*-development of certain Anopla. To this the *Tornaria*-condition of *Balanoglossus* and the *Actinotrocha*-state of certain Gephyrea show similar features; and the three forms lead by separate channels to the Annelids proper There is little analogy with the Tunicates, but the similarity of the development of certain Echinoderms to the three forms just mentioned is eminently suggestive.

Finally the Annelida as a whole show certain general features which may be grouped under three heads—(1.) The uses of the class to man; (2.) The property of phosphoresence; and (3.) The power of boring into hard substances.

The Annelida are not devoid of value in an economical sense. All round the British and many other coasts the lobworm (*Arenicola marina*, fig. 20) is used as bait; and here and there *Nephthys cœca* and *Nereilepas fucata*. In the Channel and Channel Islands two of the most plentiful of the Nereidæ (*Nereis cultrifera* and *N. diversicolor*) are extensively employed in fishing.

Fig 20. — *Arenicola marina*, L.

They are constantly sought for between tide-marks with a pointed instrument resembling a spear, and kept in vessels amongst sand and seaweeds. One of the most esteemed baits in ordinary and in conger fishing in the same regions is the large *Marphysa sanguinea*. The anterior segments of the living annelid only are preserved, since the posterior region is apt to decay and cause the death of the whole. The natives of the Fiji group much relish a form allied to our *Lysidice ninetta*, and they predict its annual appearance in their seas by observing the phases of the moon. It is called Palolo by the Samoans and Tonguese, and Mbalolo by the Fijians. Occurring in vast numbers, formal presents of the esteemed food are sent by the fortunate chiefs considerable distances to those whose dominions are not visited by the annelid. If the latter has similar habits to the British *Lysidice*, it probably leaves its retreats in the coral-reefs and rocks for the purposes of reproduction. The extensive use of the *Lumbrici* in fresh-water fishing, and that of the leech in medicine, need only be alluded to—the latter forming a considerable item in British importations. *Echiurus* is employed as bait by the Belgian fishermen, and Pallas records that the natives of the same coast formerly considered the muscular proboscis of the sea-mouse good food. Lastly, a *Sipunculus* is eaten by the Chinese. An examination, again, of the stomachs of our most valuable fishes shows the important part played by the Annelida in their food-supply; and the large number of species of fish which can be speedily captured on a rich coast with bait of *Nereis cultrifera* is ample corroboration. The stomachs of cod and haddock, for instance, are often quite filled with sea-mice with Polynoidæ, Terebellidæ, *Alitta virens*, *Owenia*, *Trophonia*, *Phascolosoma*; and in fresh water those of trout with *Lumbrici*.

The property of phosphorescence occurs in the families Polynoidæ, Syllidæ, Chætopteridæ, and in *Polycirrus* and *Lumbricus*. In the first-mentioned, light greenish and somewhat steady scintillations are given off at the attachment of each scale, and the separate organ gleams with pulsations of light at the ruptured surface. It was probably the latter appearance which caused M. de Quatrefages to state that it was emitted in muscular contraction. The synchronous emissions of light by the Italian fire-flies is interesting in this respect. In the Syllidæ the light comes from the under surface of each foot; in *Chætopterus* the most vivid luminosity is on the dorsum of the tenth segment; and *Polycirrus* is so phosphorescent, that the slightest tremor in the water causes vivid pale bluish fire to gleam along every tentacle. The exact physiology of the luminosity is still open to investigation, though P. Panceri of Naples connects it with certain fatty granules. The luminous emissions have no connection with light or darkness, with the capture of prey, or the alluring of their enemies, nor with the illumination of the depths of the sea.

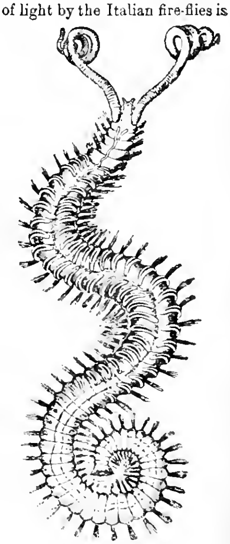


Fig 21.—*Polydora ciliata*, Johnst.

Boring and burrowing in sand, mud, and earth are very general in the Annelida. *Glycera* and *Nephthys*, for instance, disappear with great rapidity amongst sand by boring with their proboscides, the former passing its elongated organ through a considerable space in a single thrust. *Eteone* and *Ammotrypane* carry their bodies swiftly through moist sand and gravel. Others penetrate muddy clay and the debris in fissures of rocks. The labours of the earthworm in passing through the soil only require indication; and the Gephyrea and some leeches show the same habits in clay and mud. Certain Polychæta and Gephyrea have also the power, in common with cirripedes, molluscs, Bryozoa, and sponges, of perforating rocks, stones, shells, and other solid media. The most conspicuous forms are *Polydora* (fig. 21), *Dodecaceria*, *Sabella saxicava*, and *Phascolosoma Johnstoni*. Though such annelids are very abundant in corals, limestone, chalk, and shells, yet their occurrence in large numbers in aluminous shale and sandstone shows that their perforations are not necessarily due to an acid. The influence of the boring annelids in disintegrating the foregoing substances is considerable. (W. C. M.)

ANNESLEY, ARTHUR. See ANGLESEA, Earl of.

ANNI, or ANI, the ancient *Abnicum*, a ruined city of Turkey in Asia, in Armenia, situated about 25 miles E.S.E. of Kars, in a rocky ravine, past which the Arpa-Chai, a tributary of the Aras or Araxes, flows. The private houses of Anni are now little more than heaps of loose stones, but in the ruins of the public buildings there is still ample evidence of the former size and greatness of the city. Several churches, mosques, and a building which was probably the palace, as well as the massive walls of the city, are the most perfect and conspicuous remains at Anni, and exhibit many points of great architectural beauty. Anni was the capital of the Pakradian or Bagratian dynasty of Armenian kings, and under their rule reached the height of its greatness. Alp Arslan captured it in 1064, and handed it over to a tribe of Kurds, from whom it was taken by the Georgians. In 1319 an earthquake completed the misfortunes of the city, reducing it to the state in which it now exists.

ANNO BOM, or ANNABONA, a small island off the west coast of Africa, situated in lat. 1° 24′ S. and long. 5° 35′ E., 190 miles west of Cape Lopez. Its length is about four miles, its breadth two; and, rising in some parts to a height of nearly 3000 feet above the sea, it presents a succession of beautiful valleys and steep mountains, that are covered with rich woods and luxuriant vegetation. The inhabitants, who probably amount to about 3000, are negroes, very ignorant, but professing a belief in the Roman Catholic faith. Their chief town, a village on the north-east of the island, is merely a collection of rude huts, with an equally barbarous chapel. The roadstead is tolerably safe, and passing vessels frequently take advantage of it in order to obtain water and fresh provisions, of which Anno Bom contains an abundant supply. The island was discovered by the Portuguese on the 1st of January 1473, from which circumstance it received its name, "Dia de Anno Bom," being the Portuguese term for New-Year's day. It is claimed both by Spain and Portugal, but neither of these nations exercises any authority in the island, which is governed by a native, or rather it is said by a body of five natives, each of whom holds the office of governor in turn, during the period that elapses till ten ships touch at the island.

ANNONAY, a town of France, in the department of Ardèche, irregularly but picturesquely built on several small hills at the confluence of the rivers Canse and Deôme, 37 miles south of Lyons. It contains few buildings that are worthy of notice, although an obelisk in honour of the celebrated brothers Montgolfier, inventors of the balloon, who were natives of the place, and the Gothic church of Trachi, built in the 14th century, deserve to be mentioned. The manufactures of Annonay are among the most important in the department, the chief being those of paper, long considered to be the best in France, and glove leather, while cotton, woollen, and silk goods are also produced. Population, 18,445.

ANNUITIES

BY an annuity is meant a periodical payment, made annually, or at more frequent intervals, either for a fixed term of years, or during the continuance of a given life, or a combination of lives, as will be more fully explained further on. In technical language an annuity is said to be payable for an assigned *status*, this being a general word chosen in preference to such words as "time," "term," or "period," because it may include more readily either a term of years certain, or a life or combination of lives. The magnitude of the annuity is the sum to be paid (and received) in the course of each year. Thus, if £100 is to be received each year by a person, he is said to have "an annuity of £100." If the payments are made half-yearly, it is sometimes said that he has "a half-yearly annuity of £100;" but to avoid ambiguity, it is more commonly said he has an annuity of £100, payable by half-yearly instalments. The former expression, if clearly understood, is preferable on account of its brevity. So we may have quarterly, monthly, weekly, daily annuities, when the annuity is payable by quarterly, monthly, weekly, or daily instalments. An annuity is considered as accruing during each instant of the status for which it is enjoyed, although it is only payable at fixed intervals. If the enjoyment of an annuity is postponed until after the lapse of a certain number of years, the annuity is said to be deferred. When an annuity is deferred for any number of years, say n, it is said, indifferently, to commence, or to be entered upon, after n years, or to run from the end of n years; and if it is payable yearly, the first payment will be made at the end of $(n+1)$ years; if half-yearly, the first half-yearly payment will be made at the end of $(n+\frac{1}{2})$ years; if quarterly, the first quarterly payment will be made at the end of $(n+\frac{1}{4})$ years; and so on. If an annuity, instead of being payable at the end of each year, half-year, &c., is payable in advance, it is called an annuity-due.

If an annuity is payable for a term of years independent of any contingency, it is called an annuity certain; if it is to continue for ever, it is called a perpetuity; and if in the latter case it is not to commence until after a term of years, it is called a deferred perpetuity. An annuity depending on the continuance of an assigned life or lives, is sometimes called a life annuity; but more commonly the simple term "annuity" is understood to mean a life annuity, unless the contrary is stated. A life annuity, to cease in any event after a certain term of years, is called a temporary annuity. The holder of an annuity is called an annuitant, and the person on whose life the annuity depends is called the nominee.

If not otherwise stated, it is always understood that an annuity is payable yearly, and that the annual payment (or rent, as it is sometimes called) is £1. Of late years, however, it has become customary to consider the annual payment to be, not £1, but simply 1, the reader supplying whatever monetary unit he pleases, whether pound, dollar, franc, thaler, &c. It is much to be desired that this course should be followed in any tables that may be published in future.

The annuity, it will be observed, is the totality of the payments to be made (and received), and is so understood by all writers on the subject; but some have also used the word to denote an individual payment (or rent), speaking, for instance, of the first or second year's annuity,—a practice which is calculated to introduce confusion, and should therefore be carefully avoided.

The theory of annuities certain is a simple application of algebra to the fundamental idea of compound interest. According to this idea, any sum of money invested, or put out at interest, is increased at the end of a year by the addition to it of interest at a certain rate; and at the end of a second year, the interest of the first year, as well as the original sum, is increased in the same proportion, and so on to the end of the last year,—the interest being, in technical language, converted into principal yearly. Thus, if the rate of interest is 5 per cent., £1 improved at interest will amount at the end of a year to £1·05, or, as we shall in future say, in conformity with a previous remark, 1 will at the end of a year amount to 1·05. At the end of a second year this will be increased in the same ratio, and then amount to $(1·05)^2$. In the same way, at the end of a third year, it will amount to $(1·05)^3$, and so on.

Let i denote the interest on 1 for a year; then at the end of a year the amount of 1 will be $1+i$. Reasoning as above, at the end of two years the amount will be $(1+i)^2$, at the end of three years $(1+i)^3$, and so on. In general, at the end of n years the amount will be $(1+i)^n$; or this is the amount of 1 at compound interest in n years. The present value of a sum, say 1, payable at the end of n years, is such a sum as, being improved at compound interest for n years, will exactly amount to 1. We have seen that 1 will in n years amount to $(1+i)^n$, and by proportion we easily see that the sum which in n years will amount to 1, must be $\frac{1}{(1+i)^n}$, or $(1+i)^{-n}$ It is usual to put v for $\frac{1}{1+i}$, so that v is the value of 1 to be received at the end of a year, and v^n the value of 1 to be received at the end of n years.

Since 1 placed out at interest produces i each year, we see that a perpetuity of i is equal in value to 1; hence, by proportion, a perpetuity of 1 is equal in value to $\frac{1}{i}$. At 5 per cent., $i=·05$, and $\frac{1}{i}=20$; or a perpetuity is worth 20 years' purchase: at 4 per cent., it is worth 25 years' purchase, $\left(\frac{1}{·04}=25\right)$: at 3 per cent., it is worth $33\frac{1}{3}$ years' purchase, $\left(\frac{1}{·03}=33\frac{1}{3}\right)$.

Instances of perpetuities are the dividends upon the public stocks in England, France, and some other countries. Thus, although it is usual to speak of £100 consols, this £100 is a mere conception or ideal sum; and the reality is the £3 a year which the Government pays by half-yearly instalments. The practice of the French in this, as in many other matters, is more logical. In speaking of their public funds, they do not mention the ideal capital sum, but speak of the annuity or annual payment that is received by the public creditor. Other instances of perpetuities are the incomes derived from the debenture stocks now issued so largely by various railway companies, also the feu-duties commonly payable on house property in Scotland. The number of years' purchase which the perpetual annuities granted by a government or a railway company realise in the open market, forms a very simple test of the credit of the various governments or railways. Thus at the present time (May 1874) the British perpetual annuity of £3, derived from the 3 per cent. consols, is worth £93, or 31 years' purchase; and a purchaser thus obtains 3·226 per cent. interest on his investment. Other examples are given in the subjoined tables, the figures in which are deduced from the Stock Exchange quotations of the irredeemable stocks issued by the various governments:—

Name.	No. of Years'. Purchase.	Interest per cent. yielded to a Purchaser.
British,	31·00	3·23
Dutch,	23·69	4 22
Swedish,	21·20	4·72
Russian,	20·40	4 90
French,	19·67	5·08
Brazilian,	20·00	5·00
Portuguese,	15·42	6·48
Argentine,	13·50	7·41
Austrian,	13·40	7·46
Italian,	13·00	7·69
Turkish,	9·50	10·53
Spanish,	6·67	15·00
Venezuelan,	3·50	28·57

The following are a few other examples of perpetuities:—

Name.	No. of Years' Purchase.	Interest per cent yielded to a Purchaser
Metropolitan Board of Works Stock,	27·50	3·64
London and N.W. Railway Debenture Stock,	25·75	3·88
North British Railway Debenture Stock,	23·50	4·26
Edinburgh Water Annuities,	22·58	4·43

We may mention in passing that the more usual practice of foreign governments when borrowing is not to grant the lender a perpetual annuity, but to issue to him bonds of say £100 each, bearing an agreed rate of interest, these bonds being usually issued at a discount, and redeemed at par by annual drawings during a specified term of years.

We have seen that the present value of any sum payable at the end of n years is found by multiplying it by $(1+i)^{-n}$; hence the value of a perpetuity of 1 deferred n years is $\frac{(1+i)^{-n}}{i}$. Now an annuity for n years is clearly the difference between the value of a perpetuity to commence at once and a perpetuity deferred n years; its value is therefore $\frac{1}{i}-\frac{(1+i)^{-n}}{i}=\frac{1-(1+i)^{-n}}{i}$; or putting a for the value of the annuity, we have—

$$a=\frac{1-(1+i)^{-n}}{i}$$

By means of this equation, having any two of the three quantities, a, i, n, we can determine the third either exactly or approximately. Thus for n we have—

$$n=-\frac{\log\ (1-ia)}{\log\ (1+i)}.$$

There is no means of determining the value of i exactly, but it may be found to any degree of accuracy required by methods of approximation which our limits will not allow us to describe.[1]

[1] A similar difficulty meets us in many other cases, as, for instance, when we wish to determine the rate of interest, having given the amount of an annuity for a given term, or the value of an annuity or perpetuity deferred for a certain number of years. The reader who wishes to pursue this subject is referred to Francis Baily's *Doctrine of Interest and Annuities*, 1808, in the appendix to which the formulas of previous authors are examined, and new ones, which are at once simpler and more correct, are demonstrated. Particular cases of the problem are considered in Turnbull's *Tables of Compound Interest and Annuities*, p. 132, and in various papers in the *Assurance Magazine*, among which may be specified De Morgan's paper "On the Determination of the Rate of Interest of an Annuity," vol. viii. p. 61, and a letter by J. M'Lauchlan in the eighteenth volume. The analogous

If the annuity for n years is not to be enjoyed at once, but only after the lapse of t years, its value will be reduced in the proportion of 1 to the value of 1 payable in t years, or $1 : (1+i)^{-t}$; and the value of the deferred annuity to continue for n years is therefore—

$$\frac{(1+i)^{-t}}{i}\{1-(1+i)^{-n}\}.$$

It remains to find the amount at compound interest at the end of n years of an annuity payable for that term. The amount of 1 in n years being $(1+i)^n$, its increase in that time is $(1+i)^n - 1$; but this increase arises entirely from the simple interest, i, of 1 being laid up at the end of each year and improved at compound interest during the remainder of the term. Hence it follows that the amount at compound interest of an annuity of i in n years must be $(1+i)^n - 1$; and by proportion the amount of an annuity of 1 similarly improved will be $\frac{(1+i)^n-1}{i}$

One of the principal applications of the theory of annuities certain is the valuation of leasehold property; another is the calculation of the terms of advances in consideration of an annuity certain for a term of years. At present a large sum of money is annually borrowed by corporations and other public bodies upon the security of local rates in the United Kingdom. It is sometimes arranged in these transactions that a fixed portion of the loan shall be paid off every year; but it is more commonly the case that, in consideration of a present advance, an annuity is granted for a term of years, usually 25 or 30, but in some instances extending to 50. Landed proprietors also, who possess only a life interest in their property, have been authorised by various Acts of Parliament to borrow money for the purpose of improving their estates, and can grant a rent-charge upon the fee-simple for a term not exceeding 30 years. These are very favourite investments with the life insurance companies of the country, as they are thus enabled to obtain a somewhat higher interest—from $4\frac{1}{4}$ to $4\frac{3}{4}$ per cent.—than they could obtain upon ordinary mortgages with equally good security; the reason for this, of course, being that these loans are not so suitable as others for private lenders. In this case, as in all others, the price is determined by the laws of supply and demand; and the number of lenders being less than in the case of ordinary mortgages, the terms paid by the borrowers are higher. When a loan is arranged in this way, it is desirable for various purposes, and in particular for the ascertainment of the proper amount of income-tax, to consider each year's payment as consisting partly of interest on the outstanding balance of the loan and partly as an instalment of the principal. The problem of determining the separate amounts of these has been considered by Turnbull, *Tables*, p. 128; and by Gray, *Ass. Mag.*, xi. 172.

In making calculations for these and similar purposes, it is but seldom necessary to use the formulas given above. The computer usually has recourse to one of the tables which have been published, containing values and amounts calculated for various rates of interest. An extensive set of tables of this kind was published in 1726 by John Smart; and many subsequent writers, as Dr Price, Baily, Milne, Davies, D. Jones, J. Jones, have reprinted or abridged portions of these tables. They show the amount and the present value both of a payment and of an annuity of £1 for every term of years not exceeding 100, at the several rates of interest, 2, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4, 5, 6, 7, 8, 9, 10 per cent.; the five most important tables giving—

(1.) The amount of £1 in any number of years, n; or $(1+i)^n$.

(2.) The present value of £1 due in any number of years, n; or $(1+i)^{-n}$.

(3.) The amount of an annuity of £1 in any number of years, n; or $\frac{(1+i)^n-1}{i}$.

(4.) The present value of an annuity of £1 for any number of years, n; or $\frac{1-(1+i)^{-n}}{i}$.

(5.) The annuity which £1 will purchase for any number of years, n; or $\frac{i}{1-(1+i)^{-n}}$.

The scheme would be more complete if we add, with Corbaux, whose tables will be described below—

(6.) The annuity which would amount to £1 in n years; or $\frac{i}{(1+i)^n-1}$.

Smart gives the values of these functions not only for all integral values of n up to 100, but also for the half-years. In this respect, however, he has not been followed by subsequent writers. Some (as Milne) have stated that he "has given the amounts and the present values both of sums and annuities certain, wrong for every odd number of half-years." This remark requires some explanation. The fact is that Smart's tables are quite correct, but are not applicable according to the conventions that are usually observed in practice. Thus, for example, he gives the amount of 1 at the end of half a year at 4 per cent. interest as equal to $\sqrt{1\cdot04}=1\cdot01980390$, this being the strictly correct theoretical value at 4 per cent. interest. But in practice the invariable rule is, when interest is calculated for a shorter term than a year, to take a proportionate part of the year's interest, thus virtually charging a higher rate for the odd time, so that in the above case the amount at the end of half a year will be 1·02. This circumstance renders it undesirable to tabulate the amounts and values for half-years; and this is never now done. The course adopted by Smart of giving the values and amounts of annuities for the odd half-years is open to more serious objection. His figures in these cases are merely the values of the algebraical functions above given, corresponding to the values of n, $\frac{1}{2}$, $1\frac{1}{2}$, $2\frac{1}{2}$, &c., and do not give the amounts and values of annuities payable half-yearly. In fact, we are unable to see that any practical use could ever be made of his results in these cases.

The following table, on p. 75, in which the rate of interest is 5 per cent., will serve to illustrate the nature of the tables in question, as reprinted by Baily, D. Jones, and others.

It will be seen that the figures in the column numbered (2) are the reciprocals of those in (1), and the figures in column (5) the reciprocals of those in (4). Also, that the figures in (4) are the sums of the first 1, 2, 3, &c., terms of (2). Again, the figures in (3) are derived by the successive addition of those in (1) to the first term, 1·000000; and the figures in (4) are equal to the product of those in (2) and (3). We have added the column (6) from Corbaux's tables. These figures are the reciprocals of those in (3), and are equal to the product of those in (5) and (2), while the figures in (5) are the products of those in (1) and (6).

It would perhaps be more convenient in practice if tables (3) and (6) were altered so as to relate to annuities payable in advance (or annuities-due). In that case (3) would give the amount at compound interest in n years of an annuity-due of 1, and (6) the annuity-due which would, at compound interest, amount to 1 in n years; that is to say, the values of the functions $\frac{(1+i)^{n+1}-1-i}{i}$ and $\frac{i}{(1+i)^{n+1}-1-i}$, respectively. One very common application of table (3) is to find the amount of the premiums paid upon a life policy, and these premiums are always payable in advance. If that table were arranged as here suggested, the figures contained in it would be derived from those in (1), in precisely the same way as

problem of determining the rate of interest in the bonds of foreign governments above mentioned, debentures, and similar securities, has been fully treated of by Gray, *Ass. Mag.*, xiv. 91, 182, 397; and by Makeham, xviii. 132.

Table of Amounts, Present Values, &c., at 5 per cent. Interest.

$i = \cdot 05.$

n	(1) $(1+i)^n$	(2) $(1+i)^{-n}$	(3) $\frac{(1+i)^n-1}{i}$	(4) $\frac{1-(1+i)^{-n}}{i}$	(5) $\frac{i}{1-(1+i)^{-n}}$	(6) $\frac{i}{(1+i)^n-1}$
1	1·05000000	·95238095	1·00000000	·95238095	1·05000000	1·0000000
2	1·10250000	·90702948	2·05000000	1·85941043	·53780488	·4878049
3	1·15762500	·86383760	3·15250000	2·72324803	·36720856	·3172085
4	1·21550625	·82270247	4·31012500	3·54595050	·28201183	·2320118
5	1·27628156	·78352616	5·52563125	4·32947667	·23097480	·1809748
6	1·34009564	·74621540	6·80191281	5·07569207	·19701747	·1470175
7	1·40710042	·71068133	8·14200845	5·78637340	·17281982	·1228193
8	1·47745544	·67683936	9·54910883	6·46321276	·15472181	·1047218
9	1·55132822	·64460892	11·02656432	7·10782167	·14069008	·0906901
10	1·62889463	·61391325	12·57789254	7·72173493	·12950458	·0795050

(4) from (2). It would also be an improvement, for a reason to be mentioned presently, if the heading of the tables were altered, so that, for example, instead of (1) being called a table of the amounts of "£1" at the end of any number of "years," it were called a table of the amounts of "1" at the end of any number of "terms."

It is not to be understood that the tables are arranged in the manner here shown. Smart gives, in his First Table of Compound Interest, the values of our (1) for the various rates of interest arranged side by side; in his Second Table he gives the values of our (2) at different rates of interest similarly arranged; and so for (3), (4), and (5). This arrangement has been followed by most authors, not only by those mentioned above as having copied Smart's tables, but also by Chisholm, who states that the compound interest tables in his work (*Commutation Tables*, 1858) have been specially computed for it. He gives the tables (1), (2), (3), (4), and (5), at the rates of interest 3, 3½, 4, 5, 6 per cent., to any number of years up to 105. Hardy's *Doctrine of Simple and Compound Interest*, 1839, contains tables (1), (2), (3), (4), for the rates of interest ¼, ½, ¾, 1, 1¼, 1½, 1¾, 2, 2¼, 2½, 2¾, 3, 3¼, 3½, 3¾, 4, 4¼, 4½, 4¾, 5, 6, 7, and 8 per cent., for any number of years up to 100. The arrangement in our specimen is that adopted by Rance in his *Tables of Compound Interest*, 1852. He gives tables (1), (2), (3), and (4), at rates of interest proceeding, by steps of ¼ per cent., from ¼ to 10 per cent., for any number of years from 1 to 100. The same arrangement is also followed in the tables appended to Francis Corbaux's *Doctrine of Compound Interest*, 1825; but this author gives in one opening of the book not only the six tabular results in our specimen, but also the corresponding results when interest at the nominal rate of 5 per cent. is payable half-yearly and quarterly, thus giving in one opening 24 tabular results side by side. He gives results for every quarter of a year up to 16 years, and then for each year up to 100; and his rates of interest range from 3 to 6 per cent., at intervals of ¼ per cent. The only other tables we think it needful to mention are Turnbull's, 1863. His work gives tables (1), (2), (3), (4), and (5), for the rates of interest 3, 3½, 4, 4½, 5, and 6, payable yearly; for 3, 3¼, 3½, 3¾, 4, 4¼, 4½, 4¾, 5, 5½, payable half-yearly; and 3, 3½, 4, 4½, 5, 6, payable quarterly. The results extend in every case to 80 terms of conversion—that is, 80 years, 80 half-years, and 80 quarters respectively. The arrangement of the tables differs from that of all the others mentioned, as each page contains only the results pertaining to one table at one rate of interest. The results are given not only in decimals, but in £ *s. d.* in addition, which also is unusual.

A few words may be here added as to the practical method of constructing compound interest tables. The formulas we have found above are not directly used for the calculation of the greater part of the tabular results; but these are in practice deduced the one from the other by continuous processes, the values found by the formulas being used at intervals for the purpose of verification. Smart gives, on page 47 of his work, a description of the method he has employed, and the subject has been fully dealt with by Gray in his *Tables and Formulæ*, chap. 2. Since the publication of that work, the Arithmometer of M. Thomas (of Colmar) has come into extensive use for the formation of tables of this kind. For a description of the instrument, and some of its uses, the reader is referred to the papers in the *Assurance Magazine* by Major-General Hannyngton, vol. xvi. p. 244; Mr W. J. Hancock, xvi. 265; and by Gray, xvii. 249; xviii. 20 and 123.

Hitherto we have considered the annuity payments to be all made annually; and the case where the payments are made more frequently now requires attention. First, suppose that the annuity is payable by half-yearly instalments; then, in order to find the present value of the annuity, we have first to answer the question, What is the value of a sum payable in six months' time? and, in order to find the amount of the annuity in n years, we must first determine what is the amount of a sum at the end of six months. The annual rate of interest being i, it may be supposed at first sight that the amount of 1 at the end of six months will be $1+\frac{i}{2}$; but if this were the case, the amount at the end of a second period of six months would be increased in the same proportion, and be $\left(1+\frac{i}{2}\right)^2$, or $1+i+\frac{i^2}{4}$. But this is contrary to our original assumption that the annual interest is i, and the amount at the end of a year therefore $1+i$. In fact, if we suppose the interest on 1 for half a year to be $\frac{i}{2}$, the interest on it for a year will not be i, but $i+\frac{i^2}{4}$. In order that the amount at the end of a year may be $1+i$, the amount at the end of six months must be such a quantity as, improved at the same rate for another six months, will be exactly $1+i$; hence the amount at the end of six months must be $\sqrt{1+i}$, or $(1+i)^{\frac{1}{2}}$. Reasoning in the same way, it is easy to see that, the true annual rate of interest being i, the amount of 1 in any number of years, n, whether integral or fractional, will always be $(1+i)^n$. Hence, by similar reasoning to that pursued above, the present value of 1 payable at the end of any number of years, n, whether integral or fractional, will always be $(1+i)^{-n}$ or v^n.

It is now easily seen—we omit the demonstrations for the sake of brevity—that the present value of an annuity payable half-yearly for n years (n being integral) is $\frac{\sqrt{1+i}+1}{2} \cdot \frac{1-(1+i)^{-n}}{i}$; and that the amount of a similar annuity at the end of n years is $\frac{\sqrt{1+i}+1}{2} \cdot \frac{(1+i)^n-1}{i}$.

It is to be observed, however, that when we are dealing with half-yearly payments in practice, the interest is never calculated in the way we have here supposed. On the contrary, the nominal rate of interest being i, the rate paid half-yearly is $\frac{i}{2}$, so that the true annual rate in practice is $i+\frac{i^2}{4}$; for instance, if interest on a loan is payable half-yearly, at the rate of 5 per cent. per annum, the true rate of interest is ·050625, or £5, 1s. 3d. per £100. Under these circumstances interest is said to be convertible into principal twice a year. Assuming that interest is thus convertible m times a year, the rate of interest for the m^{th} part of a year will be $\frac{i}{m}$, and the amount of 1 at the end of n years, that is, at the end of mn intervals of conversion, will be $\left(1+\frac{i}{m}\right)^{mn}$. Assuming the number m now to increase indefinitely, or interest to be convertible momently, the above amount becomes $\epsilon^{i n}$, where ϵ is the base of the natural (or Napierian) logarithms.

In consequence of the above-mentioned practice as to half-yearly interest, the values given in Smart's tables for the odd half-years, though theoretically correct, are practically useless, and they have been superseded by the other tables above mentioned. It is important, however, always to bear in mind that when interest is thus payable half-yearly or quarterly, the true rate of interest exceeds the nominal. From want of attention to this point, the subject has become involved in much confusion, not to say error, in the works of Milne and some other writers.

It is easily seen from the above formula that the amount of 1 in mn years, at the rate of interest $\frac{i}{m}$, is the same as that of 1 in n years, at the rate of interest i convertible m times a year; and a similar property holds good of present values. Hence, the tables calculated at the rate of interest $\frac{i}{m}$ may be used to find the amounts and present values at the rate i convertible m times a year; for example, the tables calculated for interest 2 per cent. will give the results for 4 per cent. payable half-yearly. For this reason it would be an improvement, as remarked above, to use the word "terms" in the headings of the tables instead of "years."

We pass on now to the consideration of the theory of life annuities. This is based upon a knowledge of the rate of mortality among mankind in general, or among the particular class of persons on whose lives the annuities depend. If a simple mathematical law could be discovered which the mortality followed, then a mathematical formula could be given for the value of a life annuity, in the same way as we gave above the formula for the value of an annuity certain. In the early stage of the science, Demoivre propounded the very simple law of mortality which bears his name, and which is to the effect, that out of 86 children born alive 1 will die every year until the last dies between the ages of 85 and 86. The mortality, as determined by this law, agreed sufficiently well at the middle ages of life with the mortality deduced from the best observations of his time; but, as observations became more exact, the approximation was found to be not sufficiently close. This was particularly the case when it was desired to obtain the value of joint life, contingent, or other complicated benefits. Demoivre's law is now, accordingly, entirely a thing of the past, and does not call for any further notice from us. Assuming that law to hold, it is easy to obtain the formula for the value of an annuity, immediate, deferred, or temporary; but such formulas are entirely devoid of practical utility. Those who are curious on the subject may consult the paper by Charlon, *Ass. Mag.*, xv. 141. In vol. vi. p. 181, will be found an investigation by Gray of the formula for the value of an annuity when the mortality table is supposed to follow a somewhat more complicated law. No simple formula, however, has yet been discovered that will represent the rate of mortality with sufficient accuracy, and those which satisfy this condition are too complicated for general use.

The rate of mortality at each age is, therefore, in practice usually determined by a series of figures deduced from observation; and the value of an annuity at any age is found from these numbers by means of a series of arithmetical calculations. Without entering here on a description of the manner of making these observations and deducing the rate of mortality, and of the construction of "Mortality Tables," we append, for the sake of illustration, one of the earliest tables of this kind, namely, that of Deparcieux, given in his *Essai sur les Probabilités de la Durée de la Vie Humaine*, 1746.

Age. x	Number living. l_x	Number dying in the next year. d_x	Age. x	Number living. l_x	Number dying in the next year. d_x	Age. x	Number living. l_x	Number dying in the next year. d_x
3	1000	30	34	702	8	65	395	15
4	970	22	35	694	8	66	380	16
5	948	18	36	686	8	67	364	17
6	930	15	37	678	7	68	347	18
7	915	13	38	671	7	69	329	19
8	902	12	39	664	7	70	310	19
9	890	10	40	657	7	71	291	20
10	880	8	41	650	7	72	271	20
11	872	6	42	643	7	73	251	20
12	866	6	43	636	7	74	231	20
13	860	6	44	629	7	75	211	19
14	854	6	45	622	7	76	192	19
15	848	6	46	615	8	77	173	19
16	842	7	47	607	8	78	154	18
17	835	7	48	599	9	79	136	18
18	828	7	49	590	9	80	118	17
19	821	7	50	581	10	81	101	16
20	814	8	51	571	11	82	85	14
21	806	8	52	560	11	83	71	12
22	798	8	53	549	11	84	59	11
23	790	8	54	538	12	85	48	10
24	782	8	55	526	12	86	38	9
25	774	8	56	514	12	87	29	7
26	766	8	57	502	13	88	22	6
27	758	8	58	489	13	89	16	5
28	750	8	59	476	13	90	11	4
29	742	8	60	463	13	91	7	3
30	734	8	61	450	13	92	4	2
31	726	8	62	437	14	93	2	1
32	718	8	63	423	14	94	1	1
33	710	8	64	409	14	95	0	

It is to be understood from this table that the mortality among the persons observed was such that out of every 1000 children alive at the age of 3, 30 died before attaining the age of 4, leaving 970 alive at 4; 22 died between the ages of 4 and 5, leaving 948 alive at the age of 5; and so on, until one person is left alive at the age of 94, who died before attaining the age of 95.

For the purpose of explaining more fully the method of finding the value of a life annuity, it will be convenient, in the first instance, to establish the two following lemmas.

LEMMA 1. *To find the value of a sum to be received at a future time in the event of the happening of a given contingency.*—Suppose that the sum of 1 is to be received in n years' time, provided that a certain event shall then happen (or shall have then happened), the probability of which is p. We have seen that the value of 1 to be certainly received in n years' time is v^n. In order to introduce the idea of probability into the problem, suppose that $p=\frac{a}{a+b}$, so that there are a cases favourable to the happening of the assumed event, and b unfavourable, the total number of possible cases, all of which are equally probable, being $(a+b)$. We may suppose, for instance, that there are $(a+b)$ balls in a bag, of which a are white and b black; and that 1 is to be received if a white ball is drawn. In order to determine the value of the chance of receiving 1 in consequence of a white ball being drawn, suppose that $(a+b)$ persons draw each one ball, and that every one who draws a white ball receives 1; then the total sum to be received is a, and the value of the expectation of all the $(a+b)$ persons who draw is also a. But it is clear that each of the persons has the same chance of drawing a white ball, therefore the value of the expectation of each of them is $\frac{a}{a+b}=p$. This is the value of the chance of receiving 1 immediately before the drawing is made in

n years' time; the value at the present time will therefore be $v^n p$. We may also arrive at this result as follows: The same suppositions being still adhered to, the present value of the sum a to be distributed at the end of n years is av^n; and each of the $(a+b)$ persons having the same chance of receiving 1, the value of the expectation of each is $\frac{a}{a+b}v^n = pv^n$.

LEMMA 2. *To find the present value of 1 to be received in n years' time, if a specified person, whose age is now x, shall be then living.*—The sum to be received in this case is called an *endowment*, and the person on whose life it depends is called the *nominee*. The probability that the nominee will be alive is to be found, as already intimated, by means of a mortality table. Out of the various tables of this nature that exist, that one must be chosen which, it is believed, most faithfully represents the probabilities of life of the class of persons to which the nominee belongs. Suppose we have reason to believe that Deparcieux's table, above given, is the most suitable in the case before us,—that the age of the nominee is 30, and the term of years 10. Then, observing that, according to Deparcieux's table, the number of persons living at the age 30 is 734, while the number at the age 40 is 657, and the difference, or the number who die between the two ages, is 77, we conclude that the chances of any particular nominee of the age of 30 dying before attaining the age of 40 are as 77 to 734, and the chances in favour of his living to the age of 40 are as 657 to 734; or the probability of his living to 40 is $\frac{657}{734}$.

Passing now from figures to more general symbols, we will use l_x to denote the number given in the mortality table as alive at any age x; so that, for example, in the above table, $l_{30}=734$, $l_{40}=657$; and in accordance with what we have just explained, the probability of a nominee of the age x living to the age $x+n$, will therefore be expressed by $\frac{l_{x+n}}{l_x}$. Hence, by lemma 1, the value of 1 to be received if the nominee shall be alive at the end of n years, is $\frac{l_{x+n}}{l_x}v^n$. In the particular case supposed above, the actual value will be, taking the rate of interest at 3 per cent., $\frac{657}{734}\times(1{\cdot}03)^{-10} = {\cdot}666035$. We may look at the question from another point of view. Suppose that 734 persons of the age of 30 agree to purchase from an insurance company each an endowment of £1, payable at the end of 10 years, then the probabilities of life being supposed to be correctly given by Deparcieux's table, we see that 657 of those persons will be alive at the end of 10 years, or the engagement of the insurance company to pay £1 to each survivor amounts to the same thing as the engagement to pay £657 at the end of 10 years, and the present value of this sum is $657\ (1{\cdot}03)^{-10}$. The sum that should be paid by each of the 734 persons, so that the company shall neither gain nor lose by the transaction, is therefore $\frac{657}{734}(1{\cdot}03)^{-10}$, as before. If we suppose the probabilities of life to agree with those of the English Table, No. 3, Males, which is printed at the end of this article, the value of the same endowment will be—

$$\frac{272{,}073}{304{,}534}(1{\cdot}03)^{-10} = {\cdot}664779\ .$$

If now we carefully examine the reasoning of the last paragraph, we see that we have made an assumption that must not be allowed to pass without some further justification. We have assumed, in fact, that the lives we are dealing with will die off at the exact rate indicated by the mortality table. This, however, we know, is not necessarily the case. Even if the mortality table correctly represents in the long run the rate of mortality among the lives we are dealing with, we know that the rate of mortality will, from accidental circumstances, be sometimes greater and sometimes less than that indicated by the table. If, for example, we have 734 persons under observation all of the age 30, we have no certainty that at the end of 10 years exactly 77 will have died, leaving 657 alive. It is, indeed, within the range of possibility—firstly, that the whole 734 persons may die before the age 40; and, secondly, that none of them may die, or that the whole 734 may attain the age of 40. It appears, therefore, as if we had used the word "probability" in the second lemma in a different sense from that we attached to it in the first; for, in that case we know that if the whole of the $(a+b)$ balls are drawn, a of them will certainly be white, and b black. But the cases will be more parallel if we suppose that each of the balls, after being drawn, is replaced in the bag. If this is done, we see it is no longer certain that when $(a+b)$ drawings take place, a of the balls will be white, and b black. It may, under these altered circumstances, possibly happen that the balls drawn at each of the $(a+b)$ drawings will all be white, or on the contrary all black. But when a very large number of drawings are made, we can prove that the ratio of white balls drawn to the black will differ very little from the ratio of a to b, and will exactly equal it if the number of drawings is supposed to be indefinitely large. In this case we know that the probability of drawing a white ball is still $\frac{a}{a+b}$, and passing now to the case of lives under observation, we can say, in the same sense, that the probability of a person of the age of 30 living for 10 years is, according to Deparcieux's table, $\frac{657}{734}$, and that on the average of a very large number of observations, that fraction will accurately represent the number of persons surviving. We shall, therefore, be justified in basing all our reasonings on the assumption that the lives we are dealing with die precisely at the rate indicated by the figures of the mortality table.

We are now in a position to show how the value of a life annuity is calculated. The annual payment of the annuity being 1, which is to be made at the end of each year through which the nominee shall live, the annuity consists of a payment of 1 at the end of one year if the nominee is then alive, of the same payment at the end of two years, at the end of three years, &c., under the same condition, and is therefore equal to the sum of a series of endowments. If x is the age of the nominee, the value of the endowment to be received at the end of the nth year is, as we have seen in lemma 2, $\frac{l_{x+n}}{l_x}v^n$, and the total value of the annuity is therefore

$$\frac{l_{x+1}}{l_x}v + \frac{l_{x+2}}{l_x}v^2 + \frac{l_{x+3}}{l_x}v^3 + \ .\ .\ .\ . \qquad \text{(I.)}$$

By means of this formula, taking the values of l_x, l_{x+1}, l_{x+2}, &c., from the mortality table, and calculating the values of v, v^2, v^3, &c., according to the desired rate of interest, or taking their values from the compound interest tables previously described, we can calculate the value of an annuity at any age with any degree of accuracy desired. In practice the calculations would be most readily made by the aid of logarithms.

We can arrive at the above formula more readily by availing ourselves of the supposition which we have seen to be allowable, that the lives under observation will die off exactly at the rate indicated by the mortality table.

Thus, suppose that l_x persons of the age x buy each an annuity of 1. Then the number of persons who will survive to the age $x+1$, and claim the first payment of the annuity, will be l_{x+1}. The value of 1 to be paid at the end of a year is v, and therefore the present sum that will be required to provide for all the payments at the end of the first year will be $l_{x+1}v$. The number of persons who will survive two years, so as to claim the second year's payment, will be l_{x+2}; and multiplying this into the value of 1 payable at the end of two years, we get $l_{x+2}v^2$ as the present sum necessary to provide for the payments at the end of the second year. Proceeding in this way, the total sum that will be required to provide the annuities to the l_x persons, will be $l_{x+1}v+l_{x+2}v^2+l_{x+3}v^3+\ldots$ Hence the value of an annuity on a nominee of the age x, or the sum that will on the average be required to provide for such an annuity, will be

$$\frac{l_{x+1}v+l_{x+2}v^2+l_{x+3}v^3+\ldots\ldots}{l_x}\quad\ldots\quad(2.)$$

which is at once seen to be the same as (1) formula under another shape.

If we suppose money to bear no interest, or make $v=1$ in the formula for the value of an annuity, we shall obtain a quantity which is called the "expectation of life," or the "average duration of life," being the average number of years which persons of the given age will one with another live. Denoting this by e_x, and making $v=1$ in the formula above given, we get

$$e_x=\frac{l_{x+1}+l_{x+2}+l_{x+3}+\ldots}{l_x}.$$

As in the formula for the annuity, no payment is made on account of the year in which the nominee dies, this formula gives the average number of *complete* years that persons of the given age will live according to the mortality table, and makes no allowance for the portion of the year in which death occurs. The expectation thus found is called the curtate expectation; and in order to obtain the complete expectation of life, which is denoted by $\mathring{e}_x$, half a year must be added to it.

The first writer who is known to have attempted to obtain, on correct mathematical principles, the value of a life annuity, was Johan De Wit, Grand Pensionary of Holland and West Friesland. All our exact knowledge of his writings on the subject is derived from two papers contributed by Mr Frederick Hendriks to the *Assurance Magazine*, vol. ii. p. 222, and vol. iii. p. 93. The former of these contains a translation of De Wit's report upon the value of life annuities, which was prepared in consequence of the resolution passed by the States General, on the 25th April 1671, to negotiate funds by life annuities, and which was distributed to the members on the 30th July 1671. The latter contains the translation of a number of letters addressed by De Wit to Burgomaster Johan Hudde, bearing dates from September 1670 to October 1671. The existence of De Wit's report was well known among his contemporaries, and Mr Hendriks has collected a number of extracts from various authors referring to it; but the report is not contained in any collection of his works extant, and had been entirely lost for 180 years, until Mr Hendriks conceived the happy idea of searching for it among the state archives of Holland, when it was found together with the letters to Hudde. It is a document of extreme interest, and (notwithstanding some inaccuracies in the reasoning) of very great merit, more especially considering that it was the very first document on the subject that was ever written; and Mr Hendriks's papers will well repay a careful perusal.

It appears that it had long been the practice in Holland for life annuities to be granted to nominees of any age, in the constant proportion of double the rate of interest allowed on stock; that is to say, if the towns were borrowing money at 6 per cent., they would be willing to grant a life annuity at 12 per cent.; if at 5 per cent., the annuity granted was 10 per cent.; and so on. De Wit states that "annuities have been sold, even in the present century, first at six years' purchase, then at seven and eight; and that the majority of all life annuities now current at the country's expense were obtained at nine years' purchase;" but that the price had been increased in the course of a few years from eleven years' purchase to twelve, and from twelve to fourteen. He also states that the rate of interest had been successively reduced from 6¼ to 5 per cent., and then to 4 per cent. The principal object of his report is to prove that, taking interest at 4 per cent., a life annuity was worth at least sixteen years' purchase; and, in fact, that an annuitant purchasing an annuity for the life of a young and healthy nominee at sixteen years' purchase, made an excellent bargain. It may be mentioned that he argues that it is more to the advantage, both of the country and of the private investor, that the public loans should be raised by way of grant of life annuities rather than perpetual annuities. It appears conclusively from De Wit's correspondence with Hudde, that the rate of mortality assumed as the basis of his calculations was deduced from careful examination of the mortality that had actually prevailed among the nominees on whose lives annuities had been granted in former years. De Wit appears to have come to the conclusion that the probability of death is the same in any half-year from the age of 3 to 53 inclusive; that in the next ten years, from 53 to 63, the probability is greater in the ratio of 3 to 2; that in the next ten years, from 63 to 73, it is greater in the ratio of 2 to 1; and in the next seven years, from 73 to 80, it is greater in the ratio of 3 to 1; and he places the limit of human life at 80. If a mortality table of the usual form is deduced from these suppositions, out of 212 persons alive at the age of 3, 2 will die every year up to 53, 3 in each of the ten years from 53 to 63, 4 in each of the next ten years from 63 to 73, and 6 in each of the next seven years from 73 to 80, when all will be dead. This is the conclusion we have drawn from a careful study of the report; but, in consequence of the inaccuracies above mentioned, some doubt exists as to De Wit's real meaning; and Mr Hendriks's conclusion is somewhat different from ours (see his note, *Ass. Mag.* vol. ii. p. 246). The method of calculation employed by De Wit differs much from that described above, and a short account of it may interest the reader. Suppose that it were desired to apply it to deduce the value of an annuity according to Deparcieux's mortality table given above, then we assume that annuities are bought on the lives of 1000 nominees each 3 years of age. Of these nominees, 30 will die before attaining the age of 4, and no annuity payment will be made in respect of them; 22 will die between the ages of 4 and 5, so that the holders of the annuities on their lives will receive payment for 1 year; 18 attain the age of 5 and die before 6, so that the annuities on their lives are payable for 2 years. Reasoning in the same way, we see that the annuities on 15 of the nominees will be payable for 3 years; on 13, for 4 years; on 12, for 5 years; on 10, for 6 years; and so on. Proceeding thus to the extremity of the table, 2 nominees attain the age of 93, 1 of whom dies before the age of 94, so that 90 annuity payments will be made in respect of him; and the last survivor dies between the ages of 94 and 95, so that the annuity on his life will be payable for 91 years. Having previously calculated a table of the values of annuities certain for every number of years up to 91, the value of all the annuities on the

1000 nominees will be found by taking twenty-two times the value of an annuity for 1 year, eighteen times the value of an annuity for 2 years, fifteen times the value of an annuity for 3 years, and so on,—the last term being the value of 1 annuity for 91 years,—and adding them together; and the value of an annuity on one of the nominees will then be found by dividing by 1000. Before leaving the subject of De Wit, we may mention that we find in the correspondence a distinct suggestion of the law of mortality that bears the name of Demoivre. In De Wit's letter, dated 27th October 1671 (*Ass. Mag.*, vol. iii. p. 107), he speaks of a "provisional hypothesis" suggested by Hudde, that out of 80 young lives (who, from the context, may be taken as of the age 6) about 1 dies annually. In strictness, therefore, the law in question might be more correctly termed Hudde's than Demoivre's.

De Wit's report being thus of the nature of an unpublished state paper, although it contributed to its author's reputation, did not contribute to advance the exact knowledge of the subject; and the author to whom the credit must be given of first showing how to calculate the value of an annuity on correct principles is Dr Edmund Halley, F.R.S. In the *Philosophical Transactions*, Nos. 196 and 198 (January and March 1693), he gave the first approximately correct mortality table (deduced from the records of the numbers of deaths and baptisms in the city of Breslau), and showed how it might be employed to calculate the value of an annuity on the life of a nominee of any age. His method of procedure exactly agrees with the formula (1) above given; and while he confesses that it requires a series of laborious calculations, he says that he had sought in vain for a more concise method. His papers, which are full of interest, are reprinted in the eighteenth volume of the *Assurance Magazine*.

Previous to Halley's time, and apparently for many years subsequently, all dealings with life annuities were based upon mere conjectural estimates. The earliest known reference to any estimate of the value of life annuities rose out of the requirements of the Falcidian law, which (40 B.C.) was adopted in the Roman empire, and which declared that a testator should not give more than three-fourths of his property in legacies, so that at least one-fourth must go to his legal representatives. It is easy to see how it would occasionally become necessary, while this law was in force, to value life annuities charged upon a testator's estate. Æmilius Macer (230 A.D.) states that the method which had been in common use at that time was as follows:—From the earliest age until 30 take 30 years' purchase, and for each age after 30 deduct 1 year. It is obvious that no consideration of compound interest can have entered into this estimate; and it is easy to see that it is equivalent to assuming that all persons who attain the age of 30 will certainly live to the age of 60, and then certainly die. Compared with this estimate, that which was propounded by the Prætorian Prefect Ulpian—one of the most eminent commentators on the Justinian Code—was a great improvement. His table is as follows:—

Age.	Years' Purchase.	Age.	Years' Purchase.
Birth to 20	30	45 to 46	14
20 ,, 25	28	46 ,, 47	13
25 ,, 30	25	47 ,, 48	12
30 ,, 35	22	48 ,, 49	11
35 ,, 40	20	49 ,, 50	10
40 ,, 41	19	50 ,, 55	9
41 ,, 42	18	55 ,, 60	7
42 ,, 43	17	60 and upwards	5
43 ,, 44	16		
44 ,, 45	15		

Here also we have no reason to suppose that the element of interest was taken into consideration; and the assumption, that between the ages of 40 and 50 each addition of a year to the nominee's age diminishes the value of the annuity by one year's purchase, is equivalent to assuming that there is no probability of the nominee dying between the ages of 40 and 50. Considered, however, simply as a table of the average duration of life, the values are fairly accurate. At all events, no more correct estimate appears to have been arrived at until the close of the 17th century. Fuller information upon the early history of life annuities will be found in the article "Annuities on Lives, History of," in Mr Walford's *Insurance Cyclopædia*.

Demoivre, in his *Treatise on Annuities*, 1725, showed that it was unnecessary to go through the whole of the calculation indicated by the formula (1) or (2) for each age, and that the value of an annuity at any age might be deduced by a simple process from that at the next older age. This may be demonstrated as follows:—If it were certain that a person of any age, say 39, would live for a year, then the value of an annuity on his life would be such a sum as would increase at interest in a year to the value of an annuity on a life one year older, say 40, increased by a present payment of 1; that is, putting a for the value of an annuity and ${}^1a$ for that on a life one year older, the value would be $v(1+{}^1a)$. But it is uncertain that the life will exist to the end of a year, and the value of the annuity must therefore be reduced in the proportion of this uncertainty, or be multiplied by the probability that the given life will survive a year. Putting then p to denote this probability, we have $a = vp\,(1+{}^1a)$. This formula may also be demonstrated algebraically. We have seen that

$$a = v\frac{{}^1l}{l} + v^2\frac{{}^2l}{l} + v^3\frac{{}^3l}{l} + \ldots\ldots + v^z\frac{{}^zl}{l},$$

where z is the difference between the age of the given life and that of the oldest in the mortality table. (Assuming the present age to be 39, then in the English Table No. 3, Males, z will be $107-39=68$.) In the same way, we have

$${}^1a = v\frac{{}^2l}{{}^1l} + v^2\frac{{}^3l}{{}^1l} + v^3\frac{{}^4l}{{}^1l} + \ldots\ldots + v^{z-1}\frac{{}^zl}{{}^1l}.$$

$$\text{Hence } a = v\frac{{}^1l}{l}\left(1 + v\frac{{}^2l}{{}^1l} + v^2\frac{{}^3l}{{}^1l} + \ldots\ldots + v^{z-1}\frac{{}^zl}{{}^1l}\right)$$

$$= v\frac{{}^1l}{l}(1+{}^1a)$$

$$= vp(1+{}^1a)$$

—the same result as already proved.

If we suppose the present age to be x, we may put the formula in the shape

$$a_x = v\frac{l_{x+1}}{l_x}(1+a_{x+1});$$

but it will be found preferable to omit the subscript x whenever this can be done without risk of confusion.

This formula has been commonly attributed to Simpson, who in 1742 published his *Doctrine of Annuities and Reversions;* but, although he certainly showed that it is applicable to annuities on the joint duration of two or more lives, the first discovery of it is undoubtedly due to Demoivre. (See Farren's *Historical Essay on the Use and early Progress of the Doctrine of Life Contingencies in England*, p. 46.) The formula appears to have been independently discovered by Euler, and was given by him in a paper in the *Memoirs of the Royal Academy of Sciences at Berlin*, for the year 1760.

Mr Peter Gray has shown in his *Tables and Formulæ*, 1849, how Gauss's logarithmic table may be advantageously employed in calculating the values of annuities by the above formula. That table gives us the value of log $(1+a)$ when that of log a is known. In other words, the argument of the table is log a, and the tabular result is log $(1+a)$. When ordinary logarithmic tables are used, the formulas being

$$\log a_x = \log vp_x + \log(1+a_{x+1}),$$
$$\log a_{x-1} = \log vp_{x-1} + \log(1+a_x);$$

we have to find a_x by means of an inverse entry into the table before $\log(1+a_x)$ can be found; but when Gauss's table is used (as recomputed and extended by Gray), "All the entries of the same kind—direct and inverse—are brought together, the whole of the logarithms being found before a single natural number is taken out. We consequently proceed right through the table; and as we proceed, we find two, three, four, and even as many as six and eight entries on the same opening. At the close, moreover, the taking out of the numbers may, if necessary, be turned over to an assistant. On the other hand, when the common tables are used, direct and inverse entries alternate with each other, and involve likewise a continual turning of the leaves backwards and forwards, by which the process is rendered exceedingly irksome."—Page 165, second issue, 1870.

When the only object is to form a complete table of immediate annuities, the above is the simplest and most expeditious mode of procedure; but when it is desired to have the means of obtaining readily the values of deferred and temporary annuities, it is better to employ a wholly different method.

The value of a deferred annuity may be found as follows. —If it were certain that the nominee, whose age is supposed to be now x, would survive n years, so as to attain the age of $x+n$, the value of the annuity on his life being then a_{x+n}, its present value would be $v^n a_{x+n}$. But as the nominee may die before attaining the age of $x+n$, the above value must be multiplied by the probability of his living to that age, which is $\frac{l_{x+n}}{l_x}$, and we thus get the present value of the deferred annuity, $v^n \cdot \frac{l_{x+n}}{l_x} \cdot a_{x+n}$. We may arrive at this result otherwise. Thus, as we have seen above, the present value of the first payment of the annuity, that is, of 1 to be received if the nominee shall be alive at the end of $n+1$ years, is $\frac{{}^{n+1}l}{l}v^{n+1}$ The present value of the next payment is similarly seen to be $\frac{{}^{n+2}l}{l}v^{n+2}$, and so on. The value of the deferred annuity is therefore

$$\frac{{}^{n+1}l}{l}v^{n+1} + \frac{{}^{n+2}l}{l}v^{n+2} + \frac{{}^{n+3}l}{l}v^{n+3} + \ldots\ldots\ldots$$
$$= \frac{{}^{n}l}{l}v^n\left\{\frac{{}^{n+1}l}{{}^{n}l}v + \frac{{}^{n+2}l}{{}^{n}l}v^2 + \frac{{}^{n+3}l}{{}^{n}l}v^3 + \ldots\ldots\right\}$$
$$= \frac{{}^{n}l}{l}v^n \cdot {}^{n}a, \left(\text{or } \frac{l_{x+n}}{l_x} \cdot v^n \cdot a_{x+n}\right).$$

(We may here mention that this formula holds good, not only for ordinary annuities, but also for annuities payable half-yearly or quarterly, and for continuous annuities; also for complete annuities.)

A temporary annuity is, as explained above, an annuity which is to continue for a term of years provided the nominee shall so long live. Hence it is clear that if the value of a temporary annuity for n years is added to that of an annuity on the same life deferred n years, this sum must be equal to an annuity for the whole continuance of the same life; the value of a temporary annuity for n years will therefore be equal to the difference between the value of a whole term annuity and that of an annuity deferred n years, or to

$$a - \frac{{}^{n}l}{l}v^n \cdot {}^{n}a, \left(\text{or } a_x - \frac{l_{x+n}}{l_x}\ v^n a^{x+n}\right).$$

We are now in a position to explain the method of calculating the value of annuities above referred to. We have seen that the value of an annuity for the life of a nominee whose age is x, is

$$\frac{l_{x+1}v + l_{x+2}v^2 + \ \ldots\ldots + l_{x+s}v^s}{l_x};$$

which, multiplying both numerator and denominator by the same quantity v^x, becomes

$$\frac{l_{x+1}v^{x+1} + l_{x+2}v^{x+2} + \ \ldots\ldots + l_{x+s}v^{x+s}}{l_x v^x}$$

In the same way, the value of an annuity on the same life, deferred n years, is

$$\frac{l_{x+n+1}}{l_x}v^{n+1} + \frac{l_{x+n+2}}{l_x}v^{n+2} + \ \ldots\ldots + \frac{l_{x+s}}{l_x}v^s.$$
$$= \frac{l_{x+n+1}v^{n+1} + l_{x+n+2}v^{n+2} + \ \ldots\ldots + l_{x+s}v^s}{l_x}$$
$$= \frac{l_{x+n+1}v^{x+n+1} + l_{x+n+2}v^{x+n+2} + \ \ldots\ldots\ldots + l_{x+s}v^{x+s}}{l_x v^x}.$$

If, then, we calculate in the first instance the values of the product $l_x v^x$ for all values of x, and then form their sums, beginning at the highest age, we shall have the means of obtaining by a single division the value of any immediate or deferred annuity we wish.

It is convenient to arrange these results in a tabular form, as shown in the appended tables (3) and (4). The quantity $l_x v^x$ is placed in the column headed D, opposite the age x, and is denoted by D_x; while the sum $l_{x+1}v^{x+1} + l_{x+2}v^{x+2} + \ \ldots\ldots + l_{x+s}v^{x+s}$ is placed in the column headed N, opposite the same age x, and is denoted by N_x; so that the value of an immediate annuity on a life x is equal to $\frac{N_x}{D_x}$; the letters N and D being chosen as the first letters of the words Numerator and Denominator. Then it is easy to see that the value of an annuity on x deferred n years is equal to $\frac{N_{x+n}}{D_x}$; whence by subtraction the value of a temporary annuity for n years on the same life is $\frac{N_x - N_{x+n}}{D_x}$.

If, for example, we wish to find the value of an annuity on a male life of 40 according to the English Table No. 3, with interest at 3 per cent., we find from table (3) appended to this article, $N_{40} = 1374058$, $D_{40} = 83406$, and by division we get the value of $\frac{N_{40}}{D_{40}} = 16{\cdot}4744$, which agrees with the value contained in the table (5), also appended to this article.

Next, suppose we wish to find the value of a deferred annuity on a life of 30 to commence at the end of 10 years. From what precedes, we see that the value of this annuity will be equal to the quotient $\frac{N_{40}}{D_{30}}$ or $\frac{1374058}{125464}$, which will be found to be equal to 10·9518.

If we wish to find the value of this deferred annuity without using the D and N table, the formula for it will be $\frac{l_{40}}{l_{30}}v^{10}a_{40}$, v being equal to $\frac{1}{1{\cdot}03}$. But we have seen above that the value of $\frac{l_{40}}{l_{30}}(1{\cdot}03)^{-10} = {\cdot}664779$, and that $a_{40} = 16{\cdot}4744$; and multiplying these together, we get the value of the deferred annuity, 10·9518, as before.

We have, in conformity with popular usage, called our auxiliary table a "D and N table." It is also called a "commutation table"—a name proposed by De Morgan

In his paper "On the Calculation of Single Life Contingencies," which appeared in the *Companion to the Almanac* for the year 1840, and which is reprinted in the *Assurance Magazine*, xii. 328. His explanation of the term is to the following effect:—Taking any two ages, say 30 and 40, we have, according to the English Table No. 3, Males—see appended table (3),—

$$D_{30} = 125464\,,\ N_{30} = 2385610;$$
$$D_{40} = \ 83406\,,\ N_{40} = 1374058.$$

Transpose the numbers opposite each age to the other age; then whatever may be the present age (less than 30)—

A person might now give up £83,406, due at the age of 30, to receive £125,464, if he live to be 40.

A person might now give up an annuity of £1,374,058, to be granted at the age of 30, to receive in return another of £2,385,610 to be granted at the age of 40, if he should live so long.

"These proportions are independent of the present age of the party, and show that the most simple indication of the tables is the proportion in which a benefit due at one age ought to be changed, so as to retain the same value and be due at another age. They might, therefore, with great propriety, be called *Commutation Tables.*"

It is clear that this property will not be altered if all the quantities in the D column, and consequently those in the N column, are increased or diminished in a constant ratio.

A "D and N table" may be used, not only to find the value of annuities, immediate, deferred, and temporary, but also to find the annual premium that should be paid for a given number of years as an equivalent for a deferred annuity. If the annuity is deferred n years, and the annual premium of equal value is to be paid for m years, it will be $\frac{N_{x+n}}{N_{x-1}-N_{x+m-1}}$. The table may also be used to find the single and annual premiums for insurances, immediate, deferred, or temporary. The single premiums are—

1. For an ordinary insurance, $\frac{vN_{x-1}-N_x}{D_x}$;
2. For an insurance deferred n years, $\frac{vN_{x+n-1}-N_{x+n}}{D_x}$.
3. For a temporary insurance for n years,

$$\frac{v(N_{x-1}-N_{x+n-1})-N_x+N_{x+n}}{D_x}$$

The annual premiums payable during life for the same benefits are found by substituting N_{x-1} for D_x in the denominator; and the annual premiums payable for m years, by putting $N_{x-1}-N_{x+m-1}$ in the denominator instead of D_x.

Before quitting this subject, we should mention that in practice other columns are added to the table besides the D and N columns. A column, S, is given for the purpose of calculating the values of increasing annuities; a column, M, for calculating the values of assurances; and a column, R, for calculating the values of increasing assurances. An explanation of the M column belongs to the subject INSURANCE; for an account of the S and R columns, we refer the reader to the works and papers on life insurance contingencies, in which the D and N (or commutation) method is described; particularly to those of David Jones, Gray, and De Morgan.

The earliest known specimen of a commutation table is contained in William Dale's *Introduction to the Study of the Doctrine of Annuities*, published in 1772. A full account of this work is given by Mr F. Hendriks in the second number of the *Assurance Magazine*, pp. 15–17. Dale's table, as there quoted, differs from the one above described in that it commences only at the age of 50, and that he has tabulated $l_x v^{x-50}$ instead of $l_x v^x$. He says, "These calculations being made for the use of the societies in particular who commence annuitants at the age of 50, it was not thought necessary to begin the tables at a younger age." He gives, however, another table based on different mortality observations, commencing at the age of 40; and in this case he tabulates $l_x v^{x-40}$. His table also differs from the common form in that it is adapted to find the values of annuities payable by half-yearly instalments.

The next work in which a commutation table is found is William Morgan's *Treatise on Assurances*, 1779. In this work the values of $\frac{l_x}{l_1}v^{x-1}$ are tabulated, and not those of $l_x v^x$; but, as above mentioned, the properties of the table are not altered by the change. Morgan gives the table as furnishing a convenient means of checking the correctness of the values of annuities found by the ordinary process. It may be assumed that he was aware that the table might be used for the direct calculation of annuities; but he appears to have been ignorant of its other uses.

The first author who fully developed the powers of the table was John Nicholas Tetens, a native of Schleswig, who in 1785, while professor of philosophy and mathematics at Kiel, published in the German language an *Introduction to the Calculation of Life Annuities and Assurances.* This work appears to have been quite unknown in England until Mr F. Hendriks gave, in the first number of the *Assurance Magazine*, pp. 1–20 (Sept. 1850), an account of it, with a translation of the passages describing the construction and use of the commutation table, and a sketch of the author's life and writings, to which we refer the reader who desires fuller information.

The use of the commutation table was independently developed in England—apparently between the years 1788 and 1811—by George Barrett, of Petworth, Sussex, who was the son of a yeoman farmer, and was himself a village schoolmaster, and afterwards farm steward or bailiff. In the form of table employed by him, the quantity tabulated is not $l_x v^x$, but $l_x(1+i)^{w-x}$, where w is the last age in the mortality table used. It has been usual to consider Barrett as the originator in this country of the method of calculating the values of annuities by means of a commutation table, and this method is accordingly sometimes called Barrett's method. (It is also called the commutation method and the columnar method.) Barrett's method of calculating annuities was explained by him to Francis Baily in the year 1811, and was first made known to the world in a paper written by the latter and read before the Royal Society in 1812.

By what has been universally considered an unfortunate error of judgment, this paper was not recommended by the council of the Royal Society to be printed, but it was given by Baily as an appendix to the second issue (in 1813) of his work on life annuities and assurances. Barrett had calculated extensive tables, and with Baily's aid attempted to get them published by subscription, but without success; and the only printed tables calculated according to his manner, besides the specimen tables given by Baily, are the tables contained in Babbage's *Comparative View of the various Institutions for the Assurance of Lives*, 1826. It may be mentioned here that Tetens also gave only a specimen table, apparently not imagining that persons using his work would find it extremely useful to have a series of commutation tables, calculated and printed ready for use.

In the year 1825 Griffith Davies published his *Tables of Life Contingencies*, a work which contains, among other tables, two arranged on the plan we have above explained, the idea of them having been confessedly derived from Baily's explanation of Barrett's tables. The method was, however, improved and extended by the addition of the columns (M and R) for finding the values of assurances. Davies's treatise on annuities, as issued by his executors in 1855, with the explanation that it is an uncompleted work, but that the completed portion had been in print since 1825, contains several other tables of the same kind. In the preface to this work it is stated that "the most important distinction between the two methods is, that Mr Davies's method is much simpler in principle than that of Mr Barrett, as the columnar numbers given by the latter must be considered more as the numerical results of algebraical expressions; whereas in Davies's arrangement it will be found, on reference to age 0, that the number in column D represents the number of children just born, and those opposite ages 1, 2, 3, 4, &c., to the end of life, the present sums which would be required for the payment of £1 to each survivor of such children at the end of 1, 2, 3, 4, &c., years to the extremity of life; and the sum thereof inserted in column N, opposite age 0, represents the present fund required to provide the payment of annuities of £1 each for life to all the children given in column D at age 0; and from this method very considerable amount of labour is avoided by multiplying the number living at each age by a fraction less than a unit; but by Barrett's method, the number living at each age has to be multiplied by the amount of £1 improved for as many years as are equal to the difference between that age and the greatest tabular duration, as already stated, which makes each product a large multiple of the number living." This passage, we are informed, correctly represents Mr Davies's own views on the subject. It may be noticed that Davies does not employ the notation used above, D_x, N_x, &c., but omits the subscript x. Thus, instead of the formula $\frac{N_{x+n}}{N_{x-1}-N_{x+n-1}}$ he would write $\frac{{}^{n}N}{N_1-{}^{n}N_1}$.

In some respects this notation is perhaps preferable to that now used, as it is certainly better, when there is no risk of confusion, to omit the subscript x. But Davies's notation cannot be adopted without alteration, as N_1 might be mistaken for the number in the column N opposite the age 1. We may, however, consistently with the principles of the notation adopted by the Institute of Actuaries, write the formula $\frac{{}^{n}N}{{}^{-1}N-{}^{n-1}N}$. The notation at present commonly used is due to David Jones, whose work (mentioned below) was the first that contained an extensive series of commutation tables.

On a general review of the whole evidence, we cannot help thinking that Barrett's merits in the matter have been somewhat exaggerated. The first idea of a commutation table was not due to him, but (leaving Tetens out of view) to Dale and Morgan; and it is certain that he was familiar with the latter's treatise. The change he introduced into the arrangement of the table, namely, multiplying by a power of $(1+i)$ instead of by a power of v, is the reverse of an improvement; and accordingly, his form of table has never been in practical use by any person but himself, excepting only Babbage. It is, of course, not to be denied that great credit is due to him as a self-educated man, for perceiving more clearly than his predecessors the great usefulness of the commutation table; but in our opinion he does not stand sufficiently out from those who preceded and followed him, to justify the attempt to attach his name to the columnar method of calculating the values of annuities and assurances. Those who desire to obtain further information on the matter, and to learn the views of other writers, can refer to the appendix to Baily's *Life Annuities and Assurances*, De Morgan's paper "On the Calculation of Single Life Contingencies," *Assurance Magazine*, xii. 348–9; Gray's *Tables and Formulæ*, chap. viii.; the preface to Davies's *Treatise on Annuities*; also Hendriks's papers in the *Assurance Magazine*, No. 1, p. 1, and No. 2, p. 12; and in particular De Morgan's "Account of a Correspondence between Mr George Barrett and Mr Francis Baily," in the *Assurance Magazine*, vol. iv. p. 185.

The principal D and N tables published in this country are contained in the following works:—

David Jones, *Value of Annuities and Reversionary Payments*, issued in parts by the Useful Knowledge Society, completed in 1843, which gives for the Northampton Table, 3 per cent. interest, columns D, N, S, M, R; Carlisle Table, interest 3, 3½, 4, 4½, 5, 6, columns D, N, S, M, R; and interest 7, 8, 9, 10, columns D, N, S. Volume ii. contains D and N tables for all combinations of two joint lives, according to the Northampton Table, 3 per cent., and the Carlisle, 3, 3½, 4, 4½, 5, 6 per cent.

Jenkin Jones, *New Rate of Mortality*, 1843, Seventeen Offices' Experience, 2½, 3, 3½ per cent., columns D, N, S, M, R.

G. Davies, *Treatise on Annuities*, 1825 (issued 1855). Equitable Experience, 2½, 3, 3½, 4, 4½, 5, 6 per cent., columns D, N, S, M, R; 7, 8 per cent., columns D, N; also three tables relating to joint lives for the differences of age 19, 20, 21 years, and one relating to three joint lives of equal ages, all giving D and N columns at 3 per cent. interest: Northampton, 3 per cent., columns D, N, S, M, R; 4 per cent., columns D, N; also tables for two joint lives similar to those above mentioned.

David Chisholm, *Commutation Tables*, 1858; Carlisle, 3, 3½, 4, 5, 6 per cent., columns D, N, S, C, M, R; also columns D, N, for joint lives, and M, R, for survivorship assurances.

Neison's *Contributions to Vital Statistics*, 1857. Mortality of England and Wales (males), 3, 3½, 4, 4½, 5, 6, 7, 8, 9, 10 per cent., columns D and N, with logarithms; two joint lives, males, 7 per cent., columns D and N; also D and N columns relating to the mortality of master mariners, and to that among friendly societies, and in particular the Manchester Unity.

Jardine Henry, *Government Life Annuity Commutation Tables*, 1866 and 1873, single lives male and female, 0, 1, 2, 2½, 3, 3½, 4, 4½, 5, 5½, 6, 7, 8, 9, 10 per cent.

Institute of Actuaries Life Tables, 1872. New Experience (or Twenty Offices), males and females separately, H^M and H^F, 3, 3½, 4, 4½, 5, 6, columns D, N, S, M, R, also logarithms; and similar tables at 3, 3½, and 4 per cent. for the table $H^{M(5)}$.

R. P. Hardy, *Valuation Tables*, 1873, gives the same table at 4½ per cent. for $H^{M(5)}$.

The *Sixth Report of the Registrar-General*, 1844, contains the English Table (No. 1), 3 and 4 per cent., columns D, N, S, C, M, R, for males and females separately; also D_{xy}, N_{xy}, 3 and 4 per cent., for x male and y female; also five tables for joint lives, one male and one female, differences of ages −20, −10, 0, 10, 20.

The *Twelfth Report*, 1849, contains the English Table (No. 2), males, 3, 4, 5, per cent., columns D, N, S, C, M, R.

The *Twentieth Report*, 1857, contains the English Table (No. 2), females, 3 per cent., columns D, N, S, C, M, R.

The *English Life Table*, 1864, contains columns D, N, at 3, 3¼, 3⅓, 3½, 3¾, 4, 5, 6, 7, 8, 9, 10 per cent., also the logarithms; columns S, C, M, R, at 3, 4, 5 per cent.; special tables for half-yearly and quarterly payments, columns D, N, at 3 per cent.; joint lives at all combinations of ages, columns D, N, at 3 per cent., (1) male and female, (2) two males, (3) two females.

The explanations of the tables in the last four works are by Dr William Farr, F.R.S.

Very unfortunately, these tables are not all arranged upon the same principle, but those contained in the Reports of the Registrar-General, in the *English Life Table*, in Chisholm's and in Henry's tables, are so arranged that the column N is shifted down one year, so that in them the ratio $\frac{N_x}{D_x}$ gives, not the value of the ordinary annuity, but the value of the annuity increased by unity, or the annuity-due. It is very needful to bear this in mind for the prevention of error; and the existence of a difference of this kind is extremely perplexing. For information upon the subject of this confusing change, see De Morgan's paper "On the Forms under which Barrett's Method is represented, and on Changes of words and symbols," *Ass. Mag.*, x. 302.

All the preceding methods require a considerable amount of calculation in order to obtain the value of an annuity on a life of any particular age. We will now explain some methods of approximation, by means of which we can calculate with much less labour the value of an annuity at a single age, when we do not require a complete table of annuities. The following method was demonstrated by Mr Lubbock (afterwards Sir J. W. Lubbock) in a paper "On the Comparison of Various Tables of Annuities" in the *Cambridge Philosophical Transactions* for the year 1829. Instead of calculating the value of each payment of the annuity to be received at the ages $x+1$, $x+2$, ... to the extremity of life, it will be sufficient to calculate the values of the payments to be received at a series of equidistant ages, say at the ages $x+n$, $x+2n$, $x+3n$, ... Then, if V_m denote the payment to be received at the age $x+m$, and Δ_1, Δ_2, Δ_3, ... denote the leading differences of V_0, V_n, V_{2n}, V_{3n} . . . . . . the value of the annuity is approximately

$$n\left(V_0+V_n+V_{2n}+V_{3n}+\ldots\ldots\right)-\frac{n+1}{2}+\frac{n^2-1}{12n}\Delta_1$$
$$-\frac{n^2-1}{24n}\Delta_2+\frac{(n^2-1)(19n^2-1)}{720n^3}\Delta_3-\frac{(n^2-1)(9n^2-1)}{480n^3}\Delta_4.$$

Here $V_0=1$, $V_n=\frac{l_{x+n}}{l_x}v^n$, $V_{2n}=\frac{l_{x+2n}}{l_x}v^{2n}$, &c.

As an example, we will apply this formula to calculate the value of an annuity on a nominee of 40, according to the English Table, No. 3, Males, at 3 per cent. interest.

First, taking $n=7$, we find

V_0 = 1·0000					
	− ·2654				
V_7 = ·7346		+ ·0521			
	·2133		− ·0115		
V_{14} = ·5213		·0406		+ ·0029	
	·1727		·0086		
V_{21} = ·3486		·0320			
	·1407				
V_{28} = ·2079					
V_{35} = ·0990					
V_{42} = ·0318					
V_{49} = ·0055					
V_{56} = ·0004					
Sum = 2·9491					

Hence $\Delta_1=-\cdot2654$, $\Delta_2=\cdot0521$, $\Delta_3=-\cdot0115$, $\Delta_4=\cdot0029$; and the value of the annuity is approximately

$$=7+2\cdot9491-4-\frac{4}{7}\times\cdot2654-\frac{2}{7}\times\cdot0521-\cdot1808\times\cdot0115-\cdot1283\times\cdot0029.$$

$$\begin{aligned}&=20\cdot6437-4\cdot0000\\&\qquad\;-\cdot1517\\&\qquad\;-\cdot0149\\&\qquad\;-\cdot0021\\&\qquad\;-\cdot0004\\&=20\cdot6437-4\cdot1691\\&=16\cdot4746.\end{aligned}$$

Next, taking $n=11$, we have

V_0 = 1·0000					
	− ·3924				
V_{11} = ·6076		+ ·1115			
	·2809		− ·0310		
V_{22} = ·3267		·0805		+ ·0453	
	·2004		+ ·0143		
V_{33} = ·1263		·0948			
	·1056				
V_{44} = ·0207					
V_{55} = ·0006					
2·0819					

Hence, the value of the annuity is approximately

$$=11\times2\cdot0819-6-\frac{10}{11}\times\cdot3924-\frac{5}{11}\times\cdot1115-\cdot2878\times\cdot0310-\cdot2044\times\cdot0453$$

$$\begin{aligned}&=22\cdot9009-6\cdot0000\\&\qquad\;-\cdot3567\\&\qquad\;-\cdot0507\\&\qquad\;-\cdot0089\\&\qquad\;-\cdot0093\\&=22\cdot9009-6\cdot4256\\&=16\cdot4753.\end{aligned}$$

The value of the annuity calculated in the ordinary way is, as we have seen (page 80), 16·4744.

An improved form of this method was given by Mr W. S. B. Woolhouse in the *Ass. Mag.*, xi. 321. In order to explain this, we must introduce the reader to a term which is of recent origin, but which the application of improved mathematical methods to the science of life contingencies has rendered of great importance—*the force of mortality* at a given age. This may be defined as the proportion of the persons of that age who would die in the course of a year, if the intensity of the mortality remained constant for a year, and the number of persons under observation also remained constant, the places of those who die being constantly replaced by fresh lives. More briefly, it is the instantaneous rate of mortality. A very full explanation of this term is given by Mr W. M. Makeham, in his paper "On the Law of Mortality," *Ass. Mag.*, xiii. 325. The value of the function can be approximately found by dividing the number of persons who die in a year by the number alive in the middle of the year. Thus, if l_x denote the number of persons living at the age x, d_x the number dying between the ages x and $x+1$, and d_{x-1} the number dying between the ages $x-1$ and x, then the number dying between the ages $x-\frac{1}{2}$ and $x+\frac{1}{2}$ will be approximately $\frac{d_{x-1}+d_x}{2}$, and the force of mortality is approximately $\frac{d_{x-1}+d_x}{2l_x}$. Thus, in the English Table, No. 3, Males, the value of the force of mortality at age 40 is $\frac{3465+3529}{544146}$ $=\cdot012853$.

This quantity is usually denoted by the Greek letter μ, while δ is used to denote the quantity $\log_e(1+i)$, which Woolhouse has called the *force of discount*. This being premised, Woolhouse's formula for the approximate value of an annuity is

$$n(V_n+V_{2n}+V_{3n}+\ .\ .\ .\ )+\frac{n-1}{2}-\frac{n^2-1}{12}(\mu+\delta),$$

where it will be noticed that, since $V_0=1$, the two first terms are exactly equal in value to those in Lubbock's formula.

Taking the same example as above, we have seen that

$$\begin{aligned}\mu_{40}&=\cdot012853\\ \text{also}\qquad \delta&=\cdot029558\\ \therefore\qquad \mu_{40}+\delta&=\cdot042411\end{aligned}$$

Making $n=7$, we have the value of the annuity

$$\begin{aligned}&=16\cdot6437-4\times\cdot042411\\&=16\cdot6437-\cdot169644\\&=16\cdot4741.\end{aligned}$$

Making $n=11$, we have the value

$$\begin{aligned}&=16\cdot9009-10\times\cdot042411\\&=16\cdot9009-\cdot4241\\&=16\cdot4768.\end{aligned}$$

Comparing the two processes, we see that when we have the values of μ and δ already computed, Woolhouse's is decidedly the shorter. On the other hand, it is easy to see that Lubbock's formula applies, not only to annuities, but to other benefits; and that it will be applicable to find the values of such quantities as contingent annuities, the values of which cannot be found exactly except by a very long series of calculations. (See Davies, p. 354.) The reader who refers to Lubbock's paper (which is reprinted in the *Ass. Mag.*, v. 277), or to the short account of it given in the *Treatise on Probability*, issued by the Useful Knowledge Society, and often bound up with D. Jones's work on annuities, will see that the terms involving Δ_2, Δ_3, Δ_4 are not given there; and it may assist the student who is desirous of working out the formula fully, to be referred to De Morgan's expansion of $\frac{x}{(1+x)^z-1}$, *Diff. Calc.*, p. 314, § 184. Lubbock not only considered it unnecessary to calculate the terms involving Δ_2, Δ_3, &c. but thought that the value of the term containing Δ_1, as calculated for one mortality table, might be used without material error in finding the values of annuities by other tables. The above examples show that the formula, as now completed, is capable of giving the values of annuities (and of course of other quantities) with very great accuracy.

So long as we consider the annuity to be payable yearly, no allowance being made for the time which elapses between the death of the nominee and the last previous payment of the annuity, it is, as we have seen, a very simple problem to calculate its value. But in practice annuities are generally payable by half-yearly instalments, and it is the custom to pay a proportionate part of the annuity for the odd time that elapses between the last half-yearly payment and the death of the nominee; and the value found by the methods described above therefore require to be corrected before they are strictly applicable in practice. Approximate values of the necessary corrections are very easily found; but the strict investigation of their correct values is a problem requiring a considerable knowledge of the higher mathematics, and it would be quite beyond our present purpose to consider it.

When an annuity is payable half-yearly, the common rule for finding its value is to add ·25, or a quarter of a year's purchase, to the value of the annuity payable yearly. When it is payable quarterly, ·375 is added; and when by instalments at n equal periods throughout the year (or by $\frac{1}{n}$-thly instalments), the addition is $\frac{n-1}{2n}$. The values thus found are sufficiently correct for most purposes. More correct methods of finding the values of annuities payable half-yearly, quarterly, &c., are investigated in papers in the *Assurance Magazine*, by Woolhouse, xi. 327, and by Sprague, xiii. 188, 201, 305. Some authors have assumed that when an annuity is payable half-yearly, interest is also convertible half-yearly, overlooking the circumstance that the true rate of interest is thereby changed, as we have explained in the earlier part of this article. In fact, as we showed, 5 per cent. interest convertible half-yearly is equivalent to a true rate of interest, £5, 1s. 3d. per cent. If, then, we have found the value of an annuity when payable yearly at 5 per cent. interest, and require, perhaps, in the course of the same investigation, the value of an annuity payable half-yearly, it is clear that that value should be computed, not at £5, 1s. 3d. per cent. interest, but at 5 per cent.; or if we prefer the rate £5, 1s. 3d., then the value of the annuity payable yearly should also be calculated at that rate.

The approximate value of an annuity payable up to the day of the nominee's death, or of a "complete" annuity, as it is now usually called, is found in the case of annuities payable yearly by adding to the value of the ordinary annuity the value of $\frac{1}{2}$, payable at the instant of the nominee's death; in the case of half-yearly annuities, by adding the value of $\frac{1}{4}$; and in the case of quarterly annuities, the value of $\frac{1}{8}$, similarly payable. The more exact value of the correction is investigated by Sprague, *Ass. Mag.*, xiii. 358.

The previous remarks refer almost exclusively to annuities which depend on the continuance of one life, or to "single life annuities," as they are commonly called. But an annuity may depend on the continuance of two or three or more lives. It may continue so long as both of two nominees are alive, in which case it is called an annuity on the joint lives; or it may continue as long as either of them is alive, in which case it is called an annuity on the last survivor. Again, if it depends on the existence of three nominees, it may either continue so long only as they are all three alive, when it is called an annuity on the joint lives; or so long as any two of them continue alive, when it is called an annuity on the last two survivors; or so long as any one of them is alive, when it is called an annuity on the last survivor. In addition to these, we have "reversionary" annuities, which are to commence on the failure of an assigned life, and continue payable for the life of a specified nominee; or, more generally, to commence on the failure of a given status, or combination of lives, and continue payable during the existence of another status. There are also "contingent" annuities, which depend on the order in which the lives involved fail. Thus, we may have an annuity on the life of x, to commence on the death of y, provided that take place during the life of z, and not otherwise, and to continue payable during the remainder of the life of x. Reversionary annuities are of considerable practical importance, but contingent annuities are rarely met with. Lastly, we may mention annuities on successive lives. These are of importance in the calculation of the values of advowsons, and of fines on copyhold property. It does not fall within the scope of this article to treat at any length of annuities on more than one life, and we must refer the reader who wishes for further information with regard to them to the works of Baily, Davies, and David Jones, already mentioned, and Milne's *Treatise on the Valuation of Annuities and Assurances*, 1815.

The student who wishes to pursue the subject more thoroughly, and to become acquainted with all the improvements in the theory of annuities that have been introduced of late years, should carefully study the various articles contributed to the *Journal of the Institute of Actuaries*, particularly those of Woolhouse and Makeham. The Institute was founded in the year 1848, the first sessional meeting being held in January 1849. Its establishment has contributed in various ways to promote the study of the theory of life contingencies. Among these may be specified the following:—Before it was formed, students of the subject worked for the most part alone, and without any concert; and when any person had made an improvement in the theory, it had little chance of becoming publicly known unless he wrote a formal treatise on the whole subject. But the formation of the Institute led to much greater interchange of opinion among actuaries, and afforded them a ready means of making known to their professional associates any improvements, real or supposed, that they thought they had made. Again, the discussions which follow the reading of papers before the Institute have often served, first, to bring out into bold relief differences of opinion that were previously unsuspected, and afterwards to soften down those differences,—to correct extreme opinions in every direction, and to bring about a greater agreement of opinion on many important subjects. In no way, probably, have the objects of the Institute been so effectually advanced as by the publication of its *Journal*. The first number of this work, which was originally called the *Assurance Magazine*, appeared in September 1850, and it has been continued quarterly down to the present time. It was originated by the public spirit of two well-known actuaries (Mr Charles Jellicoe and Mr Samuel Brown), and was carried on by them for two years, we believe, at a considerable loss. It was adopted as the organ of the Institute of Actuaries in the year 1852, and called the *Assurance Magazine and Journal of the Institute of Actuaries*, Mr Jellicoe continuing to be the editor,—a post he held until the year 1867, when he was succeeded by Mr Sprague. The name was again changed in 1866, the words "*Assurance Magazine*" being dropped; but in the following year it was considered desirable to resume these, for the purpose of showing the continuity of the publication, and it is now called the *Journal of the Institute of Actuaries and Assurance Magazine*. This work contains not only the papers read before the Institute (to which have been appended of late years short abstracts of the discussions on them), and many original papers which were unsuitable for reading, together with correspondence, but also reprints of many papers published elsewhere, which from various causes had become difficult of access to the ordinary reader, among which may be specified various papers which originally appeared in the *Philosophical Transactions*, the *Philosophical Magazine*, the *Mechanics' Magazine*, and the *Companion to the Almanac*; also translations of various papers from the French, German, and Danish. Among the useful objects which the continuous publication of the *Journal* of the Institute has served, we may specify in particular two:—that any supposed improvement in the theory was effectually submitted to the criticisms of the whole actuarial profession, and its real value speedily discovered; and that any real improvement, whether great or small, being placed on record, successive writers have been able, one after the other, to take it up and develop it, each commencing where the previous one had left off. The result has been, as stated above, that great advances have lately been made in the theory. It may be truly said that the recent advances and improvements in the theory of life contingencies have rendered all the existing text-books antiquated; and until a new one shall be produced, bringing the treatment of the subject down to the present time, a complete knowledge of it can only be gained by a diligent study of the *Journal of the Institute of Actuaries and Assurance Magazine.*

As intimated above, our remarks on annuities involving more than one life will be very brief. The methods employed for the calculation of single life annuities are easily extended to the case of joint life annuities. The fundamental equation

$$a = vp\,(1 + {}^1a)$$

is true of annuities on two, three, or any number of joint lives, if we consider p to denote the probability that they will all survive for one year; and ${}^1a$ the value of an annuity on the joint continuance of lives which are severally one year older than those on which the required annuity depends. Thus we have—x, y, z, being the ages of the nominees—

$$a_{xy} = v\,\frac{l_{x+1}}{l_x}\cdot\frac{l_{y+1}}{l_y}\,(1 + a_{x+1.y+1}),$$

$$= vp_xp_y\,(1 + {}^1a_{xy}),$$

$$\text{and } a_{xyz} = vp_xp_yp_z\,(1 + {}^1a_{xyz}).$$

The columnar method of calculating annuities admits also of being extended to annuities on joint lives. In the extensive tables contained in D. Jones's work,

$\mathrm{D}_{xy} = l_xl_yv^y$, y being the older of the two ages,
and $\mathrm{N}_{xy} = {}^1\mathrm{D}_{xy} + {}^2\mathrm{D}_{xy} + {}^3\mathrm{D}_{xy} + \ldots\ldots,$

where ${}^n\mathrm{D}_{xy}$ is used to denote $\mathrm{D}_{x+n.y+n}$.

An improved form of the table was suggested by De Morgan, according to which we should have $\mathrm{D}_{xy} = l_xl_yv^{\frac{x+y}{2}}$ This would simplify the formulas for the values of contingent annuities, but no tables have as yet been published calculated on this principle. The same method might be extended to three lives, in which case the most advantageous form would be $\mathrm{D}_{xyz} = l_xl_yl_zv^{\frac{x+y+z}{3}}$; but the extent of the tables when three lives are involved renders it extremely improbable that such will ever be published. The practical construction of a D and N table for joint lives has been considered by Gray, *Tables and Formulæ*, pp. 122–137, and *Ass. Mag.*, xviii. 26. Mr Jardine Henry has described in the *Ass. Mag.*, xiv. 212, a mechanical method of computing the values of $\mathrm{D}_{xy} = l_xl_yv^y$, by means of which he has calculated the values in his extensive tables mentioned above.

The values of annuities on the last survivor of two or more lives cannot be calculated by the ordinary methods that apply to annuities on joint lives; thus, for example, the equation $a = vp\,(1 + {}^1a)$ does not hold good with regard to them. Their values must be found from those of joint life annuities by means of the following formulas:—

An annuity on the last survivor of two lives, x and y, $\quad a_{\overline{xy}} = a_x + a_y - a_{xy}$

An annuity on the last survivor of three lives, x, y, and z, $\quad a_{\overline{xyz}} = a_x + a_y + a_z - a_{yz} - a_{zx} - a_{xy} + a_{xyz}$

An annuity on the last two survivers of the three lives, x, y, z, $\quad a_{\overline{xyz}}{}^2 = a_{yz} + a_{zx} + a_{xy} - 2a_{xyz}$

If we have the values of annuities on the last survivor of two lives tabulated, as is the case in the *Institute of Actuaries Life Tables*, we may find the value of an annuity on the last of three lives by means of the formula $a_{\overline{xyz}} = a_{\overline{xz}} + a_{\overline{yz}} - a_{\overline{wz}}$, where w is found by means of the relation $a_w = a_{xy}$; see *Ass. Mag.*, xvii. 266, 379.

The methods of approximation given by Lubbock and Woolhouse also apply to the calculation of annuities on the joint existence of any number of lives; see the latter's explanation of his method, *Ass. Mag.*, xi. 322, and for an illustration of its application to complicated cases, xvii. 267. They may also be applied to find the value of an annuity on the last survivor of any number of lives; see *Ass. Mag.*, xvi. 375.

The formula usually given for the value of a reversionary annuity on the life of x to commence on the death of y is $a_x - a_{xy}$. But this is not sufficiently correct, being deduced from suppositions that do not prevail in practice. It assumes the first yearly payment of the annuity to be made at the end of the year in which y dies, and the last at the end of the year before that in which x dies; whereas in practice the annuity runs from the death of y, the first yearly payment being made one year after such death, and a proportionate part being paid up to the date of x's death. A more correct formula, as given by Sprague (*Ass. Mag.*, xv. 126), is $\frac{a_x - a_{xy}}{\sqrt{1+i}}$. If the annuity is payable half-yearly, the value will be approximately $(a_x - a_{xy})\,\frac{1 + (1+i)^{-\frac{1}{2}}}{2}$; and if quarterly, $(a_x - a_{xy})\,\frac{i}{(1+i)^{\frac{1}{4}} - 1}$. In practice, it is often sufficient to deduct half a year's interest from the value found by the formula $a_x - a_{xy}$, when the annuity is payable yearly, a quarter of a year's interest when it is payable half-yearly, and an eighth of a year's interest when quarterly.

In dealing with annuities in which three lives are involved, we are met by the difficulty that no tables exist in which the values of such annuities are given to the extent required in practice. Such tables as those computed for the Carlisle 3 per cent. table by Herschel Filipowski are of too limited extent to be of any practical utility; for the values being given only for certain ages differing by multiples of five years, a considerable amount of labour is required to deduce the values for other ages. When, therefore, we desire to find the value of an annuity on the joint lives of say x, y, and z, it is usual to take the two oldest of the lives, say x and y, and find the value of a_{xy}, then to look in the table of single life annuities for the annuity which is nearest in value to this,—a_w suppose,—and lastly, to find the value of a_{wz}, and use it as an approximation to that of a_{xyz}. De Morgan, in a paper written for the *Philosophical Magazine* for November 1839, and reprinted in the *Ass. Mag.*, x. 27, proved that the value of a_{xyz} thus found would be strictly accurate, if the mortality followed the law known as Gompertz's; that is to say, if the number of persons living according to the mortality table at any age, x, could be represented by means of the formula dg^{q^x}. Gompertz proved, in the *Philosophical Transactions* for 1825, that by giving suitable values to the constants, the above formula might be made to represent correctly the number living during a considerable portion of life, say from age 10 to 60; but in order to represent by the same formula the numbers living at higher ages, it is necessary to give fresh values to the constants, and the discontinuity thence resulting has always been a fatal obstacle to the practical use of the formula. It has, however, from its theoretical interest, attracted a great deal of attention from actuaries; and numerous papers on the subject will be found in the *Assurance Magazine*. A claim to the independent (if not prior) discovery of the formula has been put forward by Mr T. R. Edmonds; but this claim, respecting which many communicatious will be found in the *Assurance Magazine*, is generally repudiated by competent judges. De Morgan further showed (*Ass. Mag.*, viii. 181) that if the above property holds good, or $a_{xyz} = a_{wz}$, then the mortality must follow Gompertz's law; and Woolhouse gave independently a simple algebraical demonstration of the same property, x. 121. Makeham removed the above mentioned objection to Gompertz's formula by introducing another factor, and showed (*Ass. Mag.*, xii. 315) that the formula $dg^{q^x}s^x$ will correctly represent the number living at any age x from about the age of 15 upwards to the extremity of life, and this formula has been found very serviceable for certain purposes.

The fact that Gompertz's law does not correctly represent the mortality throughout the whole of life, proves that the above-described practical method of finding the value of an annuity on three joint lives is accurate only in certain cases. Makeham has shown (*Ass. Mag.*, ix. 361, and xiii. 355) that when the mortality follows the law indicated by his modification of Gompertz's formula, the value of an annuity on two, three, or any number of joint lives, can be readily found by means of tables of very moderate extent. Thus the value of an annuity on any two joint lives can be deduced from the value of an annuity at the same rate of interest on two joint lives of equal ages; the value of an annuity on any three joint lives, by means of a table of the values of annuities on three joint lives of equal ages; and so on; and Woolhouse has shown (vol. xv. p. 401) how the values of annuities on any number of joint lives, at any required rate of interest, can be found by means of tables of the values of annuities on a single life at various rates of interest. These methods, we believe, have not hitherto been practically employed to any extent by actuaries, and it would perhaps be premature to say which of them is preferable.

As the reader will have observed, neither Gompertz's nor Makeham's formula represents correctly the rate of mortality for very young ages. Various formulas have been given which are capable of representing with sufficient accuracy the number living at any age from birth to extreme old age, but they are all so complicated that they are of little more than theoretical interest. They are, however, likely to prove of increasing value in the problem of adjusting (or graduating) a table of mortality deduced from observations,—an important subject, which does not fall within the scope of this article. We may mention in particular those given by Lazarus in his *Mortalitätsverhältnisse und ihre Ursache* (*Rates of Mortality and their Causes*), 1867, of which a translation is given by Sprague in the eighteenth volume of the *Assurance Magazine*, namely, $CK^{q^x}h^xH^{p^x}$, and by Gompertz (see *Ass. Mag.*, xvi. 329),

$$l_x = \text{const. } A^{r^x}B^{f^x \cdot x}C^{q^x}D^{P}, \text{ where } P = \theta\omega^{\pi^x(x-n)}.$$

If l_x represents the number living at any age in the mortality table, the force of mortality, or the instantaneous rate of mortality, mentioned above (see p. 83), is equal to $-\frac{d}{dx}\log_e l_x$ Hence, in Gompertz's original law the force of mortality at any age x is proportional to q^x, or is equal to aq^x, where a is a constant; in Makeham's law the force of mortality is equal to $aq^x + b$, where a and b are constants; and in Lazarus's law the force of mortality is equal to $aq^x + b + cp^x$, where a, b, and c are constants, or to $a\epsilon^{-mx} + b + c\epsilon^{nx}$ Dr Thiele has shown (see *Ass. Mag.*, xvi. 313) how to graduate a mortality table, by assuming the formula for the force of mortality, $a_1\epsilon^{-b_1x} + a_2\epsilon^{-\frac{1}{2}b_2^2(x-c)^2} + a_3\epsilon^{b_3x}$, and Makeham has explained (*Ass. Mag.*, xvi. 344) a very convenient practical method for adjustment, which results in assuming that the number living at any age x can be accurately represented by the sum of three terms of the form $dg^{q^x}s^x$.

The employment of formulas such as those given in the last paragraph, and the application of the differential calculus to the theory of life contingencies, have naturally led to an improvement in the theory which is probably destined to become of very great importance—we refer to the introduction of the idea of "continuous" annuities and assurances. If the intervals at which an annuity is payable are supposed to become more and more frequent, until we come to the limit when each payment of the annuity is made momently as it accrues, the annuity is called continuous. Strictly speaking, of course, this is an impossible supposition as regards actual practice; but if an annuity were payable by daily instalments, its value would not differ appreciably from that of a continuous annuity, and if the annuity be paid weekly, the difference will be so small that it may be always safely neglected. The theory of continuous annuities has been fully developed by Woolhouse (*Ass. Mag.*, xv. 95). Assuming the number living in the mortality table at any age x to be represented by l_x, the value of a continuous annuity on a nominee of the age x is $\frac{1}{l_x}\int_x^\infty l_x v^x dx = \frac{1}{l_x}\int_x^\infty l_x \epsilon^{-\delta x} dx$, putting $\delta = \log_\epsilon(1+i)$. From the nature of the case, l_x must be a function that is never negative for positive values of x and as x becomes larger, l_x must continually diminish, and must vanish when x becomes infinite. It will be noticed here that the superior limit of the integral is ∞. This is necessary if l_x is a continuous mathematical function; for in that case, however large x be taken, l_x will never become absolutely zero. Makeham has shown (*Ass. Mag.*, xvii. 305) that when the number living, l_x, can be correctly represented by the formula $cg^{q^x}e^{-ax}$, the value of a continuous annuity is equal to $\frac{1}{\log q} \cdot \frac{1}{10^{-10^z} \cdot \epsilon^{-nz}} \int_z^\infty 10^{-10^z} \cdot \epsilon^{-nz} \cdot dz$, where $n = \frac{\alpha + \delta}{\log_{10} q}$, and $z = x \log_{10} q + \log_{10}^2 \frac{1}{g}$; and he has given (pp. 312–327) a table, by means of which the value of the annuity can be found when the values of n and z are known. This table requires a double interpolation, and is therefore rather troublesome to use. Mr Emory M'Clintock has shown in the eighteenth volume of the *Assurance Magazine*, how the value of an annuity may be found by means of the ordinary tables of the gamma-function. As Lazarus has pointed out in his above-mentioned paper, when mortality tables are given in the ordinary form, it is difficult to compare them and define precisely their differences; but if they can be accurately represented by a formula containing only a few constants, it becomes easy to show wherein one table differs from another; and the methods of Makeham and M'Clintock enable us to compare the values of annuities, for any ages desired, according to different tables as determined by such constants, without the labour of computing the mortality tables in the usual form. They can therefore scarcely fail to grow in popularity as they become better known.

The principal application of the theory of life annuities is found in life insurance. (See INSURANCE.) At the present time there are upwards of one hundred companies of various kinds transacting the business of life insurance in the United Kingdom. It is only since the passing of the Life Assurance Companies Act, 1870, that it has been possible to form an accurate estimate of the extent of the business transacted by these companies; but, from the returns made under that Act, it appears that the total assets of the companies amount to about £110,000,000, which are invested so as to produce an annual income of about £4,000,000, and that the total premiums received annually for insurance amount to about £10,000,000. There is no means at present of saying exactly what is the total sum assured; but it is probably about £330 000,000, the average premium for insurance being about 3 per cent. per annum. The actual transactions at the present time in the purchase and grant of immediate annuities, although small in comparison with the life insurance transactions, are yet of considerable amount. It appears from the returns made under the above-mentioned Act, that upwards of £250,000 is annually paid to insurance companies for the purchase of annuities, and that the aggregate amount of their liabilities under that head is nearly £420,000 a year The Government competes with the companies in the grant of annuities; and although its terms are on the whole very much less favourable than the companies', still in consequence of the greater security offered, the business transacted by the Government is much in excess of that transacted by the whole of the insurance companies. It appears from recent returns (see *Ass. Mag*, xv 23), that the life annuities annually paid by the National Debt Office amount to about £1,000,000, and that about £600,000 is on the average annually invested with the Government for the purchase of fresh annuities. The purchase and grant of life annuities have been carried on to a very considerable extent, apparently at all times. We learn from De Wit's above-mentioned report, that the Governments of Holland and West Friesland had granted annuities systematically for one hundred and fifty years before any correct estimate was formed of the value of a life annuity The British Government has at various times granted life annuities, more especially on the Tontine principle, for the purpose of raising money when it was difficult to obtain the sums required for the public service by the ordinary methods. Various local bodies have at different times raised money on the security of the local rates in consideration of the grant of life annuities; and, at the present time, the Manchester Corporation grants annuities on favourable terms for the purpose of obtaining funds to defray the expense of the waterworks belonging to the city. During the existence of the usury laws, it was very common for persons borrowing money upon the very best security to grant annuities upon their lives in consideration of a present advance. Thus, for example, if a country gentleman of the age of 40 wished to borrow £10,000 upon a landed estate, the law forbade him to pay, or the lender to receive, more than 5 per cent. interest, say £500 a year, but the law did not forbid his granting an annuity of £1000 for his life, secured upon the estate. Speaking roughly, an annual payment of £300 would be required to insure £10,000 upon the borrower's life, and the annuity would therefore return the lender about 7 per cent. interest, in addition to the premium on the insurance necessary to return his capital. In this way the law, which was intended as a protection to the borrower, to enable him to obtain a loan at a fixed moderate rate of interest, very often had the directly opposite effect of greatly increasing the cost of borrowing. The usury laws being now repealed, borrowers and lenders are left at full liberty to make such terms with each other as they may think best. (T. B. S.)

Table (1)—*Showing out of* 1,000,000 *Children born, the Number of Males and Females Surviving at each Age, and the Number Dying in each Year of Life. English Table, No.* 3.

Age.	Males.		Females.		Age	Males.		Females.		Age.	Males.		Females.	
x	Number alive at each age. l_x	Number dying in the following year d_x	Number alive at each age. l_x	Number dying in the following year d_x	x	Number alive at each age l_x	Number dying in the following year. d_x	Number alive at each age. l_x	Number dying in the following year. d_x	x	Number alive at each age. l_x	Number dying in the following year. d_x	Number alive at each age. l_x	Number dying in the following year. d_x
0	511745	83719	488255	65774	37	282296	3352	276563	3326	74	83416	7639	93071	7724
1	428026	27521	422481	26159	38	278944	3406	273237	3350	75	75777	7483	85347	7653
2	400505	14215	396322	14023	39	275538	3465	269887	3376	76	68294	7268	77694	7521
3	386290	9213	382299	9243	40	272073	3529	266511	3402	77	61026	6990	70173	7329
4	377077	6719	373056	6596	41	268544	3596	263109	3431	78	54036	6655	62844	7071
5	370358	5033	366460	4866	42	264948	3668	259678	3459	79	47381	6266	55773	6755
6	365325	3953	361594	3815	43	261280	3746	256219	3490	80	41115	5832	49018	6382
7	361372	3310	357779	3249	44	257534	3826	252729	3522	81	35283	5361	42636	5959
8	358062	2734	354530	2724	45	253708	3912	249207	3655	82	29922	4862	36677	5496
9	355328	2297	351806	2328	46	249796	4001	245652	3591	83	25060	4349	31181	5003
10	353031	1983	349478	2045	47	245795	4095	242061	3627	84	20711	3834	26178	4490
11	351048	1776	347433	1861	48	241700	4192	238434	3665	85	16877	3328	21688	3972
12	349272	1666	345572	1765	49	237508	4292	234769	3705	86	13549	2840	17716	3458
13	347606	1637	343807	1745	50	233216	4395	231064	3746	87	10709	2384	14258	2962
14	345969	1679	342062	1789	51	228821	4626	227318	3788	88	8325	1965	11296	2494
15	344290	1781	340273	1888	52	224195	4758	223530	3832	89	6360	1590	8802	2063
16	342509	1928	338385	2029	53	219437	4885	219698	3876	90	4770	1260	6739	1673
17	340581	2112	336356	2205	54	214552	5013	215822	4246	91	3510	979	5066	1331
18	338469	2320	334151	2400	55	209539	5144	211576	4439	92	2531	744	3735	1037
19	336149	2541	331751	2609	56	204395	5281	207137	4628	93	1787	553	2698	790
20	333608	2764	329142	2819	57	199114	5428	202509	4817	94	1234	401	1908	588
21	330844	2801	326323	2867	58	193686	5584	197692	5009	95	833	285	1320	428
22	328043	2836	323456	2912	59	188102	5752	192683	5206	96	548	196	892	304
23	325207	2868	320544	2952	60	182350	5929	187477	5409	97	352	132	588	210
24	322339	2897	317592	2989	61	176421	6118	182068	6619	98	220	86	378	142
25	319442	2926	314608	3024	62	170303	6314	176449	6835	99	134	55	236	92
26	316516	2954	311579	3055	63	163989	6515	170614	6057	100	79	33	144	59
27	313562	2981	308524	3084	64	157474	6720	164567	6282	101	46	21	85	36
28	310581	3009	305440	3112	65	150754	6921	158275	6509	102	25	11	49	22
29	307572	3038	302328	3138	66	143833	7116	151766	6731	103	14	7	27	12
30	304534	3068	299190	3163	67	136718	7297	145035	6947	104	7	3	15	7
31	301466	3100	296027	3187	68	129421	7458	138088	7149	105	4	2	8	4
32	298366	3134	292840	3209	69	121963	7593	130939	7332	106	2	1	4	2
33	295232	3171	289631	3233	70	114370	7695	123607	7489	107	1	1	2	1
34	292061	3211	286398	3255	71	106675	7756	116118	7613	108	...	...	1	1
36	288850	3254	283143	3279	72	98919	7770	108505	7698	109	...	...	...	...
36	285596	3300	279864	3301	73	91149	7733	100807	7736					

TABLE (2). —*Showing the Probability of a Male or Female of any Age Dying within a Year. English Table, No. 3.*

Age x.	Probability of Dying in a Year q_x		Age x	Probability of Dying in a Year. q_x		Age. x.	Probability of Dying in a Year. q_x	
	Males.	Females.		Males.	Females.		Males.	Females.
0	163597	134714	37	011873	012025	73	084840	076748
1	064298	061918	38	012212	012262	74	091570	082984
2	035494	035383	39	012575	012508	75	098758	089668
3	023850	024178	40	012968	012766	76	106412	096812
4	017820	017683	41	013392	013038	77	114544	104430
5	013590	013278	42	013845	013320	78	123154	112526
6	010820	010554	43	014334	013620	79	132256	121112
7	009160	009080	44	014858	013936	80	141844	130192
8	007636	007684	45	015418	014268	81	151926	139774
9	006465	006618	46	016018	014618	82	162500	149855
10	005616	005853	47	016660	014985	83	173564	160440
11	005060	005358	48	017343	015373	84	185116	171528
12	004768	005108	49	018072	015780	85	197148	183115
13	004710	005074	50	018844	016210	86	209654	195196
14	004854	005232	51	020220	016666	87	222626	207767
15	005173	005548	52	021222	017142	88	236050	220814
16	005630	005998	53	022263	017646	89	249914	234332
17	006203	006553	54	023364	019673	90	264203	248302
18	006854	007184	55	024548	020980	91	278900	262710
19	007558	007865	56	025838	022344	92	293987	277543
20	008285	008563	57	027260	023788	93	309442	292778
21	008468	008788	58	028830	025338	94	325243	308397
22	008645	009004	59	030575	027018	95	341367	324373
23	008820	009210	60	032518	028850	96	357787	340687
24	008990	009413	61	034676	030862	97	374479	357309
25	009160	009610	62	037074	033070	98	391411	374210
26	009333	009805	63	039733	035500	99	408556	391353
27	009507	009998	64	042672	038178	100	425883	408738
28	009688	010190	65	045910	041123	101	443358	426301
29	009878	010378	66	049470	044354	102	460953	444021
30	010073	010570	67	053370	047898	103	478631	461863
31	010283	010764	68	057626	051772	104	496361	479793
32	010504	010962	69	062256	055994	105	514109	497777
33	010740	011163	70	067278	060536	106	531839	515777
34	010994	011368	71	072708	065563	107	549520	533760
35	011265	011580	72	078556	070946	108	567116	551688
36	011558	011798						

TABLE (3).—*Auxiliary (D and N) Table for finding the Values of Annuities at 3 per cent. Interest. English Table, No. 3. Males.*

Age. x	D_x	N_x	Age. x.	D_x	N_x	Age. x.	D_x	N_x
0	511745	9288491	37	94564	1635186	74	9360·4	60726·5
1	415559	8872932	38	90720	1544466	75	8255·5	42471·0
2	377514	8495418	39	87002	1457464	76	7223·5	35247·5
3	353510	8141908	40	83406	1374058	77	6266·9	28980·6
4	335028	7806880	41	79926	1294132	78	5387·4	23593·2
5	319474	7487406	42	76559	1217573	79	4586·3	19006·9
6	305953	7181453	43	73300	1144273	80	3863·8	15143·1
7	293828	6887625	44	70145	1074128	81	3219·2	11923·9
8	282657	6604968	45	67090	1007038	82	2650·6	9273·3
9	272329	6332639	46	64132	942906	83	2155·2	7118·1
10	262688	6069951	47	61267	881639	84	1729·3	5388·8
11	253605	5816346	48	58191	823148	85	1368·1	4020·7
12	244972	5571374	49	55803	767345	86	1066·4	2954·30
13	236703	5334671	50	53198	714147	87	818·28	2136·02
14	228726	5105945	51	50676	663471	88	617·58	1518·44
15	220987	4884958	52	48205	615266	89	458·06	1060·35
16	213441	4671517	53	45808	569458	90	333·58	726·80
17	206057	4465460	54	43483	525975	91	238·30	488·50
18	198815	4266645	55	41230	484745	92	166·83	321·67
19	191701	4074944	56	39047	445698	93	114·35	207·323
20	184711	3890233	57	36930	408768	94	76·668	130·655
21	177845	3712388	58	34877	373891	95	50·225	80·430
22	171203	3541185	59	32885	341006	96	32·117	48·313
23	164780	3376405	60	30951	310055	97	20·025	28·288
24	158570	3217835	61	29072	280983	98	12·161	16·1271
25	152567	3065268	62	27247	253736	99	7·1856	8·9415
26	146767	2918501	63	25472	228264	100	4·1261	4·8154
27	141162	2777339	64	23748	204516	101	2·2999	2·5155
28	135748	2641591	65	22072	182444	102	1·2429	1·2726
29	130517	2511074	66	20446	161998	103	·6505	·6221
30	125464	2385610	67	18868	143130	104	·3293	·2928
31	120583	2265027	68	17341	125789	105	·1610	·1318
32	115867	2149160	69	15866	109923	106	·0759	·0559
33	111310	2037850	70	14445	95478	107	·0345	·0214
34	106907	1930943	71	13080	82398	108	·0151	·0063
35	102653	1828290	72	11776	70622	109	·0063	·0000
86	95540	1729750	73	10535	60086·9			

TABLE (4).—*Auxiliary (D and N) Table for finding the Values of Annuities at 3 per cent. Interest. English Table, No. 3, Females.*

Age. x.	D_x	N_x	Age. x.	D_x	N_x	Age. x.	D_x	N_x
0	488255	9203701	37	92644	1647581	74	10444	60281·5
1	410175	8793526	38	88864	1558717	75	9298·2	50983·3
2	373571	8419955	39	85218	1473499.	76	8217·9	42765·4
3	349858	8070097	40	81701	1391798	77	7206·1	35559·3
4	331456	7738641	41	78309	1313489	78	6265·6	29293·7
5	316112	7422529	42	75036	1238453	79	5398·6	23895·1
6	302830	7119699	43	71880	1166573	80	4606·6	19288·5
7	290907	6828792	44	68836	1097737	81	3890·1	15398·4
8	279870	6548922	45	65900	1031837	82	3248·9	12149·5
9	269630	6279292	46	63068	968769	83	2681·6	9467·9
10	260044	6019248	47	60336	908433	84	2185·8	7282·1
11	250993	5768255	48	57701	850732	85	1758·1	5524·0
12	242377	5525878	49	55159	795573	86	1394·4	4129·6
13	234116	5291762	50	52707	742866	87	1089·5	3040·10
14	226143	5065619	51	50343	692523	88	838·00	2202·10
15	218408	4847211	52	48062	644461	89	683·94	1568·16
16	210870	4636341	53	45862	598599	90	471·25	1096·91
17	203501	4432840	54	43741	554858	91	343 92	752·99
18	196279	4236561	55	41631	513227	92	246·18	506·81
19	189193	4047368	56	39571	473656	93	172·68	334·13
20	182238	3865130	57	37560	436096	94	118·56	215·574
21	175415	3689715	58	35598	400498	95	79·611	135·963
22	168809	3520906	59	33686	366812	96	52·221	83·742
23	162417	3358489	60	31821	334991	97	33·427	50·315
24	156234	3202255	61	30003	304988	98	20·858	29·457
25	150236	3051999	62	28230	276758	99	12·672	16·7848
26	144478	2907521	63	26501	250257	100	7·4882	9·2966
27	138894	2768627	64	24816	225441	101	4·2985	4·9981
28	133501	2635126	65	23174	202267	102	2·3942	2·6039
29	128292	2506834	66	21573	180694	103	1·2924	1·3115
30	123262	2383572	67	20016	160678	104	·6752	·6363
31	118407	2265165	68	18502	142176	105	·3410	·2953
32	113721	2151444	69	17033	125143	106	·1663	·1290
33	109198	2042246	70	15611	109532	107	·0782	·0508
34	104835	1937411	71	14238	95294	108	·0354	·0154
35	100624	1836787	72	12917	82377	109	0154	·0000
36	96562	1740225	73	11651	70726			

TABLE (5).—*Showing the Value of an Annuity, at 3 per cent., on the Life of a Male or Female of any Age. English Table, No. 3.*

Age. x.	Value of Annuity. a_x		Age. x.	Value of Annuity. a_x		Age. x.	Value of Annuity. a_x	
	Males.	Females.		Males.	Females.		Males.	Females.
0	18·1506	18·8502	34	18·0618	18·4807	68	7·2539	7·6842
1	21·3518	21·4385	35	17·8105	18·2539	69	6·9284	7·3469
2	22·5036	22·5391	36	17·5538	18·0218	70	6·6100	7·0162
3	23·0316	23·0668	37	17·2918	17·7841	71	6·2993	6·6928
4	23·3022	23·3474	38	17·0245	17·5405	72	5·9971	6·3773
5	23·4367	23·4807	39	16·7521	17·2910	73	5·7036	6·0702
6	23·4724	23·5106	40	16·4744	17·0353	74	5·4193	5·7721
7	23·4410	23·4742	41	16·1916	16·7733	75	5·1445	5·4832
8	23·3674	23·3999	42	15·9037	16·5047	76	4·8795	5·2039
9	23·2536	23·2886	43	15·6108	16·2293	77	4·6244	4·9346
10	23·1071	23·1470	44	15·3129	15·9471	78	4·3793	4·6753
11	22·9347	22·9818	45	15·0102	15·6576	79	4·1442	4·4262
12	22·7429	22·7987	46	14·7026	15·3608	80	3·9193	4·1872
13	22·5374	22·6032	47	14·3902	15·0563	81	3·7040	3·9583
14	22·3234	22·4000	48	14·0730	14·7439	82	3·4986	3·7395
15	22·1052	22·1933	49	13·7511	14·4233	83	3·3027	3·5307
16	21·8867	21·9867	50	13·4242	14·0942	84	3·1162	3·3315
17	21·6710	21·7829	51	13·0925	13·7562	85	2·9388	3·1419
18	21·4604	21·5844	52	12·7636	13·4090	86	2·7703	2·9617
19	21·2568	21·3928	53	12·4315	13·0522	87	2·6104	2·7904
20	21·0612	21·2093	54	12·0960	12·6852	88	2·4587	2·6278
21	20·8743	21·0342	55	11·7570	12·3279	89	2·3149	2·4737
22	20·6841	20·8573	56	11·4145	11·9699	90	2·1788	2·3277
23	20·4904	20·6782	57	11·0687	11·6107	91	2·0500	2·1894
24	20·2929	20·4965	58	10·7203	11·2505	92	1·9281	2·0586
25	20·0913	20·3120	59	10·3697	10·8892	93	1·8129	1·9350
26	19·8853	20·1244	60	10·0176	10·5274	94	1·7042	1·8181
27	19·6748	19·9334	61	9·6650	10·1653	95	1·6014	1·7078
28	19·4596	19·7387	62	9·3125	9·8037	96	1·5043	1·6036
29	19·2394	19·5401	63	8·9612	9·4431	97	1·4126	1·5052
30	19·0143	19·3374	64	8·6119	9·0844	98	1·3261	1·4123
31	18·7840	19·1303	65	8·2657	8·7284	99	1·2444	1·3245
32	18·5486	18·9187	66	7·9233	8·3758	100	1·1671	1·2415
33	18·3078	18·7022	67	7·5858	8·0275			

ANNUNCIATION, the announcement made by the angel Gabriel to the Virgin Mary of the incarnation of Christ (Luke i. 26–38). A festival commemorative of the annunciation is kept by the church on the 25th of March. The first authentic allusions to it are in a canon of the Council of Toledo (656 A.D.), and another of the Council of Trullo (692), forbidding the celebration of all festivals in Lent, excepting the Lord's day and the Feast of the Annunciation. An earlier origin has been claimed for it on the ground that it is mentioned in sermons of Athanasius and of Gregory Thaumaturgus, but both these documents are now admitted to be spurious.

ANODYNE (α privative, and ὀδύνη, pain), denotes etymologically anything which relieves pain. The common usage of the word restricts it, however, to medicines which lessen the sensibility of the brain or nervous system, without acting directly on the cause of pain The anodynes generally employed are opium, henbane, hemlock, tobacco, stramonium, and chloroform.

ANOINTING, the practice of pouring an aromatic oil upon the head or over the whole body, has been in use from the earliest times among Oriental nations, from whom it passed, chiefly in its ceremonial application, to the nations of the west. It served three distinct purposes, being regarded as a means of health and comfort, as a token of honour, or as a symbol of consecration. Reasoning from analogy, it seems probable that anointing was practised for sanative reasons before it became a religious ceremonial, but it is impossible to determine this with certainty. Its adoption as a sanative agent was dictated chiefly by the conditions of climate in the East. Used as it generally was in conjunction with the bath, it closed the pores, repressed undue perspiration, and so prevented loss of strength. It was also regarded as a protection against the heat of the sun, and the oil, being aromatic, counteracted disagreeable smells The anointing of the head as a token of honour paid to guests and strangers is mentioned in Scripture (Ps. xxiii. 5, Luke vii. 46), and was customary among the Egyptians (Wilkinson's *Ancient Egyptians*, ii. 213), the Greeks, and the Romans. Anointing as a symbol of consecration was practised among the Jews from the time of the exodus from Egypt, as part of the ceremonial investiture with the sacred offices of prophet (1 Kings xix. 16), priest (Exod. xxix. 7), and king (1 Sam. ix. 16). It does not seem to have been essential to the consecration of a prophet, and, as each individual holder of the office of priest or king was not anointed, it has been generally inferred that in these cases it was essential only at the consecration of a new line or dynasty. The titles *Messiah* and *Christ*, both meaning anointed, are applied to our Saviour as the anti-typical prophet, priest, and king. Anointing has passed from the Jewish into the Christian economy, and finds a place in the rites of baptism, confirmation, dedication of a church, &c., as these are administered in the Roman Catholic and Episcopalian communions. Its use at coronations symbolises the idea of monarchy as a mediate theocracy The practice of anointing the sick in the primitive church, and the dying in the Roman Catholic Church, will be found treated in the article EXTREME UNCTION.

ANOUKIS, or ANAKA, the name of an Egyptian goddess, one of the contemplar or companion goddesses of Khnum or Chnoumis. Her name meant "the Clasper" or "Embracer." She belonged to the "triad of Elephantine," formed of Khnum or Chnoumis, Sati or Satis —the Egyptian Hera or Juno, "the sunbeam"—and herself. As Sati personified the upper world or hemisphere, and wore the white crown upon her head, so Anoukis wore the red crown, emblem of the lower world or hemisphere. She personified Hestia or Vesta, and had the crown surmounted by a tiara of feathers, similar to those of the Pulusata, or supposed Pelasgi, and Tsakkaru, or Teucri, as if she had been a goddess of these nations. Some have compared her name to that of the Phœnician goddess *Onga*. It rarely appears in the texts and monuments, although it is occasionally seen. Statuettes of Anoukis are of the greatest rarity, if, indeed, they occur. —Champollion, *Panth. Egypt;* Wilkinson, *Mann. and Cust.*, v. p. 26, Rosellini, *Mon. d. Cult.*, ii., Letronne, *Recherches*, pp. 345–6.

ANQUETIL, LOUIS PIERRE, a French historian, was born at Paris, 21st Jan. 1723. He was for some time director of the academy at Rheims, and published in 1757 three volumes of a history of that city. In 1759 he was appointed prior of the abbey de la Roe, in Anjou, and soon after director of the college of Senlis. In 1766 he obtained the curacy or priory of Chateau-Renard, near Montargis, which he exchanged, at the commencement of the Revolution, for the curacy of La Villette, in the neighbourhood of Paris. During the reign of terror he was imprisoned at St Lazare. On the establishment of the National Institute he was elected a member of the second class, and was soon afterwards employed in the office of the minister for foreign affairs. He died on the 6th of September 1808. Anquetil left a very considerable number of historical works; but his style is censurable in many respects, and he appears to have been almost entirely destitute of the critical discernment and philosophical sagacity of a good historian. A list of his works is given in the *Biographie Universelle*.

ANQUETIL DU PERRON, ABRAHAM HYACINTHE, an eminent Oriental scholar, brother of the subject of the preceding article, was born at Paris 7th Dec. 1731. He was a distinguished student at the university of that city, and at first intended to enter the church; but his taste for Hebrew, Arabic, Persian, and other languages of the East, developed into a passion, and he discontinued his theological course to devote himself entirely to them. His diligent attendance at the Royal Library, and his ardour in the prosecution of his favourite studies, attracted the attention of the keeper of the manuscripts, the Abbé Sallier, whose influence procured for him a small salary as student of the Oriental languges. He had scarcely received this appointment, when, lighting on some manuscripts in the Zend, he formed the project of a voyage to India, with the view of discovering the works of Zoroaster. Seeing no other means of accomplishing his plan, he enlisted as a common soldier on the 7th of November 1754, in the Indian expedition which was about to start from the port of L'Orient. His friends procured his discharge, and the minister, affected by his romantic zeal for knowledge, granted him a free passage, a seat at the captain's table, and a salary, the amount of which was to be fixed by the governor of the French settlement in India. After a passage of nine months, Anquetil landed, on the 10th of August 1755, at Pondicherry. Here he remained a short time to master modern Persian, and then hastened to Chandernagore, to acquire Sanscrit. Just then war was declared between France and England; Chandernagore was taken; and Anquetil resolved to return to Pondicherry by land. The journey was one of a hundred days, and he had many adventures and suffered many hardships by the way. He found one of his brothers at Pondicherry, and embarked with him for Surat, but, with the view of exploring the country, he landed at Mahe, and proceeded on foot. At Surat he succeeded, by perseverance and address in his intercourse with the native priests, in acquiring a sufficient knowledge of the languages to enable him to translate the dictionary called the *Vedidad-Sade*, and some other works. Thence he proposed going to

Benares, to study the languages, antiquities, and sacred laws of the Hindus; but the capture of Pondicherry obliged him to quit India. Returning to Europe in an English vessel, he spent some time in London and Oxford, and then set out for France. He arrived in Paris in May 1762, without fortune or the desire of acquiring it, but esteeming himself rich in the possession of one hundred and eighty Oriental manuscripts, besides other curiosities. The Abbé Barthelemy procured for him a pension, with the appointment of interpreter of Oriental languages at the Royal Library. In 1763 he was elected an associate of the Academy of the Belles Letters; and began to arrange for the publication of the materials he had collected during his Eastern travels. In 1771 he published in three vols. 4to, the *Zend-Avesta*, containing collections from the sacred writings of the Persians, a life of Zoroaster, and fragments of works ascribed to that sage. The work was a very important accession to our stores of Oriental literature. Sir John Malcolm (*Hist. of Persia*, vol. i. p. 193, note) refers to the *Zend-Avesta* as the most authentic source of information on the religion and institutions of the great Persian legislator. In 1778 he published his *Législation Orientale*, in which he controverted the system of Montesquieu, and endeavoured to prove that the nature of Oriental despotism had been greatly misrepresented. His *Recherches Historiques et Géographiques sur l'Inde* appeared in 1786, and formed part of Thieffenthaler's *Geography of India*. The Revolution seems to have greatly affected him. During that period he abandoned society, and shut himself up in literary seclusion. In 1798 he published in 2 vols. 8vo, *L'Inde en Rapport avec l'Europe*, a work remarkable for its invectives against the English, and its numerous misrepresentations. In 1804 he published in 2 vols. 4to, a Latin translation from the Persian of the *Oupnek'hat* or *Upanischada, i.e.*, secrets which must not be revealed. It is a curious mixture of Latin, Greek, Persian, Arabic, and Sanscrit. (See *Ed. Rev.*, vol. i. pp. 412–421). On the reorganisation of the Institute, Anquetil was elected a member, but soon afterwards gave in his resignation. He died at Paris 17th January 1805. Besides the works named above, he was the author of several others on subjects connected with the history and antiquities of the East. See *Biographie Universelle; Monthly Review*, vol. lxi.; Lord Teignmouth's *Life of Sir William Jones*.

ANSBACH, or ANSPACH, originally ONOLZBACH, a town of Bavaria, capital of the circle of Middle Franconia, and formerly of the margraviate of Ansbach, situated on the Rezat, 25 miles S.W. of Nuremberg, and 90 N. of Munich. It is a pleasantly-built place, containing a castle, once the residence of the margraves, and still noted for the gardens that surround it; several churches, the finest of which are those dedicated to St John and St Gunibert; a gymnasium; and a picture gallery. The chief manufactures of Ansbach are woollen, cotton, and half-silk stuffs, earthenware, tobacco, cutlery, and playing cards. There is a considerable trade in grain, wool, and flax. In 1791 the last margrave of Ansbach sold his principality to Frédérick William II., king of Prussia; it was transferred by Napoleon to Bavaria in 1806, an act which was confirmed by the Congress of Vienna in 1815. Population of the town, 12,635.

ANSELM, Archbishop of Canterbury, was born in 1033, at or near Aosta, in Piedmont. His family was accounted noble, and was possessed of considerable property. Gundulph, his father, was by birth a Lombard, and seems to have been a man of harsh and violent temper; his mother, Ermenberga, was a prudent and virtuous woman, from whose careful religious training the young Anselm derived much benefit. At the early age of fifteen he desired to devote himself to the service of God by entering a convent, but he could not obtain his father's consent. Disappointment brought on an illness, on his recovery from which he seems for a time to have given up his studies, and to have plunged into the gay life of the world. During this time his mother died, and his father's harshness became unbearable. He left home, and with only one attendant crossed the Alps, and wandered through Burgundy and France. Attracted by the fame of his countryman, Lanfranc, then prior of Bec, he entered Normandy, and, after spending some time at Avranches, settled at the monastery of Bec. There, at the age of twenty-seven, he became a monk; three years later, when Lanfranc was promoted to the abbacy of Caen, he was elected prior. This office he held for fifteen years, and then, in 1078, on the death of Herluin, the warrior-monk who had founded the monastery, he was made abbot. Under his rule Bec became the first seat of learning in Europe, a result due not more to his intellectual powers than to the great moral influence of his noble character, and his loving, kindly discipline. It was during these quiet years at Bec that Anselm wrote his first philosophical and religious works, the dialogues on Truth and Freewill, and the two celebrated treatises, the *Monologion* and *Proslogion*. Meanwhile the convent had been growing in wealth, as well as in reputation, and, among other properties, had acquired considerable possessions in England. Anselm paid frequent visits to that country in connection with the convent lands, and by his mildness of temper and unswerving rectitude, so endeared himself to the English that he was looked upon and desired as the natural successor to Lanfranc, then archbishop of Canterbury. But on the death of that great man, the ruling sovereign, William Rufus, seized the possessions and revenues of the see, and made no new appointment. About four years after, in 1092, on the invitation of Hugh, earl of Chester, Anselm, with some reluctance, for he feared to be made archbishop, crossed to England. He was detained by business for nearly four months, and when about to return, was refused permission by the king. In the following year William fell ill, and thought his death was at hand. Eager to make atonement for his sin with regard to the archbishopric, he nominated Anselm to the vacant see, and, after a great struggle, compelled him to accept the pastoral staff of office. After obtaining dispensation from his duties in Normandy, Anselm was consecrated in 1093. He demanded of the king, as the conditions of his retaining office, that he should give up all the possessions of the see, accept his spiritual counsel, and acknowledge Urban as Pope, in opposition to the anti-pope, Clement. He only obtained a partial consent to the first of these, and the last involved him in a serious difficulty with the king. It was a rule of the church that the consecration of metropolitans could not be completed without their receiving from the hands of the Pope the *Pallium*, or robe. Anselm, accordingly, insisted that he must proceed to Rome to receive the pall. But William would not permit this; he had not acknowledged Urban, and he maintained his right to prevent any Pope being acknowledged by an English subject without his permission. A great council of churchmen and nobles, held to settle the matter, advised Anselm to submit to the king, but failed to overcome his mild and patient firmness. The matter was postponed, and William meanwhile privately sent messengers to Rome, who acknowledged Urban, and prevailed on him to send a legate to the king, bearing the archiepiscopal pall. A partial reconciliation was then effected, and the matter of the pall was compromised. It was not given by the king, but was laid on the altar at Canterbury, whence Anselm took it. Little more than a year after, fresh trouble arose with the king, and Anselm resolved to proceed to Rome and seek the counsel of his spiritual father.

With great difficulty he obtained a reluctant permission to leave, and in October 1097 he set out for Rome. William immediately seized on the revenues of the see, and retained them to his death. Anselm was received with high honour by Urban, and at a great council held at Bari, he was put forward to defend the Latin doctrine of the Holy Ghost against the objections of the Greek Church. But Urban was too politic to embroil himself with the king of England, and Anselm found that he could obtain no substantial result. He withdrew from Rome, and spent some time at the little village of Schlavia. Here he finished his treatise on the atonement, *Cur Deus homo*, and then retired to Lyons. In 1100 William was killed, and Henry, his successor, at once recalled Anselm. But Henry demanded that he should again receive from him in person investiture in his office of archbishop, thus making the dignity entirely dependent on the royal authority. Now, the Papal rule in the matter was plain; all homage and lay investiture were strictly prohibited. Anselm represented this to the king; but Henry would not relinquish a privilege possessed by his predecessors, and proposed that the matter should be laid before the Holy See. The answer of the Pope reaffirmed the law as to investiture. A second embassy was sent, with a similar result. Henry, however, remained firm, and at last, in 1103, Anselm and an envoy from the king set out for Rome. The Pope, Paschal, reaffirmed strongly the rule of investiture, and passed sentence of excommunication against all who had infringed the law, except Henry. Practically this left matters as they were, and Anselm, who had received a message forbidding him to return to England, unless on the king's terms, withdrew to Lyons, where he waited to see if Paschal would not take stronger measures. At last, in 1105, he resolved himself to excommunicate Henry. His intention was made known to the king through his sister, and it seriously alarmed him, for it was a critical period in his affairs. A meeting was arranged, and a reconciliation between them effected. In 1106 Anselm crossed to England, with power from the Pope to remove the sentence of excommunication from the illegally invested churchmen. In 1107 the long dispute as to investiture was finally ended by the king resigning his formal rights. The remaining two years of Anselm's life were spent in the duties of his archbishopric. He died 21st April 1109. His canonization appears to have taken place in 1494.

Anselm may, with some justice, be considered the first scholastic philosopher and theologian. His only great predecessor, Scotus Erigena, had more of the speculative and mystical element than is consistent with a schoolman; but in Anselm are found that recognition of the relation of reason to revealed truth, and that attempt to elaborate a rational system of faith, which form the special characteristics of scholastic thought. His constant endeavour is to render the contents of the Christian consciousness clear to reason, and to develop the intelligible truths interwoven with the Christian belief. The necessary preliminary for this is the possession of the Christian consciousness. "He who does not believe will not experience; and he who has not experienced will not understand." That faith must precede knowledge is reiterated by him. "Neque enim quæro intelligere ut credam, sed credo ut intelligam. Nam et hoc credo, quia, nisi credidero, non intelligam." "Christianus per fidem debet ad intellectum proficere, non per intellectum ad fidem accedere." "Rectus ordo exigit, ut profunda Christianæ fidei credamus, priusquam ea præsumamus ratione discutere." But after the faith is held fast, the attempt must be made to demonstrate by reason the truth of what we believe. It is wrong not to do so. "Negligentiæ mihi esse videtur, si, postquam confirmati sumus in fide, non studemus quod credimus, intelligere." To such an extent does he carry this demand for rational explanation that, at times, it seems as if he claimed for unassisted intelligence the power of penetrating even to the mysteries of the Christian faith. On the whole, however, the qualified statement is his real view; merely rational proofs are always, he affirms, to be tested by Scripture. (*Cur Deus homo*, i. 2 and 38; *De Fide Trin.* 2.)

The groundwork of his theory of knowledge is contained in the tract *De Veritate*, in which, from the consideration of truth as in knowledge, in willing, and in things, he rises to the affirmation of an absolute truth, in which all other truth participates. This absolute truth is God himself, who is therefore the ultimate ground or principle both of things and of thought. The notion of God comes thus into the foreground of the system; before all things it is necessary that it should be made clear to reason, that it should be demonstrated to have real existence. This demonstration is the substance of the *Monologion* and *Proslogion*. In the first of these the proof rests on the ordinary grounds of realism, and coincides to some extent with the earlier theory of Augustine, though it is carried out with singular boldness and fulness. Things, he says, are called good in a variety of ways and degrees; this would be impossible if there were not some absolute standard, some good in itself, in which all relative goods participate. Similarly with such predicates as great, just; they involve a certain greatness and justice. The very existence of things is impossible without some one Being, by whom they are. This absolute Being, this goodness, justice, greatness, is God. Anselm was not thoroughly satisfied with this reasoning; it started from *a posteriori* grounds, and contained several converging lines of proof. He desired to have some one short demonstration. Such a demonstration he presented in the *Proslogion*; it is his celebrated ontological proof. God is that being than whom none greater can be conceived. Now, if that than which nothing greater can be conceived existed only in the intellect, it would not be the absolutely greatest, for we could add to it existence in reality. It follows, then, that the being than whom nothing greater can be conceived, *i.e.*, God, necessarily has real existence. This proof has rarely seemed satisfactory. It was opposed at the time by the monk Gaunilo, in his *Liber pro Insipiente*, on the ground that we cannot pass from idea to reality. The same criticism is made by several of the later schoolmen, among others by Aquinas, and is in substance what Kant advances against all ontological proof. Anselm replied to the objections of Gaunilo in his *Liber Apologeticus*. The existence of God being thus held proved, he proceeds to state the rational grounds of the Christian doctrines of creation and of the Trinity. With reference to this last, he says we cannot know God from himself, but only after the analogy of his creatures; and the special analogy used is the self-consciousness of man, its peculiar double nature, with the necessary elements, memory and intelligence, representing the relation of the Father and the Son. The mutual love of these two, proceeding from the relation they hold to one another, symbolises the Holy Spirit. The further theological doctrines of man, original sin, free will, are developed, partly in the *Monologion*, partly in special treatises. Finally, in his greatest work, *Cur Deus homo*, he undertakes to make plain, even to infidels, the rational necessity of the Christian mystery of the atonement. The theory rests on three positions: that satisfaction is necessary on account of God's honour and justice; that such satisfaction can be given only by the peculiar personality of the God-man; that such satisfaction is really given by the voluntary death of this infinitely valuable person. The demonstration is, in brief, this. All the actions of men are due to the furtherance of God's glory; if, then, there be sin, *i.e.*, if God's honour be wounded, man of himself can give no satisfaction. But the justice of God demands satisfaction; and as an insult to infinite honour is in itself infinite, the satisfaction must be infinite, *i.e.*, it must outweigh all that is not God. Such a penalty can only be paid by God himself, and, as a penalty for man, must be paid under the form of man. Satisfaction is only possible through the God-man. Now this God-man, as sinless, is exempt from the punishment of sin; His passion is therefore voluntary, not given as due. The merit of it is therefore infinite; God's justice is thus appeased, and His mercy may extend to man. This theory has exercised immense influence on the form of church doctrine. It is certainly an advance on the older patristic theory, in so far as it substitutes for a contest between God and Satan, a contest between the goodness and justice of God; but it puts the whole relation on a merely legal footing, gives it no ethical bearing, and neglects altogether the consciousness of the individual to be redeemed. In this respect it contrasts unfavourably with the later theory of Abelard.

Anselm's speculations did not receive, in the Middle Ages, the respect and attention justly their due. This was perhaps owing to their unsystematic character, for they are generally tracts or dialogues on detached questions, not elaborate treatises like the great works of Albert, Aquinas, and Duns Scotus. They have, however, a freshness and philosophical vigour, which more than makes up for their want of system, and which raises them far above the level of most scholastic writings.

A full account of Anselm's life is given by Eadmer, *Vita Anselmi*. His works have been frequently published; the best editions are by Gerberon (containing the life, by Eadmer), Paris, 1675, 2nd ed. 1721; and in Migne, *Patrologiæ Cursus Completus*, vol. clv.

The *Cur Deus homo* has been frequently published in a separate form. The *Monologion* and *Proslogion* have been translated, with notes, by Bouchitté, *Le Rationalisme Chrétien*, Paris, 1842. In addition to the copious notices in general histories of theology and philosophy, the following works may be referred to:—Möhler, *Anselm*, translated into English, 1842; Franck, *Anselm von Canterbury*, 1842; Hasse, *Anselm von Canterbury*, I. "Leben," 1843, II. "Philosophie," 1852; Remusat, *Anselm de Cantorbéry*, 1855, 2d ed. 1868; R. W. Church, *St Anselm*, 1870.

ANSELM, of LAON, a famous theologian, was born of very humble parents at Laon before the middle of the 11th century. He is said to have studied under St Anselm at Bec. About 1076 he taught at Paris with great success, but not long afterwards removed to his native place, where his school for theology rapidly became the most famous in Europe. He died 1117. His greatest work was an interlinear gloss on the Scriptures, which has been frequently reprinted. Other commentaries apparently by him have been ascribed to various writers, principally to the great Anselm. A list of them, with notice of Anselm's life, is contained in the *Histoire Littéraire de la France*, x. 170–189.

ANSON, GEORGE, LORD, the famous circumnavigator, was born at Shuckborough Manor, Staffordshire, on the 22d of April 1697. He entered the navy at the age of fifteen. By the time he was twenty-one he had been promoted to the command of the "Weasel" sloop, and by 1724 to the command of the man-of-war "Scarborough." Between this year and 1735 he was engaged in active service, chiefly on the Carolina stations in America, and a town and county, named Ansonborough, in South Carolina, commemorate his residence there. He was recalled in 1739, on the outbreak of the Spanish war, and entrusted with the command of a squadron of eight vessels, equipped to annoy the Spaniards in the South Seas, and to co-operate with Admiral Vernon across the Isthmus of Darien. Anson sailed in September 1740; doubled Cape Horn in a dangerous season; lost most of his men by the scurvy, and with only one remaining ship, the "Centurion," crossed the Pacific Ocean. If no considerable national advantage resulted from this voyage, Commodore Anson made his own fortune, and enriched his surviving companions, by the capture of a rich galleon on her passage from Acapulco to Manilla. He was no less fortunate in escaping a French fleet, then cruising in the Channel, by sailing through it during a fog. Soon after his return, in 1744, he was appointed rear-admiral of the blue, and one of the lords of the Admiralty. In April 1745 he was made rear-admiral of the white, and the following year vice-admiral of the blue, when he was chosen member of parliament for the borough of Heydon. In 1747 he intercepted, off Cape Finisterre, a powerful fleet, bound from France to the East and West Indies, taking six men-of-war and four East Indiamen, not one of them escaping. The French admiral, Jonquiere, on presenting his sword to the conqueror, said, *Monsieur, vous avez vaincu l'Invincible, et la Gloire vous suit*—"Sir, you have conquered the Invincible, and Glory follows you," pointing to the ships named the "Invincible" and the "Glory," which he had taken. For his signal services he was created Baron Anson, of Soberton, in Hants, and vice-admiral of the red; and, on the death of Sir John Norris, vice-admiral of England. In 1748 he was made admiral of the blue. In 1757 he became first lord of the Admiralty, and in 1761 admiral of the fleet, in which rank he continued, with a very short interval, until his death; and the last service he performed was to convey Queen Charlotte to England. He died 6th June 1762. No book ever met with a more favourable reception than *Lord Anson's Voyage Round the World*, which, though printed under the name of his chaplain, was composed by Benjamin Robins under the inspection of, and from materials furnished by Lord Anson.

ANSTEY, CHRISTOPHER, poet, was son of the Rev. Christopher Anstey, rector of Brinkley, Cambridgeshire, where he was born in 1724–5. He was educated at Eton and King's college, Cambridge. He was originally designed for the church, but his degrees being withheld from him, he retired into privacy "upon a competent fortune." He was rusticated from the university. A speech made by him in one of the public schools upon some offence given by him, thus began, "Doctores sine doctrinâ, magistri artium sine artibus, et baccalaurei baculo potius quam lauro digni." The penalty was his rustication. He entered the army, and having married a daughter of Cabert of Allbury Hall, Herts, he obtained a seat in parliament for Hertford by his father-in-law's influence. One of the most glaring of current literary blunders is the common statement that the *New Bath Guide* of Christopher Anstey was in a great measure built on Smollett's novel of *Humphrey Clinker*. The facts are that the *New Bath Guide* was published in 1766, whilst *Humphrey Clinker* was not written until 1770, and was first published in 1771. It may be conceded that Sir Walter Scott holds the balance even in his verdict, as follows:—"But Anstey's diverting satire was but a slight sketch compared to the finished and elaborate manner in which Smollett has, in the first place, identified his characters, and then filled them with language, sentiments, and powers of observation in exact correspondence with their talents, temper, condition, and disposition" (*Works of Smollett*, Introduction). Perhaps "diverting" is a rather inadequate word, for there is depth of insight and weight of shrewd sense beneath the sparkle and the laughter of the *New Bath Guide*. The *Election Ball, in Poetical Letters from Mr Inkle at Bath to his Wife at Gloucester*, sustained the reputation won by the

Guide. It seems to us even more brilliant in its wit, and finely touched as verse. Other productions in verse and prose have long passed into oblivion. The poetical works were collected in 1808 (2 vols.) by the author's son John, himself author of *The Pleader's Guide*, in the same vein with the *New Bath Guide*. He died on 3d August 1805. (A. B. G.)

ANSTRUTHER-EASTER, a royal and parliamentary burgh of Scotland, in the county of Fife, situated on the Firth of Forth, 9 miles S. of St Andrews. It is on the whole an ill-built place, containing tanning, shipbuilding, and fish-curing establishments, and carrying on a considerable amount of sea-fishing and some coasting trade, to accommodate which a new harbour is in course of construction, under the direction of the Board of Fisheries. In 1871 the parliamentary burgh, which, along with Anstruther-Wester, Crail, Cupar, Kilrenny, Pittenweem, and St Andrews, returns one member to parliament, contained 1289 inhabitants; the royal burgh had a population of 1169. Dr Thomas Chalmers was born at Anstruther-Easter in 1780.

ANSTRUTHER-WESTER, also a royal and parliamentary burgh in Fifeshire, close to Anstruther-Easter, from which it is separated by a small stream called the Dreal Burn. In 1871 the population was 484.

ANT. The insects included under this name are divisible into two distinct groups, which exhibit important differences not only in structure but also in habits. The familiar ant (*Formica*), found in Britain and Europe generally, belongs to an order of insects known as the *Hymenoptera*, of which division the bees, wasps, hornets, are also well-known examples. But the *Termites*, or white ants—insects which also live in social communities, and which inhabit tropical regions—belong to a different order, that of the *Neuropterous* insects, and exhibit differences in several important respects from the ordinary ants. To both species or kinds of these forms it will be necessary to direct attention, and the familiar ants naturally fall to be considered first.

The Hymenopterous insects are distinguished by the possession of four membranous wings, although in certain exceptional instances—as among certain members of the ant community—the wings may be wanting. The organs of the mouth are partly fitted for mastication by the development of jaws, and partly for suctorial purposes by the possession of a proboscis or "antlia." The females of this order generally possess a terminal abdominal appendage, forming a "sting" (*aculeus*), or which may be used in the deposition of the eggs, when it is termed an *ovipositor*. The Hymenoptera, besides, undergo a "complete" metamorphosis,—that is, in their passage from the egg towards adult or mature existence they appear first as grubs, or *larvæ*, then are enclosed in a pupa-case, and finally appear as the perfect, and generally winged insect, or "imago." The Hymenoptera exhibit, perhaps, the most remarkable development among insects of the faculty of instinct, and constitute excellent examples of so-called "social" insects, living in communities regulated by definite laws, each member of the society bearing a separate and well defined part in the organisation and arrangement of the colony at large.

From the earliest times ants have attracted the attention, not only of naturalists, but of philosophers and poets. The ancients were familiar with many of the phenomena characteristic of the ant colony. Aristotle and Pliny, for example, inform us that the labours of ants are regulated in a great measure by the phases of the moon. Pliny also makes mention of a species which he alleges is found in Northern India, which were said to equal Egyptian wolves in size, and were supposed to occupy themselves in digging gold from the bowels of the earth, whilst the inhabitants of the country were said to rob the ants in summer of their accumulated winter treasures.

The harvesting and grain-storing habits of ants, so familiar to the popular reader, were at first supposed to be common to *all* species of ants, but this view has been abundantly proved to be erroneous, whilst the opposite extreme of asserting that no species practise these habits is to be viewed as equally incorrect. In many cases it is probable that observers have been deceived into the supposition that certain species of ants really carried grains of corn in their mouths, whereas the so-called corn grains of these species were in reality the cocoons or pupæ-cases containing the young and immature forms. And whilst most species of ants are granivorous, or vegetable feeders, certain species are as decidedly carnivorous. These latter kinds do not, therefore, participate in the frugal and industrious habits of their allies.

The bibliography of ants is very extensive. Dr King, in the 23rd number of the *Philosophical Transactions*, described the form of the eggs and of the larvæ, and also the habits of ants in reference to their care of their young. Leeuwenhoeck, the Dutch naturalist, traced the successive stages of development in the ants, and demonstrated the egg, "larva," "pupa," and "imago," or perfect insect. Swammerdam, with the application of the microscope, further advanced the knowledge of the development and structure of the ants, and Linnæus (*Memoirs of the Royal Academy of Sciences of Stockholm*) ascertained many facts relative to the reproduction of these forms, and determined that the winged ants are those which alone exercise the generative functions. A Mr Gould published *An Account of English Ants*, of which work a notice by the Rev. Dr Miles is given in the *Philosophical Transactions* for 1747. This account, excellent in many respects, is nevertheless erroneous in certain points,—the result of following too closely the analogy presumed to exist between bees and ants. Geoffroy (*Histoire des Insectes qui se trouvent aux Environs de Paris*), a good naturalist otherwise, is a bad authority on the subject of ants. The most complete series of observations on ants, which appeared among the earlier accounts of these forms, are those of De Geer, a Swedish entomologist (*Mémoires pour servir à l'Histoire des Insectes*), an observer on whose fidelity the utmost reliance may be placed. Olivier, in the *Encyclopédie Méthodique* (article *Fourmi*), summarised the knowledge of his own and of preceding times, and described a few new species of ants; and Bonnet, in his *Observations sur les Insectes* (vol. ii.), has given us some interesting, though by no means extensive information regarding the habits of ants. The "sugar-ant" (?) forms the subject of a memoir in the *Philosophical Transactions* for 1790, this latter species having caused much havoc among the sugar-plantations of Grenada over a period of ten years. Latreille, a famous entomologist, in his special monograph (*Histoire Naturelle des Fourmis*), published at Paris in 1802, gave the most succinct and accurate account of the ant-tribe which had appeared up to that date. His description of the structure and classification of these insects is remarkably clear, and he fully describes one hundred species known to himself, and mentions twenty-four species which he was enabled to describe from the reports of others. He distributed these species among nine families, selecting as the bases of his classification the situation and structure of the "antennæ" or "feelers," and the disposition of the abdominal scales.

The habits of ants receive the fullest attention at the hands of Pierre Huber of Geneva, who in a treatise (*Traité des Mœurs des Fourmis Indigènes*) published in 1810, gave a very interesting, lucid, and valuable account of his native ants, drawn from actual observation of the nests and communities. This result he achieved by means of an apparatus which enabled him to view the interior of the nest. Many facts have been added to the history of ants since 1810; the list of works and treatises upon this and allied entomological pursuits having been largely increased, especially of late years.

The constitution of an ant-community may be readily appreciated; but it is, at the same time, important to note the distinctions between the various groups or sects into which the curious colony is divided. A threefold distinction of sex, resulting in the production of three kinds of individual forms, is to be perceived in the ant-colony, as well as among other hymenopterous insects (*e.g.* bees). These three grades of individuals are known respectively as males, females, and neuters. The males and females

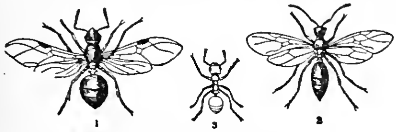


Fig 1.—Wood Ant (*Formica rufa*). 1, Female; 2, Male; 3, Neuter.

are winged,—the former retaining their wings throughout life, and the latter losing these organs after the pairing is over. During the summer the winged males and females are produced in large numbers, and they soon leave the nest to take their "nuptial flight" in the air, in the course of which the females are impregnated. The function of the male ants having been thus performed, they die; the females, after impregnation, lose their wings; and whilst in this comparatively helpless state they are conveyed by the neuters to new situations, where they become the founders of fresh colonies.

Each fertile female or "queen" is carefully attended by a retinue of "neuters," the latter being simply females the sexual organs of which are undeveloped. The curious experiments of entomologists have proved that, in all probability, the cause of this differentiation of sex is dependent upon the nature of the food with which during the larval state the ant is fed. Exempted thus from all sexual functions, the duties of the neuters are confined to the performance of all the offices which contribute to, or are connected with, the welfare and labour of the ant-community. They thus not only construct and build the nest or home, and keep it in constant and assiduous repair, but they are also the providers of food and sustenance for the community; and they act the part of nurses, in that they carefully attend to the hatching, nutrition, and rearing of the young. They are also the defenders of the colony, in that they protect the nest and its inmates from the attacks and assaults of nearly-related enemies or foreign foes. In connection with the defence of the ant-colony, certain species possess peculiar neuters, termed "soldiers," upon which the care and protection of the community more especially devolve. These "soldiers" are provided with large mandibles or biting-jaws, which constitute efficient organs of offence or defence; and they are distinguished from the ordinary neuters by several characteristics in addition to this larger development of the jaws.

Regarding the more intimate structural differences which have been ascertained to exist between the various members of the ant-community, it may be remarked that the antennæ of the male ants possess thirteen joints each, and those of the female twelve. The antennæ of the neuters are composed of twelve joints. The abdomen of the male ant consists of seven joints, and that of the female and neuter of six. The mandibles or large jaws of the female and neuter ants are larger than those of the males, and are frequently found to be serrated or even hooked at their extremities. The external sexual organs of the neuters correspond to those of the females, although, as already remarked, the essential internal reproductive organs are wholly undeveloped in the neuter ants; and to this most important distinction there is added the absence of wings, the neuters being thus distinguished from the females by a variety of characters, while the near relation is at the same time shown of the one series of truly sexual forms to those in which the sex is undeveloped. The neuters, it may lastly be remarked, conform to the female characteristics, in having the abdomen provided with a sting, the male ants being destitute of this appendage.

The nervous system of the ants conforms to the ordinary insect-type; but in these and other insect forms, we find the highest development of those faculties to which the general name of *Instinct* is applied. By instinctive acts, in their simplest sense, we mean those acts which an animal performs chiefly from impressions made by surrounding objects upon its nervous or sensory apparatus. These are very different in character and origin from the actions of the higher vertebrate animals, in which the independent faculty of *mind* operates as the direct source of action, in place of the surrounding circumstances of the lower form. Thus, in the case of ants, bees, &c., wonderful as their operations may appear, and regular and methodical as the manner in which they are performed may seem, it will be found that a marked uniformity and likeness of conditions exist, which tend to produce a corresponding similarity of effects. The same external conditions thus tend to induce undeviatingly similar series of phenomena, and under the operation of these acts the animal exercising them may justly be compared to an automatic machine, or to a piece of mechanism, self-directing only in so far as it is directed by external circumstances and outside conditions. Hence we find certain species of ants or bees invariably constructing similar series of cells or habitations, and engaging in the same labours as their predecessors, which labours or operations will be faithfully and exactly repeated by succeeding generations. And the automatic and mechanical nature of instinctive acts may be clearly viewed when we contrast them in their essential nature with the directing intelligence and guiding impulse of mind, as we find these qualities exercised in the highest vertebrates. In the latter case, the mental impulse itself directs alike the physical and psychical operations, and so far from the animal being merely automatic, it assumes the higher phase of nervous action involved in self-originating mental impulse. The actions of the intelligent being are self-determined: those of the instinctive being originate from the outer world. Through the higher nervous centres the intelligent being first appreciates the outward circumstances, and then reacts upon them; the nervous centres of the lower being are, in the first instance, acted upon by the outer world, and then in their turn react upon the organism. Lastly, and in accordance with the more perfect appreciation of external objects through sensations and perceptions, we have to note in the higher being the operation of the educative power we entitle *experience*. The ant or bee, when first introduced into the special sphere of its labours, assumes its functions, and performs its duties as perfectly as if it had been engaged in their performance for a lengthened period. And the long-continued performance of these duties will in no degree tend to make the ant or bee a more perfect or more skilful worker than when the performance of the duties first commenced. Here, again, we observe the operation of the automatic powers; the lower animal, like the perfected machine, operates at once and without any previous experience as perfectly as after a lengthened period of working. But, in the higher operations directed by intelligence, the being acquires in a gradual manner, and only after a lengthened experience, the perfect manner of working. In the one case instinct incites the being automatically, or through the excitory outward impressions, to perform the acts; in the other, an intelligent mind first appreciates the impressions, and, through the educative training of experience, is enabled to perform the acts, and to understand in a greater or less degree the reasons which prompt and justify them.

Apart from the possession of high instincts, however, we find ants, in common with many other insects, to be possessed of very perfect senses. In addition to the large compound eyes with which most insects are provided, they possess simple organs of vision. The sense of smell also appears to be represented in the ants and insects generally, but the seat of this sense has not been well or satisfactorily determined. Judging from analogy, however, the olfactory apparatus has been supposed to reside in the basal joints of the feelers or antennæ. Ants have been long observed to follow accurately the track of their companions. Bonnet concluded that they were enabled to follow up this line of march by their scent, and in proof of this he repeatedly drew his finger at various parts across the line of march. The ants, on arriving at the interrupted spots, seemed to lose scent, and directed their steps in an irregular and hesitating manner, but having once crossed the interrupted space of the finger track, they resumed their journey once more in a regular manner along the line of march. Latreille, with the view of ascertaining if the sense of smell resided in the antennæ, cut off these organs in several ants, when he found that they appeared to lose their way, and to be incapable of directing their further steps. It may, however, on obvious grounds be doubted whether this experiment may be deemed at all satisfactory or conclusive on the point. In this experiment it was noticed that the neighbouring ants appeared to observe the distress of their mutilated companions, and they seemed to stanch the wounds of the sufferers by an application of the organs of the mouth to the wounded surface.

The antennæ in insects are certainly the organs of touch, but in ants these organs appear to subserve some undetermined function, in that through their agency communication may be made from one ant to the other. M. Huber was so strongly impressed with this latter fact, that he applied the term *langage antennal* to the intercourse which he supposed took place between ants through the media of the antennæ. For example, by each ant striking its head against its neighbour, and by the transmission of this impulse, the whole ant-community appeared to be warned of danger, and in other ways, but chiefly through the antennæ, the sense of danger appears to be appreciated by each member of the colony.

The food of ants has formed a debatable point ever since the attention of naturalists was directed to the investigation of their economy. As already remarked, many species are truly carnivorous, and prey upon the soft parts of other insects, and particularly of larvæ, which they are enabled to seize and capture with little danger and trouble. The well-known partiality of ants for animal food is taken advantage of by those who wish to obtain the hard parts or skeletons of animal forms; since by placing an animal body within reach of an ant-colony, the soft parts are gradually eaten away, and the harder portions are left intact. In tropical climates, rats, mice, and poultry, even in a living state, are said to succumb to the attack of these creatures; and man himself, as related by Prévost in his *Histoire Général des Voyages*, is even subject to the attacks of ants. Prévost relates that an Italian missionary in Congo was awakened from sleep by his negroes, with the intelligence that an immense horde of ants was invading his house. Before he could rise they had already covered his legs, and the floor of his house was carpeted by a thick layer of the invading forms. Fire seemed to be the only preventive to their onward march; and it was stated that cows were known to be devoured in their stalls by these creatures. These remarks may be viewed as applying more particularly to the *white ants* or *termites*, of which an account will be given afterwards. For *sugar* ants seem to have a special predilection; and they appear not only to obtain the saccharine matter from vegetables, but also to abstract it from animal sources. The *aphides*, or plant lice, become in this way the subjects of very extraordinary attentions on the part of ants. The plant lice possess a glandular structure, situated at the extremity of the abdomen, which communicates with the external surface by two small ducts. This gland secretes a sweet or saccharine liquid of viscous nature, of which ants are extremely fond, and the *aphides* appear to be literally "milked" by their smaller neighbours. The antennæ of the ants in this case also appear to be the media of intercourse between the *aphides* and themselves, and by touching the abdomen of the plant lice with the antennæ, a drop of the saccharine liquid exudes from the gland, which is eagerly seized upon by the ants; and in this fashion the milking process is continued until the ant is satisfied. The *aphides*, in this instance, appear voluntarily to surrender themselves for the purpose of affording the saccharine matter; but it has been also alleged that certain species of ants keep *aphides* within their nests for the purpose of affording the desired matter. Whether or not this alleged domestication of the aphides by ants is to be deemed worthy of belief yet remains to be proved. A single *aphis* may be occasionally seen surrounded by three or four ants,—the latter ordinarily finding the *aphides* on the leaves of plants and in their natural habitat. The association of ants and aphides, strange as it may seem, is not, however, without its parallels in the history of the ant-colony. Thus wood-lice are not infrequently found as apparently normal guests within the ant-nest; and Siva of Pisa observed a species of grasshopper, to which he has given the name *Gryllus myrmecophilus*, which inhabits the nest of an Italian ant. The ant-nest, in fact, appears to be the normal habitation of this grasshopper.

The ant-nest forms a very interesting subject for consideration, and the various groups of ants differ widely in the outward form and internal plan according to which the nests are constructed, as well as in the materials of which the habitations are built. Clay, earth, and vegetable matters form the chief sources of supply, and excavations in the ground, or erections above ground, in trees, walls, and house-roofs, may be mentioned as the most common situations for the nests. The internal arrangement also varies even to a greater extent than the external appearance or materials. The general plan of the nest shows an arrangement of flats or stories, connected throughout by passages, and supported by definite pillars or partitions. The chief ends and objects in the construction of the nest appear to be directed to the preservation of the larvæ, and to their protection from changes of temperature. During the night the larvæ are placed in the furthest chambers of the nest, the entrance to the nest being carefully secured for warmth and for ensuring protection from the raids of enemies. In the morning the larvæ are transferred by the diligent neuters to the outer chambers, to which the sun's heat has access; or they may even be exposed directly to the sun. A change of temperature or weather is sufficient to set the watchful neuters on the alert, and to cause them to hurry the larvæ to the inner recesses of the abode, where they may be safely protected from the variable effects of the climate.

Some of the most curious and extraordinary traits in ant-character relate to the acquiring by certain ants (*e.g.* Amazon-ants) of the pupæ or immature young of other species, and the training and subjection of these pupæ as slaves and servitors. Regular raids and forays appear to be made by the slave-making ants upon the nests of certain species, the pupæ of which are captured, and when developed brought into bondage and subjection to the captors.

No closer imitation of the ways of man could well be found in the entire animal economy; and the circumstances of these curious cases have been so thoroughly investigated that the matter is placed above the possibility of doubt or error. The relative position of the masters and slaves varies greatly, the extreme of hard servitorship being seen in some cases, whilst in other cases the position of the slaves is much easier. The slaves of *Formica sanguinea* are aided by their masters in the work of the colony. But in the case of *Formica rufescens* the labours of the slaves are greatly increased,—the entire work of the community devolving upon the unfortunate captives, and the neuters, laborious in other species, being merely employed in the duty of capturing fresh servitors. This latter trait also appears among the Amazon-ants, which literally stir neither "hand nor foot," nor make any effort to help themselves, but are waited upon and attended in the most devoted manner by their willing serfs. The slave-making forays are by no means invariably destitute of bloodshed or warfare, and frequent and hot combats appear to be engaged in between the would-be masters and the species of intended slaves. Once captured, developed, and domiciled within the nests of their masters, the slave-ants appear to be thoroughly at home, and no effort at insurrection or attempt to gain their freedom appears ever to be made. The early state of development in which the pupæ are generally captured, would necessarily favour the complete domestication of the captured ants within the home of the slave-making community; and the ants appear to possess and exhibit the greatest care and solicitation for the welfare of their serfs, —the slaves being carried in the mouths of their owners when the latter shift their abode, or undertake any expedition leading them from home.

From the accounts of Messrs Bates and Belt, we gain some curious and interesting information regarding species of ants peculiar to South and Central America, which exhibit marked differences in habits from all British or even other foreign species. Chief among these South American ants are the *Foraging* Ants (*Eciton*), of which there are several distinct species. These ants are truly carnivorous in their tastes, and ravage whole districts, their march being regarded with terror by the natives of Central America. Mr Bates tells us that different species have different modes of marching, by which they may be recognised. The Ecitons in Nicaragua are termed "Army Ants," and they appear regularly to change their hunting-grounds in quest of food. Their community comprises males and females, and two kinds of neuters or workers—a "worker-major," or large-headed worker, and a small-headed kind, termed the "worker-minors." The former kind are noted for their elongated jaws; and in some species these forms are denominated "soldiers," their peculiar office being the protection of the community from the attacks of enemies, or the making forays on the nests of other species, or upon other animals. The habit the Ecitons have of hunting in regular organised bands distinguishes them from other and more familiar British species (*e.g.*, *Myrmica*, the Red Stinging Ant of Britain), which are predatory, but hunt in an irregular and ill-defined manner. One of the best-defined species of foraging ants is the *Eciton predator*, a small species which hunts in dense hordes, and marches rapidly over a territory. A moving phalanx of this species will extend over from 4 to 6 square yards; and any unwary insect meeting with, or falling into the serried ranks, is soon torn to pieces and devoured. *Eciton hamata* hunts both in dense masses or in detached columns. The nature of the prey appears to regulate the mode of march. Thus, when proceeding in columns, Mr Belt found that the *Eciton hamata* was in search of the nests of another ant (*Hypoclinea*), the larvæ and pupæ of which are seized by the Ecitons for the purpose of being brought up as slaves, in accordance with the habits already alluded to. The Hypoclineas rush out on being attacked, bearing their pupæ and larvæ in their jaws; but the Ecitons at once seize the young ants, although they never appear to injure the parent Hypoclineas. The latter appear a cowardly race, as they make no effort at self-defence, their habits leading them chiefly to milk *aphides*, which they desert at once on seeing another and even smaller species of ant approach. Birds and opossums are terrified, as well as insects, at the Foraging Ants, and frequently fall victims to the determined onslaught of the little furies.

The other species of Ecitons comprise *Eciton rapax*, the largest of the race, the body of which is half-an-inch in length; *Eciton legionis*, famed for its ravages on other species of ants (*Formicæ*); *Eciton hamata* and *E. drepanophora*, nearly related species; and the so-called *Blind Ecitons*, thus named from the imperfect condition of the eyes. The *E. vastator* and *E. erratica*, species of blind Ecitons, proceed on their raids by means of covered roads or ways, which are excavated and formed in front at a rate corresponding to the advance of the army.

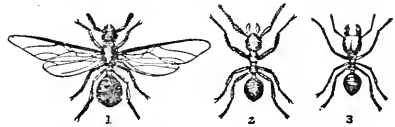


FIG. 2.—Leaf-cutting and Foraging Ants. 1, *Œcodoma cephalus*; 2, *Eciton drepanophora*; 3, *Eciton erratica*.

Some interesting information regarding the senses and instincts of the Foraging Ants appears to corroborate the opinions of some earlier observers, already alluded to, on the subject. About a dozen individuals of *Eciton hamata* were observed to assemble together, as if in consultation, in a tramway excavation in Nicaragua. One ant suddenly left the assembly, and ran up the perpendicular side of the cutting. The example of this first ant was followed by several others, which ran after the first ant for a short distance, then returned, and again proceeded for a farther distance along the track of the first. The object of this proceeding was to make the track readily determinable by the succeeding travellers, and the route of the first individual was unerringly followed by the others, who were at long distances behind. A portion of the trail was removed, when the ants appeared at fault, and occupied themselves in making detours until they again hit upon the interrupted track. On arriving at the top of the excavation, a suitable spot for hunting was descried, when the information appeared to be quickly communicated to those that were below, and the whole army rushed upwards in obedience to the behest of the scouts. All the Foraging Ants are migratory in habits, and appear to possess no fixed place of abode, but shift their camp at intervals of from four to six or more days. The temporary abode is found in hollow trees, or under fallen trunks. An Eciton, intentionally imprisoned beneath a stone, was discovered by a companion, who at once informed his neighbours. The other ants then came to the rescue; and by biting at the stone, trying to move it, and seizing the prisoned ant by the legs, they, by their united efforts, set their companion free. An ant embedded in clay, with only the points of the antennæ protruding, was discovered by his neighbours, and soon disentombed. And in cases where the efforts of one ant have been inadequate to release a comrade placed in peril, the others were duly informed of the fact, and hurried to assist their less fortunate neighbour. In crossing a crumbling slope, which was gradually disintegrating under the passage of the ant-army, a portion of the band, by adhering to each other, formed a solid pathway, over which the others passed safely. A twig formed a bridge across a small rill; but this proving insufficient and too narrow for the transit of the army, it was widened by ants clinging to each side of the twig, and in this way the track was broadened sufficiently to admit of the easy passage of the mass. Such acts would appear to lie beyond the category of purely instinctive processes, since they appear to involve an adaptation of faculties to special cases, and result in special actions being instituted, and thus bear some resemblance to what we familiarly see involved in the process of reasoning characteristic of man's mental powers. The more ordinary operations of ant-life are purely instinctive, as has been already shown; but it may be a matter for consideration if the theory of some naturalists, that the higher development of instinctive powers is akin to reason itself, may not be tenable. Such instances as these just given of the curious and extraordinary acts of the Foraging Ants may serve to show from what circumstances the theory obtains support. Houzeau, in particular, among recent writers, adopts analogous views to these, and maintains that the ants most nearly approach man in the arrangement and general nature of their social existence and condition.

The Leaf-cutting Ants (*Œcodoma*) are noted pests of central and tropical America; and, as is implied by their name, commit fearful havoc among trees, laboriously and persistently carrying off in their mouths, piece by piece, the foliage of trees and shrubs. The orange, lemon, and mango trees in particular have suffered from their attacks. Carbolic acid has been tried with success as a remedy against these ants, the use of this antiseptic killing large numbers; and corrosive sublimate in powder, sprinkled across their paths, has a deadly effect upon the leaf-cutters. Coal tar has also been employed against them. Gigantic black ants, averaging an inch in length, are found in Central America. They are notable as being solitary in their habits, and possess well-developed eyes and formidable stings. These forms contrast with the gregarious and social ants, in which the eyes are comparatively weak, or may be rudimentary.

Certain curious little ants (*Pseudomyrma bicolor*) inhabit the hollow thorns of the "bull's horn" acacia of Central America. The horn-like thorns form the nest, the aperture being situated near the tip of the thorn. These ants preserve the plant from the attack of the Leaf-cutting Ants, and also from mammals feeding upon it. The ants obtain a supply of food from the plant, in the shape of a honey-like secretion, found in a gland situated at the base of the leaflets. Protected by, and at the same time protecting the plant, the intimate relations between the acacia and the ants may be argued to possess a deeper significance than relates to a merely casual or chance connection. The *Cecropia*, or trumpet tree of Central America, is tenanted by ants, which obtain a sweet fluid, through the agency of brown scale-insects (*Coccidæ*), kept by them in the cells of the trunk. This recalls the case of the *aphides*, or ordinary plant lice, the ants sucking the fluid from the scale-insects through a dorsal or back-pore. The queen-ant in her royal cell is attended by a special bevy of *Coccidæ*, who supply her with the requisite food. The *Coccidæ* in America take the place of the European *aphides* as ant-cows, but the tropical ants appear to attach themselves to other insects also. Thus, the leaf-hoppers (*Membracis*) are attended by ants, for the sake of the honey which the larvæ exude. Those insects which are attended by ants are protected from the attacks of other animal forms; and the shelter given to the ants thus serves to protect the tree or shrub, and to save it from becoming exterminated.

The "soldier ants," referred to in the foregoing account of the Foraging Ants, are not peculiar to that race, many other species also possessing "soldiers." These forms, as has been already stated, appear to be merely neuters which have the jaws very largely developed, for the protection of the true neuters or workers, and for the defence of the nest generally. This further subdivision of the ant-community would seem to indicate an additional approach to the social arrangements which characterise the human state.

The reproduction and development of the ordinary ants may be very briefly touched upon in the present notice. The impregnation of the females in their aerial nuptial flight has been already alluded to, as also has the death of the males after the congress. The impregnated females are conveyed to the nest, and the deposition of eggs is proceeded with, the young forms being tended through their larvæ and pupæ stages by the assiduous neuters. Unlike the bees, several female ants may inhabit the same nest; and the swarming or exodus of the young ants, so far from having for its one and essential object the formation of a new colony, appears to be simply devoted to further reproductive measures. Thus, those that leave the nest are the fresh males and females, the sexual history of which has already been traced; and the nest thus remains a more or less permanent institution, changing its inmates only in part, and in exceptional circumstances alone giving origin to a new and independent colony.

The stings with which the neuters and females are armed constitute formidable organs of defence. The poison, to which the violent or painful effects of the sting are due, appears to consist of a definite chemical organic compound, the chief acid of which is known by the appropriate name of *formic acid*, the formula for this compound being CH_2O_2. Formic acid is also found in the glands attached to the pointed hairs of stinging-nettles. This acid, in itself possessing irritant qualities of a high order, also appears capable of producing even more serious effects when manipulated by chemical means.

The ant-colony, powerful as we have seen it to be, and well protected as it undoubtedly is, is nevertheless subject to the attacks of enemies which wage a successful war against it. Certain species of ants appear to be more subject than others to the attack of such higher forms as the mammalian ant-eaters (*Echidna* and *Myrmecophagidæ*) and armadillos, as well as to the onslaught of the insect ant-lion (*Myrmeleo*). The latter literally digs a pit for his

FIG. 3.—Ant-lion (*Myrmeleo formicaleo*).

victim, in the bottom of which he lies securely hidden, ready to devour any unwary ant which may chance to tumble in. And even where the victim is not within actual reach of the *Myrmeleo*, the latter by means of a shower of sand-particles frequently succeeds in causing it to fall into the snare. Several substances which have a noxious effect upon the ant-colony have been already mentioned. Thus carbolic acid and corrosive sublimate appear to affect the ant-colony as poisonous agents; and solutions of tobacco, lime, soot, and walnut leaves, with urine, are also stated to prove effectual in destroying them, although these latter are decidedly inferior to the two first-mentioned substances. Corrosive sublimate, indeed, appears to have a curious and even specific action upon these forms, in rendering them actually *maniacal*, to use a phrase which is applicable generally to the human subject alone. Under the influence even of external contact with this substance, the ants in Grenada during their ravages of last century, were observed to be singularly affected, and were seen even to attack each other with outrageous violence,—an effect also corroborated of late years in Central America by Mr Belt, who saw the rabid ants collected into small balls biting one another, and seizing hold of each other in a most extraordinary fashion under the influence of the mercurial poison. The corrosive sublimate, it is stated, can be effectively used only in dry weather.

White ants. A brief description of the *Termites*, or white ants, may appropriately conclude the present article. These forms have already been stated to be entirely different from the familiar and true ants, and to belong to the Neuropterous insects, whereas the true ants are classed with the *Hymenoptera*. They resemble the true ants in living in highly organised social communities, and in being endowed with as high and as specialised instincts. But they differ from them, first, in the fact that they do not undergo a complete metamorphosis, that is, the Termite larvæ and pupæ resemble the perfect insect, and do not pass through the defined stages of change and development characteristic of the true ants, bees, and other insects. The young Termite, in fact, differs from the ordinary adult only in the non-possession of eyes, and from the sexual forms in the non-development of wings. The white ants inhabit the tropical regions of the world generally, but are found in the greatest abundance in tropical South America. Their nests form characteristic structures, rising sometimes to a height of 5 or 6 feet, and constructed of earthy particles worked into a mass as hard and durable as stone. Many species of Termites are known, but they resemble one another in essential structure and habits. As indicated by their popular name, they are of a whitish colour and are soft-bodied. The Termite community consists, as in the true ants, of males, females, and workers or neuters. In the true ants the latter are undeveloped females, whereas in the Termites the sex of the neuters is wholly undeterminable; and in addition the workers are invariably divided into two distinct classes: the "soldiers," with largely-developed jaws, whose sole office is to defend the community; and the ordinary "workers," on whom devolves the entire labour of the nest. Both classes of neuters are blind; and from a close examination of the eggs, the distinctions, not only between males and females, but also between the soldiers and workers, may be easily seen. The difference in food, so powerful in the development of sex and characteristics in other insects, does not therefore operate in the case of the Termites. The entire white ant colony and species also exhibits a division into subordinate groups and classes, the recognition and characters of which are very difficult of determination. And on this, as well as upon other grounds, the organisation of the white ant community is generally to be regarded as of a higher type than that of the familiar and true ants.

Fig. 4.—White Ant (*Termes bellicosus*). Male.

Fig. 5.—White Ant (*Termes bellicosus*). Soldier.

The nest of the Termites is known as a *termitarium*, the essential internal arrangement of which consists of a large number and series of chambers, connected by galleries and passages. Entrance to the nest is afforded by concealed roads and subterranean passages. A large hillock may be a compound termitarium, formed by and inhabited by different species; and certain kinds of Termites build their nests of smaller size, sometimes of the consistence of paper. Their structures may be attached to the branches of trees, or they may be entirely subterranean, or concealed under the bark or within the stems of trees. The latter species are those which destroy timber, furniture, and household objects.

Within this curious home an equally curious community is found to reside. The king and queen represent the sexual part of the community, the true neuters or workers form the greater part of the ordinary individuals, and the soldiers and winged Termites complete the list of inmates. The royal cells, tenanted by the king and queen, exist in the inmost part of the nest, and are closely guarded by a retinue of workers. The king and queen are wingless and much larger than the neuter ants. The queen Termite when within the royal cell is permanently gravid, the abdomen being immensely distended with eggs, which as they are produced, are seized upon by the workers,

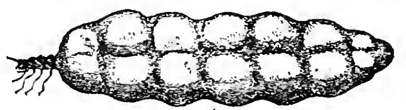


Fig. 6.—White Ant (*Termes bellicosus*). Gravid female.

and conveyed to special cells prepared for their reception. The relations of the winged Termites to the other members of the nest long formed a subject of great difficulty to naturalists; but they appear to be males and females, which are ready to assume sexual relations, and to become the progenitors or kings and queens of new communities. The neuters are, accordingly, quite distinct from the sexual forms, and do not pass through any similar developmental phases, but differ from the others, even in the egg, as has been already mentioned. Occasionally a new termitarium may be found, in which a king and queen are absent, and which contains workers only. These, however, gradually prepare the nest for full completion, by bringing eggs into the cells from a neighbouring termitarium, from which the due population of the colony will be in time produced.

The exodus or swarming of the Termites appears to resemble more nearly that of the bees, although like that of the true ants, it is more purely reproductive in its nature, and not so much connected with the departure of fully grown forms from a hive which has become inadequate to the comfortable accommodation of all its inmates. The larvæ, prior to the swarming, are fed and tended by the workers, the youngest larvæ receiving the greatest share of attention. The workers apparently feed the larvæ by injecting a fluid from their mouths into the larval cells; and in about a year after the deposition of the eggs the larvæ become fully grown, and the period of the exodus arrives. The exodus generally takes place on damp evenings, or cloudy mornings, and many extend over several days, or until such time as all the males and females have emerged from the nest. Having reached the ground, the wings of each ant are shed by a natural effect—a seam or place of separation existing at the roots of the wings—and after the throwing off of the wings, the surviving males and females pair, and become the parents of new colonies. Many fall victims to the attacks of enemies, as spiders, bats, lizards, toads, and goat-suckers. The pairs that survive take up their abode in some secluded situation, as under leaves, or under a clod of earth; there the females become impregnated, and by-and-by a new hive and its population are produced. The Termites serve an important purpose, in the particular areas of the world they inhabit, in disintegrating, removing, and destroying decaying wood.

See Moggridge's *Harvesting Ants* and *Trap Door Spiders;* Bates's *Naturalist on the Amazons;* Belt's *Naturalist in Nicaragua*, &c. (A. W.)

ANTÆUS, in Greek Mythology, a giant of Lybia, the son of Poseidon and Ge (Terra). He compelled all strangers passing through the country to wrestle with him, and as, when thrown, he derived fresh strength from each successive contact with his mother earth, he proved invincible. With the skulls of those whom he had slain he built a temple to his father. Hercules, in combat with him, discovered the source of his strength, and lifting him up from the earth crushed him to death. The struggle between Antæus and Hercules is a favourite subject in ancient sculpture.

ANTALCIDAS, a Spartan politician, who rendered conspicuous service to his native state at one of the turning-points in Greek history. He comes first into notice as ambassador from Sparta to Tiribazus, the Persian satrap of Ionia, to sue for peace (393–2 B.C.) Upon hearing of this the Athenians, becoming anxious lest they should lose their growing ascendency, also sent an embassy, at the head of which was Conon, to counteract the efforts of the Spartans. Tiribazus favoured the cause of Sparta, and secretly supplied Antalcidas with the means of carrying on war against Athens. Artaxerxes, however, disapproving the conduct of his satrap, recalled him, and appointed Struthas, whose sympathies were on the side of Athens, in his place. But this check to the policy of Antalcidas was only temporary. In a few years circumstances became even more favourable than at first to a successful negotiation, Tiribazus having been restored to his satrapy, and accordingly, in 388–7, Antalcidas was again sent upon an embassy to Asia. By skilful diplomacy he succeeded in securing the active assistance of the Persian power against Athens. Appointed on his return admiral of the Spartan fleet, he carried on a naval warfare in a manner so vigorous, that the Athenians were glad to accept peace on the terms Artaxerxes chose to dictate. These were made known by Tiribazus to a congress of deputies from Sparta, Argos, and Athens, and formed the basis of "the peace of Antalcidas," so called from its being arranged in accordance with the views of the Spartan ambassador. Antalcidas seems to have been engaged in another mission to Persia in 371; but the later incidents of his career are involved in uncertainty. Plutarch states that he committed suicide on the failure of his last mission, but there seems no proof of this.

ANTALO, a town of Tigré, in Abyssinia, capital of the district of Enderta, situated in lat. 13° 17′ N., and long. 39° 28′ E., on a plateau about 8000 feet above the level of the sea, out of which a steep hill rises on the north of the town, while beneath it a wide plain stretches southward. A large part of Antalo is now in ruins, but it still possesses a weekly market of considerable importance, and contains several churches. Its population was once estimated at 8000.

ANTARA, or, as he is usually called, ANTAR, an early Arabian warrior and poet, famous as the author of one of the poems hung up in the Kaaba at Mecca, and as the hero of a romance which bears somewhat the same relation to Arabic literature which the Arthurian legend bears to our own. He was the son of Shedad-el-Absi, a warrior in the army of Zoheir, by Zabuba, a negro slave who had been captured in some plundering expedition; and, if we can trust the Arabian romancist, he bore strong evidence of his negro origin. He spent his youth in servitude and neglect, but soon became known for his strength and high-handedness. Before long, while yet a slave, he fell in love with his cousin, the beautiful Abla, whose praises are still preserved at Mecca, but at the same time had the misfortune to incur the hate of his father's wife, Shameeah. A number, however, of happy opportunities presenting themselves, he showed such extraordinary prowess against some hostile tribes, that his father was constrained to join in the public appreciation of his services, and to recognise him as his son. He now gradually rose in favour, and held for long a position of the greatest influence among his people, filling the surrounding country with the fame equally of his song and his sword. In a great war between two rival tribes, which lasted forty years, he is said to have played a very prominent part. The time and manner of his death are matter of dispute,—Ibn Doreid making him be slain by Wasr-ben-Jaber, while, according to Abu Obeida, he died a natural death when well stricken in years. Wherever the Arabic language is known his fame is still green · and frequent references are made to *Chubli Antar*, *Istabli Antar*, Antar's house and Antar's stable. By whom the romantic account of his life was originally written is far from being satisfactorily decided; but it is generally ascribed to Asmai, who lived at the court of Harun-al-Rashid. It is composed in rhythmic prose, interspersed with fragments of verse, many of which are attributed to Antar himself. The style is remarkably pure, and a picture is afforded of early Arabian life that is equally graphic and minute. The romance, which in its fuller form extends to fifty or sixty MS. volumes, was first brought under European notice in 1802 by Von Hammer, who, after repeated perusal, spoke of it as surpassing the *Arabian Nights* in interest and beauty. Sir William Jones had already written in the highest terms about a part of it which had fallen in his way. In 1820 Terrick Hamilton, brother of W. Hamilton, the author of *Ægyptiaca*, published a translation of a portion of it from a condensed Syrian manuscript obtained at Aleppo; and this gave occasion for a number of articles on Antar in our periodical literature. (See Von Hammer, *Mines de l'Orient*, 1802; Arnold's *Moallakat*, Leipsic, 1850; Ahlwardt's *Divans of Six Ancient Arabic Poets*, London, 1870; Kitto's *Journal of Sacred Lit.*, 1850.)

ANTARCTIC OCEAN, a name that should, strictly speaking, be applied only to the ice-bound sea to the south of the antarctic circle; in practice, however, it is usually vaguely extended so as to include more or less of the cold regions round the south pole, without reference to the circle. As compared with the corresponding Arctic Ocean, little is known about this portion of the earth's surface; but it is sufficiently clear that the cold and the dangers to navigation in the southern ocean greatly exceed those of the northern, and that human beings and most other animals cannot, or at least do not, ordinarily subsist within its limits. See POLAR REGIONS.

ANTELOPE. The term antelope is applied to denote a genus of *Mammalia*, included in the *Ungulate* or *Hoofed* order of that large class. Of the ungulate or hoofed mammals, the *Ruminants*, or those that "chew the cud," form a chief subdivision; and the antelopes, sheep, oxen, and goats, are included and classified together in this division as the family *Cavicornia*, or "hollow-horned" ruminants. The chief character by which the Cavicornia are distinguished from other families of the Ruminantia

ANTELOPE.

1.

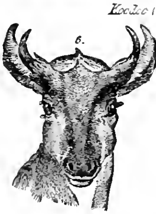
Koodoo (Strepsiceros Koodoo)

2.

Algazel (Antilope leucoryx)

3.

Antilope corinna.



6.

Head of Prongbuck (Antilocapra Americana)

5.

Common Antelope (Antilope cervicapra)

4.

Water Bok (Kobus Ellipsiprymnus)

ANTELOPE.

1.

Harnessed Antelope (Antilope scripta) Fem.

2

(Antilope rupicapra) Chamois

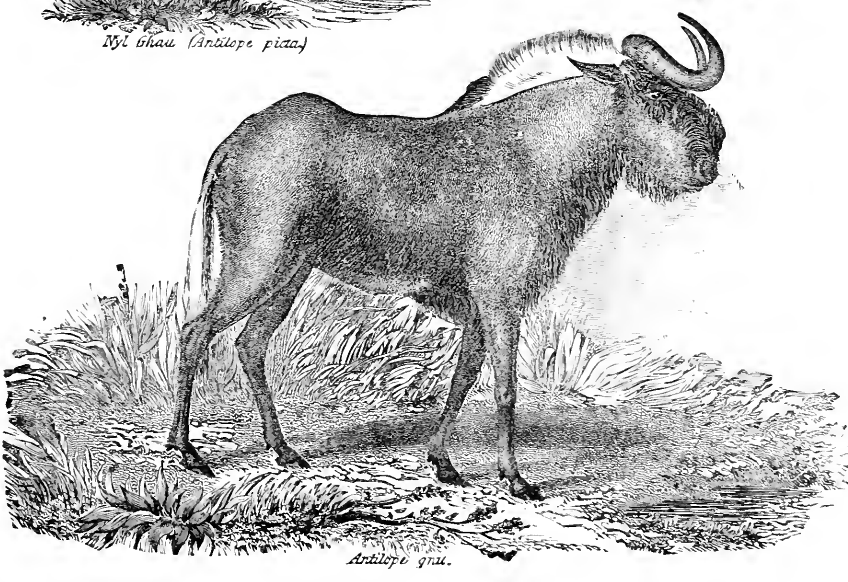
3

Nyl Ghau (Antilope picta)

4.

Antilope chickara.

5



Antilope gnu.

consists in the peculiar and characteristic type of structure of the horns. These appendages are essentially processes of the frontal or forehead bone of the skull, and so far from being deciduous,—that is, being shed at stated periods,—as in the deer, the horns in the Cavicornia are permanent and persistent throughout life. The process arising from the frontal bone constitutes the inner shaft, or "core" of the horn; and this bony core is covered by a horny sheath. The horny sheath is purely epidermic in its origin and nature; that is, it consists of a special development of the outer skin or epidermal tissue. When these structures are contrasted with the horns of the deer,—with which group, it may be remarked, the antelopes are frequently confused, but from which they are essentially distinct,—they are at once seen to be different in every particular. The horns or "antlers" of the deer are solid, and consist entirely of bony tissue; and they are, furthermore, shed annually.

The antelopes, with the other Cavicornia, participate in the following characters, in addition to those furnished by the structure of the horns. Both sexes are generally provided with horns. The dental formula or arrangement of the teeth exhibits a want of incisor teeth in the upper, and six incisors in the lower jaw; canines totally wanting in the upper jaw, and two in the lower jaw; and twelve molars in each jaw. The dental formula, therefore, runs thus:—

$$\text{I.}\ \frac{0-0}{3-3}\ \text{C.}\ \frac{0-0}{1-1}\ \text{PM.}\ \frac{3-3}{3-3}\ \text{M.}\ \frac{3-3}{3-3}=32.$$

The feet are cleft; and accessory or supplemental hoofs exist on the back aspect of the feet.

The antelope family (*Antilopidæ*), including a great number of different species, is generally distinguished from the allied families of the sheep, oxen, and goats, by the light, graceful, and deer-like form of its members. The horns are chiefly cylindrical in shape, but may be twisted in an annular or spiral manner. The beard, or "dew-lap," characteristic of the deer tribe, is generally absent in the antelopes; and of all the Cavicornia, they constitute the only family in which the curious "tear-pits" or "lachrymal sinuses" of the eyes are found. These latter organs are small sacs situated below the eyes, and devoted to the secretion of a yellow substance of a sebaceous or waxy nature.

As regards their distribution, the antelopes are chiefly found in the eastern hemisphere, and Africa appears to be the great centre of distribution of the group. South Africa is especially rich in antelopes, and they may be regarded as representing in that continent the deer of other regions of the world. In habits they are, for the most part, gregarious, and are frequently found in immense herds inhabiting the grassy plateaus and plains; whilst some species are exclusively mountainous in their distribution.

The particular form to which the name of "antelope" has been generally assigned is the *Antilope cervicapra* (Plate I. fig. 5), found in the East, and distinguished by the triple curve of its annulated horns. The gazelle or Barbary antelope (*Gazella Dorcas*) has long been famed in the poetic imagery of Eastern writers. It has two small black horns. The algazel (*Gazella Leucoryx*) (Plate I. fig. 2), found in Persia and Arabia, has slender limbs, and the horns of the male are horizontal, bent backwards, obliquely annulated, with smooth tips, and nearly three feet long. Several nearly allied species inhabit the northern portions of Africa, the *Gazella Corinna* (Plate I. fig. 3) exemplifying one of these latter forms. The springbok (*Gazella Euchore*) of the Dutch settlers, or "springer" antelope, is a well-known form inhabiting the southern districts of Africa. The horns are simple and annulate, and are curved, so as to form a lyrate or lyre-shaped figure. This animal's activity and powers of leaping have procured for it its familiar names; and travellers have long noted the immense numbers of these forms which congregate in vast herds in the plains of Southern and Central Africa. The bontebok (*Gazella Pygarga*), and the blesbok (*Gazella albifrons*), are allied to the springbok, and inhabit the same regions as that form. The other species found in Southern Africa include the rarer blue antelope (*Gazella leucophæa*), and the roan antelope (*Gazella equina*), a large species described by Burchell.

The water bok (*Kobus ellipsiprymnus*) (Plate I. fig. 4), a well-known African form, is of considerable size. Its familiar name has been derived from its habit of frequenting rivers, and from its powers of swimming. The horns are large, curved, and spreading. The klippspringer (*Oreotragus saltatrix*) of South Africa has a close resemblance in size and habits to the European chamois. The koodoo (*Strepsiceros Koodoo*) (Plate I. fig. 1), inhabiting South and West Africa, and otherwise widely distributed over the continent, is provided with very long spiral horns, which, however, exist only in the male animals. These latter antelopes represent "solitary" species, that is, they are generally found living in detached pairs, or as solitary individuals. A related species to the koodoo has been described under the name of *Antilope Doria.*

The pigmy antelopes present examples of singular members of the family, in that they are of exceedingly diminutive size. The *Guevei* (*Antilope* [or *Cephalolophus*] *pygmæa*) presents two well-marked varieties, and one female specimen of the smaller variety scarcely exceeded the dimensions of a large rat. The gueveis occur on the Guinea Coast, but are also occasionally found at the Cape of Good Hope. The bush antelope (*Cephalolophus sylvicultrix*), inhabiting the districts around Sierra Leone, is also of a smaller size than the more typical antelopes, and is nearly related to the preceding forms. The harnessed antelope (*Antilope scripta*) (Plate II. fig. 1), so named from the white stripes with which its body is encircled, has been described as occurring in Senegal.

The eland or impophoo (*Boselaphus Oreas*) is one of the largest of the antelopes, and is ox-like in its general proportions and appearance. The horns are straight and erect, and the breast possesses a "dew-lap" or tuft. It inhabits the flat lands of Southern Africa. Allied to the elands, but of smaller size, we find the addax (*Oryx nasomaculata*). Of this species there are several varieties; but the typical form is found in Northern Africa, and is distinguished by the elongated spiral horns.

The gnus of South Africa form connecting links between the antelope and ox families, presenting characters in external aspect which separate them out as singular and somewhat abnormal forms. The gnu proper or wildebeest (*Catoblepas Gnu*) (Plate II. fig. 5), and the bastard wildebeest (*Catoblepas Gorgon*), are the two forms included in this genus. The head is bovine in its appearance, and to the ox-like head are added the mane of the horse, the limbs of the stag, and the horns of the buffalo. The horns are possessed by both sexes, and are curved from their broad bases, at first downwards and forwards, their terminal portions being directed upwards and backwards. These animals resemble a small horse in size, and occur in large herds on the flat steppes of Southern Africa, although they appear to be migratory in habits, and to have a wide range in distribution over the southern half of the continent.

Having thus indicated the more familiar of the antelopes inhabiting the great African or central tract of distribution of the family, we may next glance at the species found in the other continents. The Chinese antelope (*Antilope gutturosa*), or dzerin of the Mongolian Tartars, possesses short, thick horns, directed backwards, divergent, with their points turned inwards. It occurs in the deserts lying between China and Thibet. The chiru (*Pantholops Hodgsonii*), inhabiting Thibet and the mountainous slopes of the Himalayas, possesses elongated horns of an annulated character, and is besides distinguished by a soft glandular swelling above each nostril. It has an abundant woolly coating; and from the fact of it sometimes appearing with a single horn,—the second horn being rudimentary or undeveloped,—the mythical tales of "unicorns" are supposed to have arisen.

The chicara (*Tetracerus quadricornis*) (Plate II. fig. 4), or four-horned antelope, found in the forests of India generally, and plentifully in Bengal, is of small size, and distinguished by the presence, in the males only, of four horns, the larger pair of which are situated on the upper aspect of the forehead, and are smooth, erect, inclined slightly forwards, divergent, and about three inches long. The smaller horns are situated in front of the first pair, and average in length an inch or more. The nyl ghau (*Portax picta*) (Plate II. fig. 3), found in Northern India, like its African representative, the gnu, appears to unite in itself the characters of the antelopes and oxen. The native name of the creature, *nyl ghau*, signifies *blue ox*, and by the inhabitants of India it is regarded as being an ox, although its true place is undoubtedly among the antelopes. In size the nyl ghau resembles a stag; the tail is tufted; and the horns, occurring in the males only, are curved upwards, and diverge at their extremities. The nyl ghau is susceptible of being partly domesticated, and it has been ascertained to breed freely in a tame state.

The European species of antelope include the chamois (*Rupicapra Tragus*) (Plate II. fig. 2), and the saiga (*Colus* or *Antilocapra Saiga*). The former is essentially European in its distribution, but the latter extends from Poland and Russia into Asia. The chamois inhabits the Alps and mountains of Southern Europe, and occurs in small herds. The horns are present in both males and females, and are of small size, and recurved at their extremities. The chamois may be regarded as tending to link the antelope type to that of the sheep. The saiga is distinguished by the large size of the horns, and by the peculiar conformation of the nose, the opening of which is large, and bounded by a soft cartilaginous margin.

The American continent possesses but two representatives of the antelope family. These are the so-called Rocky Mountain sheep or goat—a true antelope—and the prongbuck or cabrit of North American regions. The Rocky Mountain sheep or goat (*Haplocerus laniger*), possessing a coat of long woolly hair, is closely related to the chamois of Europe; and in this form, as well as in the prongbuck, the connection between the antelopes and goats may be traced.

The prongbuck (*Antilocapra furcifera* or *americana*) (Plate I. fig. 6) presents a singular exception to the other members of the antelope family, in the deciduous nature of the *sheaths* of the horns, which are annually shed and developed. Accessory hoofs are wanting in the prongbuck, and the lachrymal sinuses of other antelopes are undeveloped; as also are the "inguinal pores," or groin-sacs, found in most members of the family, and which secrete a viscid substance, the function of which is undetermined. The females are devoid of horns, and those of the males are branched in front, or are "furcate,"—a conformation of these structures not found in any other member of the antelope family. The chief habitat of the prongbuck appears to be the prairie lands of Central America, and its northern limit would appear to be about the fifty-third degree of north latitude. (A. W.)

ANTEMNÆ, a small Latian town, of great antiquity, built on the top of a hill that rose above the alluvial plain at the meeting of the Anio and Tiber. Hersilia, the wife of Romulus, was a native of Antemnæ; and the city was one of those that endeavoured to avenge the rape of the Sabine women. In purely historic times it is of the smallest importance. The Samnites were pursued thither by Crassus, after the battle of the Colline Gate (82 B.C.), and surrendered there to Sulla. In 409 A.D. Alaric encamped on the hill, which now retains no trace of the ancient city.

ANTENOR, a Trojan elder of great prudence, who advised his fellow-townsmen to send Helen back to her husband, and in various ways showed himself not unfriendly to the Greeks. In the Homeric poems there is no intimation of this disposition having led him into any breach of his natural allegiance; but in the later development of the romance he appears as a full-blown traitor, and in the general sack of the city his house, distinguished by a panther's skin at the door, is spared by the victors in reward of his treachery. He afterwards, according to various versions of the legend, either rebuilt a city on the site of Troy, or settled at Cyrene, or became the founder of Padua (*Patavium*) and several other towns in Eastern Italy.

ANTENOR, son of Euphranor, the native sculptor to whom the Athenians were indebted for the bronze statues of Harmodius and Aristogiton, which, after adorning the Ceramicus, were carried off to Susa by Xerxes, and restored, it is probable, by Alexander.

ANTEQUERA, an ancient city of the province of Malaga, in Spain, supposed to be the Roman *Antiquaria*, or *Anticaria*, beautifully situated in a fertile valley on the south of the river Guadaljorce, 28 miles N. of Malaga, and 45 W. of Granada. It occupies a commanding position, while the remains of its walls, and of a fine Moorish castle on a rock that overhangs the town, show how admirably its natural defences were supplemented by art. In 1410 it was recaptured from the Moors by the regent Fernando, and thereafter became one of the most important outposts of the Christian power in Spain. Antequera possesses manufactures of flannels, paper, leather, silk, soap; it has also a large trade in grain, fruit, and oil, while marble is quarried to a considerable extent in the neighbourhood. Population, 27,201.

ANTHEM is derived from the Greek ἀντίφωνα, through the Saxon *Antefn*, and originally had the same meaning as antiphony. (See ANTIPHONY.) It is now, however, generally restricted to a form of musical composition peculiar to the service of the Church of England, and appointed by the rubrics to follow the third collect at both morning and evening prayer, "in choirs and places where they sing." Several anthems are included in the English coronation service. The words are selected from Holy Scripture, or in some cases from the Liturgy, and the music is generally more elaborate and varied than that of psalm or hymn tunes. Anthems may be written for soli voices only, for the full choir, or for both, and according to this distinction are called respectively *Verse*, *Full*, and *Full with Verse*. Though the anthem of the Church of England is analogous to the *motett* of the Roman Catholic and Lutheran Churches, both being written for a trained choir, and not for the congregation, it is as a musical form essentially English in its origin and development. The English school of musicians has from the first devoted its chief attention to this form, and scarcely a composer of any note can be named who has not written several good anthems. Tallis, Tye, Bird, and Farrant, in the 16th century; Orlando Gibbons, Blow, and Purcell, in the 17th; and Croft, Boyce, Kent, Nares, Cooke, and Samuel Arnold, in the 18th, have composed anthems which are still to be regularly heard in cathedral services.

ANTHEMIUS, a Greek mathematician and architect of great genius, who produced, under the patronage of Justinian (532 A.D.), the original and daring plans for the church of St Sophia, in Constantinople, which strikingly displayed at once his knowledge and his ignorance. He was one of five brothers—the sons of Stephanus, a physician of Tralles—who were all more or less eminent in their respective departments. Dioscorus followed his father's profession in his native place; Alexander became at Rome one of the most celebrated medical men of his time; Olympius was deeply versed in Roman jurisprudence; and Metrodorus was one of the distinguished grammarians of the great Eastern capital. There appears to be good grounds for believing that Anthemius anticipated Buffon in the invention of burning glasses; he has also been credited, though on very dubious authority, with a knowledge of gunpowder, or some similar compound, and with a certain acquaintance with the force of steam. Some portions of his περὶ παραδόξων μηχανημάτων were published by Dupuy in 1777, and also appeared, in 1786, in the forty-second volume of the *Hist. de l' Acad. des Inscr.* (See Gibbon's *Dec. and Fall,* vol. vii. cap. xl.; Procopius, *de Ædific.*)

ANTHESTERIA, an Athenian festival held annually in the month of Anthesterion, corresponding nearly to our February, at which time the wine stored at the previous vintage was considered fit for use. The object of the festival was to celebrate the arrival of that season, and the beginning of spring. It lasted three days, from the 11th to the 13th of the month. On the first day, called *Pithoigia,* or "jar opening," libations were offered from the newly-opened jars to the god of wine, all the household, including servants or slaves, joining in the festivity of the occasion. The rooms and the drinking vessels in them were adorned with spring flowers, as were also the children over three years of age. The second day, which was named *Choës,* or "the pouring," was a time of merry-making. The people dressed themselves gaily, some in the disguise of the mythical personages in the suite of Bacchus, and paid a round of visits to their acquaintances. Drinking clubs met to drink off matches, the winner being he who drained his cup most rapidly. Others did not forget deceased relations, but poured libations on their tombs. On the part of the state this day was the occasion of a peculiarly solemn and secret ceremony in one of the temples of Bacchus, which for the rest of the year was closed. The Basilissa, or Basilinna, wife of the Archon Basileus for the time, went through a ceremony of marriage to the wine god, in which she was assisted by fourteen Athenian matrons, called *Geraræ,* chosen by the Basileus, and sworn to secrecy. The third day was named χύτροι, or "jugs." Cooked fruit of all kinds was offered to Mercury, in his capacity of a god of the lower world; rejoicings and games were held; and though no tragedy was allowed to be performed in the theatre, there was yet a sort of rehearsal, at which the players for the ensuing dramatic festival were selected.

ANTHOLOGY. The term anthology, literally denoting a collection of flowers, is figuratively applied to any selection of literary beauties, and especially to that great body of fugitive poetry, comprehending about 4500 pieces, by upwards of 300 writers, which is commonly known as the GREEK ANTHOLOGY.

Literary History of the Greek Anthology.—The art of occasional poetry had been cultivated in Greece from an early period,—less, however, as the vehicle of personal feeling, than as the recognised commemoration of remarkable individuals or events, or the accompaniment of votive offerings. Such compositions were termed epigrams, *i.e.,* inscriptions. The modern use of the word is a departure from the original sense, which simply indicated that the composition was intended to be engraved or inscribed. Such a composition must necessarily be brief, and the restraints attendant upon its publication concurred with the simplicity of Greek taste in prescribing conciseness of expression, pregnancy of meaning, purity of diction, and singleness of thought as the indispensable conditions of excellence in the epigrammatic style. The term was soon extended to any piece by which these conditions were fulfilled. The transition from the monumental to the purely literary character of the epigram was favoured by the exhaustion of more lofty forms of poetry, the general increase, from the general diffusion of culture, of accomplished writers and tasteful readers, but, above all things, by the changed political circumstances of the times, which induced numbers who would otherwise have engaged in public affairs to addict themselves to literary pursuits. These causes came into full operation during the Alexandrian era, in which we find every description of epigrammatic composition perfectly developed. About 90 B.C., the sophist and poet, Meleager of Gadara, undertook to combine the choicest effusions of his predecessors into a single body of fugitive poetry. Collections of monumental inscriptions, or of poems on particular subjects, had previously been formed by Polemon the grammarian, Alcetas, and others; but Meleager first gave the principle a comprehensive application. His selection, compiled from forty-six of his predecessors, from Sappho downward, and including numerous contributions of his own, was entitled *The Garland* (Στέφανος); and in an introductory poem each poet is compared to some flower, fancifully deemed appropriate to his genius. The arrangement of the collection was alphabetical, according to the initial letter of each epigram.

In the age of Tiberius (rather than of Trajan, as commonly stated) the work of Meleager was continued by another epigrammatist, Philip of Thessalonica, who first employed the term anthology. His collection included the compositions of thirteen writers subsequent to Meleager. Somewhat later, another supplement was formed by the sophist Diogenianus, and, under Hadrian, Strato of Sardis compiled his elegant but tainted Μοῦσα παιδική from his own productions and those of earlier writers. No further collection from various sources is recorded until the time of Justinian, when epigrammatic writing, especially in its amatory department, experienced a great revival at the hands of Agathias, the historian, Paulus Silentiarius, and their circle. Their ingenious but mannered productions were collected by Agathias into a new anthology, entitled *The Circle* (Κύκλος); the first to be divided into books, and arranged with reference to the subjects of the pieces.

Five Greek anthologies, accordingly, existed at the commencement of the Middle Ages. The partial incorporation of these into a single body was the work of a certain Constantinus Cephalas, whose name alone is preserved in the single MS. of his compilation extant, but who probably lived during the temporary revival of letters under Constantine Porphyrogenitus, at the beginning of the 10th century. He appears to have merely made excerpts from the existing anthologies, with the addition of selections from Lucillius, Palladas, and other epigrammatists, whose compositions had been published separately. His arrangement, to which we shall have to recur, is founded on a principle of classification, and nearly corresponds to that adopted by Agathias. His principle of selection is unknown; it is only certain that while he omitted much that he should have retained, he has preserved much that would otherwise have perished. The extent of our obligations may be ascertained by a comparison between his anthology and that of the next editor, the monk Maximus Planudes

(1320 A.D.), who has not merely grievously mutilated the anthology of Cephalas by omissions, but has disfigured it by interpolating verses of his own. We are, however, indebted to him for the preservation of the epigrams on works of art, which seem to have been accidentally omitted from our only transcript of Cephalas.

The Planudean was the only recension of the anthology known at the revival of classical literature, and was first published at Florence, by Janus Lascaris, in 1594. It long continued to be the only accessible collection, for although the Palatine MS., the sole extant copy of the anthology of Cephalas, was discovered at Heidelberg by Salmasius in 1606, it was not published until 1772, when it was included in Brunck's *Analecta Veterum Poetarum Græcorum.* This edition was superseded by the standard one of Friedrich Jacobs (Leipsic, 1794–1803, 13 vols.), the text of which was reprinted in a more convenient form in 1813–17, and occupies three pocket volumes in the Tauchnitz series of the classics. The best edition for general purposes is perhaps that of M. Dübner in Didot's *Bibliotheca* (Paris, 1864–72), which contains the Palatine Anthology, the epigrams of the Planudean Anthology not comprised in the former, an appendix of pieces derived from other sources, copious notes selected from all quarters, a literal Latin prose translation by Boissonade, Bothe, and Lapaume, and the metrical Latin versions of Hugo Grotius. The best edition of the Planudean Anthology is the splendid one by Van Bosch and Van Lennep (Utrecht, 1795–1822). Welcker, Meineke, and other German scholars have written valuable monographs on the Anthology.

Arrangement of the Anthology.—The Palatine MS., the archetype of the present text, was transcribed by different persons at different times, and the actual arrangement of the collection does not correspond with that signalised in the index. It is as follows:—Book 1. Christian epigrams; 2. Christodorus's description of certain statues, 3. Inscriptions in the temple at Cyzicus; 4. The prefaces of Meleager, Philip, and Agathias to their respective collections; 5. Amatory epigrams; 6. Votive inscriptions; 7. Epitaphs; 8. The epigrams of Gregory of Nazianzus; 9. Rhetorical and illustrative epigrams; 10. Ethical pieces; 11. Humorous and convivial; 12. Strato's Μοῦσα παιδική; 13. Metrical curiosities; 14. Puzzles, enigmas, oracles; 15. Miscellanies. The epigrams on works of art, as already stated, are missing from the *Codex Palatinus,* and must be sought in an appendix of epigrams only occurring in the Planudean Anthology. The epigrams hitherto recovered from ancient monuments and similar sources form another appendix in the second volume of Dübner's edition.

Style and Value of the Anthology.—One of the principal claims of the Anthology to attention is derived from its continuity, its existence as a living and growing body of poetry throughout all the vicissitudes of Greek civilisation. More ambitious descriptions of composition speedily ran their course, and having attained their complete development became extinct, or at best lingered only in feeble or conventional imitations. The humbler strains of the epigrammatic muse, on the other hand, remained ever fresh and animated, ever in intimate union with the spirit of the generation that gave them birth. To peruse the entire collection, accordingly, is as it were to assist at the disinterment of an ancient city, where generation has succeeded generation on the same site, and each stratum of soil enshrines the vestiges of a distinct epoch, but where all epochs, nevertheless, combine to constitute an organic whole, and the transition from one to the other is hardly perceptible. Four stages may be indicated:—1. The Hellenic proper, of which Simonides is the characteristic representative. This is characterised by a simple dignity of phrase, which to a modern taste almost verges upon baldness, by a crystalline transparency of diction, and by an absolute fidelity to the original conception of the epigram. Nearly all the pieces of this era are actual *bona fide* inscriptions, or addresses to real personages, whether living or deceased; narratives, literary exercises, and sports of fancy are exceedingly rare. 2. The epigram received a great development in its second or Alexandrian era, when its range was so extended as to include anecdote, satire, and amorous longing; when epitaphs and votive inscriptions were composed on imaginary persons and things, and men of taste successively attempted the same subjects in mutual emulation, or sat down to compose verses as displays of their ingenuity. The result was a great gain in richness of style and general interest, counterbalanced by a falling off in purity of diction and sincerity of treatment. The modification,—a perfectly legitimate one, the resources of the old style being exhausted,—had its real source in the transformation of political life, but may be said to commence with and to find its best representative in the playful and elegant Leonidas of Tarentum, a contemporary of Pyrrhus, and to close with Antipater of Sidon, about 140 B.C. It should be noticed, however, that Callimachus, one of the most distinguished of the Alexandrian poets, affects the sternest simplicity in his epigrams, and copies the austerity of Simonides with as much success as an imitator can expect. 3. By a slight additional modification in the same direction, the Alexandrian passes into what, for the sake of preserving the parallelism with the eras of Greek prose literature, we may call the Roman style, although the peculiarities of its principal representative are decidedly Oriental. Meleager of Gadara was a Syrian; his taste was less severe, and his temperament more fervent than those of his Greek predecessors; his pieces are usually erotic, and their glowing imagery sometimes reminds us of the Song of Solomon. The luxuriance of his fancy occasionally betrays him into far-fetched conceits, and the lavishness of his epithets is only redeemed by their exquisite felicity. Yet his effusions are manifestly the offspring of genuine feeling, and his epitaph on himself indicates a great advance on the exclusiveness of antique Greek patriotism, and is perhaps the first clear enunciation of the spirit of universal humanity characteristic of the later Stoical philosophy. With respect to his more strictly poetical qualities, Mr Symonds does not overpraise him when he says "his poetry has the sweetness and the splendour of the rose, the rapture and full throated melody of the nightingale." His gaiety and licentiousness are imitated and exaggerated by his somewhat later contemporary, the Epicurean Philodemus, perhaps the liveliest of any of the epigrammatists; his fancy reappears with diminished brilliancy in Philodemus's contemporary, Zonas, in Crinagoras, who wrote under Augustus, and in Marcus Argentarius, of uncertain date; his peculiar gorgeousness of colouring remains entirely his own. At a later period of the empire another *genre,* hitherto comparatively in abeyance, was developed, the satirical. Lucillius, who flourished under Nero, and Lucian, more renowned in other fields of literature, display a remarkable talent for shrewd, caustic epigram, frequently embodying moral reflections of great cogency, often lashing vice and folly with signal effect, but not seldom indulging in mere trivialities, or deformed by scoffs at personal blemishes. This style of composition is not properly Greek, but Roman; it answers to the modern definition of epigram, and has hence attained a celebrity in excess of its deserts. It is remarkable, however, as an almost solitary example of direct Latin influence on Greek literature. The same style obtains with Palladas, an Alexandrian grammarian of the 4th century, the last of the strictly classical epigrammatists, and the first to be guilty of downright bad taste. His better pieces, however, are characterised by an austere ethical impressiveness, and his literary position is very interesting, as that of an indignant but despairing opponent of Christianity. 4. The fourth or Byzantine style of epigrammatic composition was cultivated by the *beaux-esprits* of the court of Justinian. To a great extent this is merely imitative, but the circumstances of the period operated so as to produce a species of originality. The peculiarly ornate and *recherché* diction of Agathias and his compeers is not a merit in itself, but applied for the first time, it has the effect of revivifying an old form, and many of their new locutions are actual enrichments of the language. The writers, moreover, were men of genuine poetical feeling, ingenious in invention, and capable of expressing emotion with energy and liveliness; the colouring of their pieces is sometimes highly dramatic. The charge of impurity, alleged by Mr Symonds against them as a body, applies to Rufinus alone in any considerable degree, and he is purity itself compared with Martial. There is something very touching in the attitude of these last belated stragglers towards the antique culture from which they are hopelessly severed,—their half-conscious yearning for the glorious past, whose monuments still surrounded them on every side, but whose spirit had departed for ever. With them the volume of the Greek anthology is closed, for the "Christian epigrams" are totally valueless in a literary point of view.

It would be hard to exaggerate the substantial value of the Anthology, whether as a storehouse of facts bearing on antique manners, customs, and ideas, or as one among the influences which have contributed to mould the literature of the modern world. The multitudinous votive inscriptions, serious and sportive, connote the phases of Greek religious sentiment, from pious awe to irreverent familiarity and sarcastic scepticism; the moral tone of the nation at various periods is mirrored with corresponding fidelity; the sepulchral inscriptions admit us into the inmost sanctuary of family affection, and reveal a depth and tenderness of feeling beyond the province of the historian to depict, and which we should not have surmised even from the dramatists; the general tendency of the collection is to display antiquity on its most human side, and to mitigate those contrasts with the modern world which more ambitious modes of composition force into relief. The constant reference to the details of private life renders the Anthology an inexhaustible treasury for the student of archæology; art, industry, and costume receive their fullest illustration from its pages. Its influence on European literatures will be appreciated in proportion to the inquirer's knowledge of each. The further his researches extend, the greater will be his astonishment at the extent to which the Anthology has been laid under contribution for thoughts which have become household words in all cultivated languages, and at the beneficial effect of the imitation of its brevity, simplicity, and absolute verbal accuracy upon the undisciplined luxuriance of modern genius.

Translations, Imitations, &c., of the Anthology.—The best versions of the Anthology ever made are the Latin renderings of select epigrams by Hugo Grotius. They have not been printed separately, but will be found in Bosch and Lennep's edition of the Planudean *Anthology*, in the Didot edition, and in Dr Wellesley's *Anthologia Polyglotta*. The number of more or less professed imitations in modern languages is infinite, that of actual translations less considerable. French and Italian, indeed, are ill adapted to this purpose, from their incapacity of approximating to the form of the original, and their poets have usually contented themselves with paraphrases or imitations, often exceedingly felicitous. Dehesme's French prose translation, however (1863), is most excellent and valuable. The German language alone admits of the preservation of the original metre,—a circumstance advantageous to the German translators, Herder and Jacobs, who have not, however, compensated the loss inevitably consequent upon a change of idiom by any added beauties of their own. Though unfitted to reproduce the precise form, the English language, from its superior terseness, is better adapted to preserve the spirit of the original than the German; and the comparative ill success of many English translators must be chiefly attributed to the extremely low standard of fidelity and brevity observed by them. Bland, Merivale, and their associates (1806–13), are often intolerably diffuse and feeble, from want, not of ability, but of painstaking. Archdeacon Wrangham's too rare versions are much more spirited; and John Sterling's translations of the inscriptions of Simonides deserve high praise. Professor Wilson (*Blackwood's Magazine*, 1833–35), collected and commented upon the labours of these and other translators, with his accustomed critical insight and exuberant geniality, but damaged his essay by burdening it with the indifferent attempts of William Hay. In 1849 Dr Wellesley, principal of New Inn Hall, Oxford, published his *Anthologia Polyglotta*, a most valuable collection of the best translations and imitations in all languages, with the original text. In this appeared some admirable versions by Mr Goldwin Smith and Dean Merivale, which, with the other English renderings extant at the time, will be found accompanying the literal prose translation of the *Public School Selections*, executed by the Rev. George Burges for Bohn's Classical Library (1854). This is a useful volume, but the editor's notes are worthless. In 1864 Major R. G. Macgregor published an almost complete translation of the Anthology, a work of stupendous industry and fidelity, which almost redeem the general mediocrity of the execution. *Idylls and Epigrams*, by R. Garnett (1869), include about 140 translations or imitations, with some original compositions in the same style. An agreeable little volume on the Anthology, by Lord Neaves, is one of Collins's series of *Ancient Classics for Modern Readers*. Two recent critical contributions to the subject should be noticed, the Rev. James Davies's essay on Epigrams, in the *Quarterly Review* (vol. cxvii.), especially valuable for its lucid illustration of the distinction between Greek and Latin epigram; and the brilliant disquisition in Mr J. A. Symonds's *Studies of the Greek Poets* (1873).

The LATIN ANTHOLOGY is the appellation bestowed upon a collection of fugitive Latin verse, from the age of Ennius to about 1000 A.D., formed by Peter Burmann the Younger. Nothing corresponding to the Greek anthology is known to have existed among the Romans, though professional epigrammatists like Martial published their volumes on their own account, and detached sayings were excerpted from such sententious authors as Publius Syrus, while the *Priapeia* were probably but one among many collections on special subjects. The first general collection of scattered pieces made by a modern scholar was Scaliger's, in 1573, succeeded by the more ample one of Pithœus, in 1594. Numerous additions, principally from inscriptions, continued to be made, and in 1759 Burmann digested the whole into his *Anthologia veterum Latinorum Epigrammatum et Poematum*. This, occasionally reprinted, has been the standard edition until recently; but in 1869 Alexander Riese commenced a new and more critical recension, from which many pieces improperly inserted by Burmann are rejected, and his classified arrangement is discarded for one according to the sources whence the poems have been derived. The first volume contains those found in MSS., in the order of the importance of these documents; those furnished by inscriptions are to follow. Being formed by scholars actuated by no æsthetic principles of selection, but solely intent on preserving everything they could find, the Latin anthology is much more heterogeneous than the Greek, and unspeakably inferior. The really beautiful poems of Petronius and Apuleius are more properly inserted in the collected editions of their writings, and more than half the remainder consists of the frigid conceits or pedantic professional exercises of grammarians of a very late period of the empire, relieved by an occasional gem, such as the apostrophe of the dying Hadrian to his spirit, or the epithalamium of Gallienus. The collection is also, for the most part, too recent in date, and too exclusively literary in character, to add much to our knowledge of classical antiquity. The epitaphs are interesting, but the genuineness of many of them is very questionable. (R. G.)

ANTHON, Charles, an American philologist and professor of classics, was born in New York city in 1797, and died there 29th July 1867. After graduating with honours at Columbia College in 1815, he commenced the study of law, and in 1819 was admitted to the bar. But in 1820 he was appointed assistant professor of languages in his alma mater, and he thenceforth devoted himself solely to classical literature. Soon after he commenced his well-known editions of the classics, the best known being that of the *Poems* of Horace, with extensive notes and comments, published in 1830. In the latter year he was made rector of the grammar school attached to his college, and in 1835 he succeeded to the chair of Professor Morse.

ANTHONY, Saint, the founder of monasticism, was born at the village of Coma in Egypt 251 A.D. Inheriting a large fortune, he thought it his duty to distribute it among his neighbours and the poor, and to live a rigidly ascetic life. He spent several years in solitude, where according to tradition he was sorely tempted by the devil. Many disciples flocked to his retreat at Fayoom, and built their cells around his, thus forming the earliest monastic community. (See Abbey.) Anthony visited Alexandria when upwards of a hundred years old, and took an important part in the controversy with the Arians,—a fact to which we are probably indebted for the record of the life of the saint written by Athanasius. Soon after returning to his cell he died (356 A.D.), his last injunction being that the place of his burial should be kept secret. Seven Latin translations of his letters are extant in the *Bibliotheca Patrum*. Many miracles were believed to have been wrought by his intervention, among others, the cure of what was called the "sacred fire," and afterwards "St Anthony's fire" (Erysipelas). For this reason he is usually represented with a fire by his side, as typical of the inflammatory disease which he was supposed to relieve. The festival of Saint Anthony is observed on the 17th of January, under which date the *Acta Sanctorum* of the Bollandists contains a Latin translation of Athanasius's life of the saint, and other documents giving an account of his miracles. The events of his life—in particular his temptation by the devil and his meeting with St Paul—form the subjects of celebrated pictures by Caracci, Guido, Velasquez, and others. For further details of Anthony's connection with the monastic system, see Monasticism.

ANTHRACITE, Stone Coal, Kilkenny Coal, or Culm, is a variety of coal differing from the common or bituminous kind in containing a larger proportion of carbon in its composition; that element being present in anthracite to the extent of from 90 to 95 per cent. of its entire mass, while the carbon in bituminous coal usually varies from 75 to 90 per cent. Anthracite is further distinguished by its compactness, high specific gravity, bright lustre, which is frequently iridescent on the natural surfaces, and its conchoidal fracture. It does not soil the fingers when handled, like ordinary coal; it ignites with difficulty, and burns with a feeble, smokeless flame, giving out an intense heat. No sharply defined line of demarcation can be drawn between anthracite and the bituminous varieties of coal, as the one series merges by imperceptible degrees into the other. This gradation is observable in the coal deposits themselves, anthracite and bituminous coal being frequently found not far removed in different parts of the same seam, and the gradual transformation from a flaming coal to a compact, lustrous, non-flaming kind, being easily traceable. Anthracite has been defined as "the ultimate product of the conversion of vegetable matter into coal;" and the following table, drawn up by Dr Percy (*Manual of Metallurgy*), may be taken as indicating the successive stages in the process. In this table the carbon is stated at a constant standard of 100, in order better to exhibit the comparative quantities of the other elements which enter into the composition of the bodies named:—

	Carbon.	Hydrogen.	Oxygen.
1. Wood (mean of 26 analyses)	100	12·18	83·07
2. Peat	100	9·85	55·67
3. Lignite (average of 15 varieties).....	100	8·37	42·42
4. Ten Yard Coal, South Staffordshire	100	6·12	21·23
5. Steam Coal, from the Tyne...........	100	5·91	18·32
6. Pentrefelin Coal of South Wales ...	100	4·75	5·28
7. Anthracite of Pennsylvania, U.S. ...	100	2·84	1·74

The chief deposits of anthracite in Great Britain exist in the great coal-field of South Wales. They extend principally along the north side of the coal basin; and on its western limit, in Pembrokeshire, the coal is entirely anthracitic. Professor Warrington Smyth remarks, on the disposition of the deposits in South Wales:—"Even within the distance of a few hundred yards the Llanelly beds are seen to be bituminous where they rise to the south, and anthracitic in the opposite side of the trough." In the neighbourhood of Bideford, in North Devonshire, a series of thin seams of an impure, clayey anthracite are worked, to which properly the name *culm* ought to be restricted, although the whole of the anthracite exported from this country appears under that designation in the Board of Trade returns. The very meagre coal-bearing strata of Ireland yield anthracite almost exclusively. The name Kilkenny coal is given to anthracite, because that county is the centre of the South Irish coal-field, which yields no bituminous coal whatever. In the limited patches of coal found in the north of Ireland, however, some bituminous seams occur associated with anthracite. On the European continent anthracite is generally found accompanying the deposits of bituminous coal. In Belgium and Westphalia the lowest or oldest deposits of the series are anthracitic, while in Rhenish Bavaria it is the upper beds which are "dry," or least bituminous. In North America, where enormous stores of coal exist, anthracite is found in due proportion, the deposits in Pennsylvania being the richest known. The late Professor H. D. Rogers pointed out an interesting relation between the contortion or disturbance of strata in the Appalachian coal-field and the amount of bituminous matter the coal contains. In the western extension of the coal-field, where the beds are horizontal and undisturbed, the seams are highly bituminous; and in proportion as disturbance increases, the volatile compounds decrease, till on its eastern limit, in the Appalachian chain, enormous seams of a compact, pure anthracite are developed. Anthracite is used for iron-smelting and in other metallurgical operations, for lime-burning, for heating kilns, and other purposes requiring a steady, smokeless heat. As it burns with an intense concentrated heat, it is not so suitable for steam boilers as ordinary flaming coal, and the difficulty with which it ignites, as well as its disagreeable decrepitation, renders it less eligible for household purposes.

ANTHROPOLOGY

Definition and objects of the science.

ANTHROPOLOGY (the *science of man*, ἄνθρωπος, λόγος) denotes the natural history of mankind. In the general classification of knowledge it stands as the highest section of zoology or the science of animals, itself the highest section of biology or the science of living beings. To anthropology contribute various sciences, which hold their own independent places in the field of knowledge. Thus anatomy and physiology display the structure and functions of the human body, while psychology investigates the operations of the human mind. Philology deals with the general principles of language, as well as with the relations between the languages of particular races and nations. Ethics or moral science treats of man's duty or rules of conduct toward his fellow-men. Lastly, under the names of sociology and the science of culture, are considered the origin and development of arts and sciences, opinions, beliefs, customs, laws, and institutions generally among mankind, their course in time being partly marked out by the direct record of history, while beyond the historical limit our information is continued by inferences from relics of early ages and remote districts, to interpret which is the task of præ-historic archæology and geology. Not only are these various sciences concerned largely with man, but several among them have in fact suffered by the almost entire exclusion of other animals from their scheme. It is undoubted that comparative anatomy and physiology, by treating the human species as one member of a long series of related organisms, have gained a higher and more perfect understanding of man himself and his place in the universe than could have been gained by the narrower investigation of his species by and for itself. It is to be regretted that hitherto certain other sciences—psychology, ethics, and even philology and sociology—have so little followed so profitable an example. No doubt the phenomena of intellect appear in vastly higher and more complete organisation in man than in beings below him in the scale of nature, that beasts and birds only attain to language in its lower rudiments, and that only the germs of moral tendency and social law are discernible among the lower animals. Yet though the mental and moral interval between man and the nearest animals may be vast, the break is not absolute, and the investigation of the laws of reason and instinct throughout the zoological system, which is already casting some scattered rays of light on the study of man's highest organisation, may be destined henceforth to throw brighter illumination into its very recesses. Now this condition of things, as well as the accepted order in which the sciences have arranged themselves by their mode of growth, make it desirable that anthropology should not too ambitiously strive to include within itself the sciences which provide so much of its wealth, but that each science should pursue its own subject through the whole range of living beings, rendering to anthropology an account of so much of its results as concerns man. Such results it is the office of anthropology to collect and co-ordinate, so as to elaborate as completely as may be the synopsis of man's bodily and mental nature, and the theory of his whole course of life and action from his first appearance on earth. As will be seen from the following brief summary, the information to be thus brought together from contributing sciences is widely different both in accuracy and in soundness. While much of the descriptive detail is already clear and well filled in, the general principles of its order are still but vaguely to be discerned, and as our view quits the comparatively distinct region near ourselves, the prospect fades more and more into the dimness of conjecture.

Relation of Man to the lower animals.

I. *Man's Place in Nature.*—It is now more than thirty years since Dr Prichard, who perhaps of all others merits the title of founder of modern anthropology, stated in the following forcible passage, which opens his *Natural History of Man*, the closeness of man's physical relation to the lower animals:—

"The organised world presents no contrasts and resemblances more remarkable than those which we discover on comparing mankind with the inferior tribes. That creatures should exist so nearly approaching to each other in all the particulars of their physical structure, and yet differing so immeasurably in their endowments and capabilities, would be a fact hard to believe, if it were not manifest to our observation. The differences are everywhere striking: the resemblances are less obvious in the fulness of their extent, and they are never contemplated without wonder by those who, in the study of anatomy and physiology, are first made aware how near is man in his physical constitution to the brutes. In all the principles of his internal structure, in the composition and functions of his parts, man is but an animal. The lord of the earth, who contemplates the eternal order of the universe, and aspires to communion with its invisible Maker, is a being composed of the same materials, and framed on the same principles, as the creatures which he has tamed to be the servile instruments of his will, or slays for his daily food. The points of resemblance are innumerable; they extend to the most recondite arrangements of that mechanism which maintains instrumentally the physical life of the body, which brings forward its early development and admits, after a given period, its decay, and by means of which is prepared a succession of similar beings destined to perpetuate the race."

Referring the reader to the articles HISTOLOGY and PHYSIOLOGY for evidence of the similarity of minute organisation both in structure and function, through the range of animal life upward to man, and to the article ANIMAL KINGDOM for the general classification of the series of invertebrate and vertebrate animals, we have here to show in outline the relations between man and the species most closely approaching him. It is admitted that the higher apes come nearest to man in bodily formation, and that it is essential to determine their zoological resemblances and differences as a step toward ascertaining their absolute relation in nature. "At this point," writes Professor Owen in a paper on the "Osteology of the Apes," "every deviation from the human structure indicates with precision its real peculiarities, and we then possess the true means of appreciating those modifications by which a material organism is especially adapted to become the seat and instrument of a rational and responsible soul." (On the "Osteology of the Chimpanzee and Orang Utan," in *Proc. Zool. Soc.*, vol. i.) Professor Huxley, in his *Man's Place in Nature* (London 1863), comparing man with order after order of the mammalia, decides "There would remain then but one order for comparison, that of the Apes (using that word in its broadest sense), and the question for discussion would narrow itself to this—is Man so different from any of these Apes that he must form an order by himself? Or does he differ less from them than they differ from one another, and hence must take his place in the same order with them?" This anatomist states the anatomical relations between man and ape in untechnical terms suited to the present purpose, and which would be in great measure accepted by zoologists and anthropologists, whether agreeing or not with his ulterior views. The relations are most readily stated in comparison with the gorilla, as on the whole the most anthropomorphous ape. In the general proportions of the body and limbs there is a marked difference between the gorilla and man, which at once strikes the eye. The gorilla's brain-case is smaller, its trunk larger, its lower limbs shorter, its upper limbs longer in proportion than those of man. The differences between a gorilla's skull and a man's are truly immense. In the gorilla, the face,

Apes and Man.

formed largely by the massive jaw-bones, predominates over the brain-case or cranium; in the man these proportions are reversed. In man the occipital foramen, through which passes the spinal cord, is placed just behind the centre of the base of the skull, which is thus evenly balanced in the erect posture, whereas the gorilla, which goes habitually on all fours, and whose skull is inclined forward, in accordance with this posture has the foramen further back. In man the surface of the skull is comparatively smooth, and the brow-ridges project but little, while in the gorilla these ridges overhang the cavernous orbits like penthouse roofs. The absolute capacity of the cranium of the gorilla is far less than that of man; the smallest adult human cranium hardly measuring less than 63 cubic inches, while the largest gorilla cranium measured had a content of only 34½ cubic inches. The large proportional size of the facial bones, and the great projection of the jaws, confer on the gorilla's skull its small facial angle and brutal character, while its teeth differ from man's in relative size and number of fangs. Comparing the lengths of the extremities, it is seen that the gorilla's arm is of enormous length, in fact about one-sixth longer than the spine, whereas a man's arm is one-fifth shorter than the spine; both hand and foot are proportionally much longer in the gorilla than in man; the leg does not so much differ. The vertebral column of the gorilla differs from that of man in its curvature and other characters, as also does the conformation of its narrow pelvis. The hand of the gorilla corresponds essentially as to bones and muscles with that of man, but is clumsier and heavier; its thumb is "opposable" like a human thumb, that is, it can easily meet with its extremity the extremities of the other fingers, thus possessing a character which does much to make the human hand so admirable an instrument; but the gorilla's thumb is proportionately shorter than man's. The foot of the higher apes, though often spoken of as a hand, is anatomically not such, but a prehensile foot. It is argued by Professor Owen and others that the position of the great toe converts the foot of the higher apes into a hand, an extremely important distinction from man; but against this Professor Huxley maintains that it has the characteristic structure of a foot, with a very movable great toe. The external unlikeness of the apes to man depends much on their hairiness, but this and some other characteristics have no great zoological value. No doubt the difference between man and the apes depends, of all things, on the relative size and organisation of the brain. While similar as to their general arrangement to the human brain, those of the higher apes, such as the chimpanzee, are much less complex in their convolutions, as well as much less both in absolute and relative weight—the weight of a gorilla's brain hardly exceeding 20 ounces, and a man's brain hardly weighing less than 32 ounces, although the gorilla is considerably the larger animal of the two.

Zoological classification.

These anatomical distinctions are undoubtedly of great moment, and it is an interesting question whether they suffice to place man in a zoological order by himself. It is plain that some eminent zoologists, regarding man as absolutely differing as to mind and spirit from any other animal, have had their discrimination of mere bodily differences unconsciously sharpened, and have been led to give differences, such as in the brain or even the foot of the apes and man, somewhat more importance than if they had merely distinguished two species of apes. Among the present generation of naturalists, however, there is an evident tendency to fall in with the opinion, that the anatomical differences which separate the gorilla or chimpanzee from man are in some respects less than those which separate these man-like apes from apes lower in the scale. Yet naturalists agree to class both the higher and lower apes in the same order. This is Professor Huxley's argument, some prominent points of which are the following:—As regards the proportion of limbs, the hylobates or gibbon is as much longer in the arms than the gorilla as the gorilla is than the man, while on the other hand, it is as much longer in the legs than the man as the man is than the gorilla. As to the vertebral column and pelvis, the lower apes differ from the gorilla as much as, or more than, it differs from man. As to the capacity of the cranium, men differ from one another so extremely that the largest known human skull holds nearly twice the measure of the smallest, a larger proportion than that in which man surpasses the gorilla; while, with proper allowance for difference of size of the various species, it appears that some of the lower apes fall nearly as much below the higher apes. The projection of the muzzle, which gives the character of brutality to the gorilla as distinguished from the man, is yet further exaggerated in the lemurs, as is also the backward position of the occipital foramen. In characters of such importance as the structure of the hand and foot, the lower apes diverge extremely from the gorilla; thus the thumb ceases to be opposable in the American monkeys, and in the marmosets is directed forwards, and armed with a curved claw like the other digits, the great toe in these latter being insignificant in proportion. The same argument can be extended to other points of anatomical structure, and, what is of more consequence, it appears true of the brain. A series of the apes, arranged from lower to higher orders, shows gradations from a brain little higher than that of a rat, to a brain like a small and imperfect imitation of a man's; and the greatest structural break in the series lies not between man and the man-like apes, but between the apes and monkeys on one side, and the lemurs on the other. On these grounds Professor Huxley, restoring in principle the Linnean classification, desires to include man in the order of *Primates*. This order he divides into seven families: first, the *Anthropini*, consisting of man only; second, the *Catarhini*, or Old World apes; third, the *Platyrhini*, all New World apes, except the marmosets; fourth, the *Arctopithecini*, or marmosets; fifth, the *Lemurini*, or lemurs; sixth and seventh, the *Cheiromyini* and *Galeopithecini*. It seems likely that, so far as naturalists are disposed to class man with other animals on purely zoological grounds, some such classification as this may, in the present state of comparative anatomy, be generally adopted.

Psychological classification.

It is in assigning to man his place in nature on psychological grounds that the greater difficulty comes into view. The same naturalist, whose argument has just been summarised against an absolute structural line of demarcation between man and the creatures next in the scale, readily acknowledges an immeasurable and practically infinite divergence, ending in the present enormous gulf between the family of apes and the family of man. To account for this intellectual chasm as possibly due to some minor structural difference, is, however, a view strongly opposed to the prevailing judgment. The opinion is deeply rooted in modern as in ancient thought, that only a distinctively human element of the highest import can account for the severance between man and the highest animal below him.

Bodily structure.

Differences in the mechanical organs, such as the perfection of the human hand as an instrument, or the adaptability of the human voice to the expression of human thought, are indeed of great value. But they have not of themselves such value, that to endow an ape with the hand and vocal organs of a man would be likely to raise it through any large part of the interval that now separates it from humanity. Much more is to be said for the view that man's larger and more highly organised brain accounts for those mental powers in which he so absolutely surpasses the brutes

Senses. The distinction does not seem to lie principally in the range and delicacy of direct sensation, as may be judged from such well-known facts as man's inferiority to the eagle in sight, or to the dog in scent. At the same time, it seems that the human sensory organs may have in various respects acuteness beyond those of other creatures.

Mental powers. But, beyond a doubt, man possesses, and in some way possesses by virtue of his superior brain, a power of co-ordinating the impressions of his senses, which enables him to understand the world he lives in, and by understanding to use, resist, and even in a measure rule it. No human art shows the nature of this human attribute more clearly than does language. Man shares with the mammalia and birds the direct expression of the feelings by emotional tones and interjectional cries; the parrot's power of articulate utterance almost equals his own; and, by association of ideas in some measure, some of the lower animals have even learnt to recognise words he utters. But, to use words in themselves unmeaning, as symbols by which to conduct and convey the complex intellectual processes in which mental conceptions are suggested, compared, combined, and even analysed, and new ones created—this is a faculty which is scarcely to be traced in any lower animal. The view that this, with other mental processes, is a function of the brain, is remarkably corroborated by modern investigation of the disease of aphasia, where the power of thinking remains, but the power is lost of recalling the word corresponding to the thought, and this mental defect is found to accompany a diseased state of a particular locality of the brain (see APHASIA). This may stand among the most perfect of the many evidences that, in Professor Bain's words, "the brain is the principal, though not the sole organ of mind." As the brains of vertebrate animals form an ascending scale, more and more approaching man's in their arrangement, the fact here finds its explanation, that lower animals perform mental processes corresponding in their nature to our own, though of generally less power and complexity. The full evidence of this correspondence will be found in such works as Brehm's *Thierleben*; and some of the salient points are set forth by Mr Darwin, in the chapter on "Mental Powers," in his *Descent of Man.* Such are the similar effects of terror on man and the lower animals, causing the muscles to tremble, the heart to palpitate, the sphincters to be relaxed, and the hair to stand on end. The phenomena of memory, both as to persons and places, is strong in animals, as is manifest by their recognition of their masters, and their returning at once to habits disused for many years, but of which their brain has not lost the stored-up impressions. Such facts as that dogs "hunt in dreams," make it likely that their minds are not only sensible to actual events, present and past, but can, like our minds, combine revived sensations into ideal scenes in which they are actors,—that is to say, they have the faculty of imagination. As for the reasoning powers in animals, the accounts of monkeys learning by experience to break eggs carefully, and pick off bits of shell, so as not to lose the contents, or of the way in which rats or martens after a while can no longer be caught by the same kind of trap, with innumerable similar facts, show in the plainest way that the reason of animals goes so far as to form by new experience a new hypothesis of cause and effect which will henceforth guide their actions. The employment of mechanical instruments, of which instances of monkeys using sticks and stones, and some other similar cases, furnish the only rudimentary traces among the lower animals, is one of the often quoted distinctive powers of man. With this comes the whole vast and ever-widening range of inventive and adaptive art, where the uniform hereditary instinct of the cell-forming bee and the nest-building bird are supplanted by multiform processes and constructions, often at first rude and clumsy in comparison to those of the lower instinct, but carried on by the faculty of improvement and new invention into ever higher stages. "From the moment," writes Mr Wallace (*Natural Selection*, p. 325), "when the first skin was used as a covering, when the first rude spear was formed to assist in the chase, when fire was first used to cook his food, when the first seed was sown or shoot planted, a grand revolution was effected in nature, a revolution which in all the previous ages of the earth's history had had no parallel; for a being had arisen who was no longer necessarily subject to change with the changing universe,—a being who was in some degree superior to nature, inasmuch as he knew how to control and regulate her action, and could keep himself in harmony with her, not by a change in body, but by an advance of mind."

As to the lower instincts tending directly to self-preservation, it is acknowledged on all hands that man has them in a less developed state than other animals; in fact, the natural defencelessness of the human being, and the long-continued care and teaching of the young by the elders, are among the commonest themes of moral discourse. Parental tenderness and care for the young are strongly marked among the lower animals, though so inferior in scope and duration to the human qualities; and the same may be said of the mutual forbearance and defence which bind together in a rudimentary social bond the families and herds of animals. Philosophy seeking knowledge for its own sake; morality, manifested in the sense of truth, right, and virtue; and religion, the belief in and communion with superhuman powers ruling and pervading the universe, are human characters, of which it is instructive to trace, if possible, the earliest symptoms in the lower animals, but which can there show at most only faint and rudimentary signs of their wondrous development in mankind. That the tracing of physical and even intellectual continuity between the lower animals and our own race, does not necessarily lead the anthropologist to lower the rank of man in the scale of nature, cannot be better shown than by citing one of the authors of the development theory, Mr A. R. Wallace (*op. cit.*, p. 324). Man, he considers, is to be placed "apart, as not only the head and culminating point of the grand series of organic nature, but as in some degree a new and distinct order of being."

Materialistic and spiritualistic theories. To regard the intellectual functions of the brain and nervous system as alone to be considered in the psychological comparison of man with the lower animals, is a view satisfactory to those thinkers who hold materialistic views. According to this school, man is a machine, no doubt the most complex and wonderfully adapted of all known machines, but still neither more nor less than an instrument whose energy is provided by force from without, and which, when set in action, performs the various operations for which its structure fits it, namely, to live, move, feel, and think. This doctrine, which may be followed up from Descartes's theory of animal life into the systems of modern writers of the school of Moleschott and Büchner, underlies the *Lectures on Man* of Professor Carl Vogt, one of the ablest of modern anthropologists (English translation published by Anthropological Society, London, 1864). Such views, however, always have been and are strongly opposed by those who accept on theological grounds a spiritualistic doctrine, or what is, perhaps, more usual, a theory which combines spiritualism and materialism in the doctrine of a composite nature in man, animal as to the body and in some measure as to the mind, spiritual as to the soul. It may be useful, as an illustration of one opinion on this subject, to continue here from an earlier page the citation of Dr Prichard's comparison between man and the lower animals:—

"If it be inquired in what the still more remarkable difference consists, it is by no means easy to reply. By some it will be said that man, while similar in the organisation of his body to the lower tribes, is distinguished from them by the possession of an immaterial soul, a principle capable of conscious feeling, of intellect and thought. To many persons it will appear paradoxical to ascribe the endowment of a soul to the inferior tribes in the creation, yet it is difficult to discover a valid argument that limits the possession of an immaterial principle to man. The phenomena of feeling, of desire and aversion, of love and hatred, of fear and revenge, and the perception of external relations manifested in the life of brutes, imply, not only through the analogy which they display to the human faculties, but likewise from all that we can learn or conjecture of their particular nature, the superadded existence of a principle distinct from the mere mechanism of material bodies. That such a principle must exist in all beings capable of sensation, or of anything analogous to human passions and feelings, will hardly be denied by those who perceive the force of arguments which metaphysically demonstrate the immaterial nature of the mind. There may be no rational grounds for the ancient dogma that the souls of the lower animals were imperishable, like the soul of man: this is, however, a problem which we are not called upon to discuss; and we may venture to conjecture that there may be immaterial essences of divers kinds, and endowed with various attributes and capabilities. But the real nature of these unseen principles eludes our research: they are only known to us by their external manifestations. These manifestations are the various powers and capabilities, or rather the habitudes of action, which characterise the different orders of being, diversified according to their several destinations."

Dr Prichard here puts forward distinctly the time-honoured doctrine which refers the mental faculties to the operation of the soul. The view maintained by a distinguished comparative anatomist, Professor Mivart, in his *Genesis of Species*, ch. xii., may fairly follow. "Man, according to the old scholastic definition, is 'a rational animal' (*animal rationale*), and his animality is distinct in nature from his rationality, though inseparably joined, during life, in one common personality. Man's animal body must have had a different source from that of the spiritual soul which informs it, owing to the distinctness of the two orders to which those two existences severally belong." Not to pursue into its details a doctrine which has its place rather in a theological than an anthropological article, it remains to be remarked that the two extracts just given, however significant in themselves, fail to render an account of the view of the human constitution which would probably, among the theological and scholastic leaders of public opinion, count the largest weight of adherence. According to this view, not only life but thought are functions of the animal system, in which man excels all other animals as to height of organisation: but beyond this, man embodies an immaterial and immortal spiritual principle which no lower creature possesses, and which makes the resemblance of the apes to him but a mocking simulance. To pronounce any absolute decision on these conflicting doctrines is foreign to our present purpose, which is to show that all of them count among their adherents men of high rank in science.

Doctrines of creation and evolution.

II. *Origin of Man.*—Available information on this great problem has been multiplied tenfold during the present generation, and the positive dicta of the older authorities are now more and more supplanted by hypotheses based on biological evidence. Opinion as to the genesis of man is divided between the theories of the two great schools of biology, that of creation and that of evolution. In both schools the ancient doctrine of the contemporaneous appearance on earth of all species of animals having been abandoned under the positive evidence of geology, it is admitted that the animal kingdom, past and present, includes a vast series of successive forms, whose appearances and disappearances have taken place at intervals during an immense lapse of ages. The line of inquiry has thus been directed to ascertaining what formative relation subsists among these species and genera, the last link of the argument reaching to the relation between man and the lower creatures preceding him in time. On both the theories here concerned it would be admitted, in the words of Agassiz (*Principles of Zoology*, pp. 205-6), that "there is a manifest progress in the succession of beings on the surface of the earth. This progress consists in an increasing similarity of the living fauna, and, among the vertebrates especially, in their increasing resemblance to man." Agassiz continues, however, in terms characteristic of the creationist school: "But this connection is not the consequence of a direct lineage between the faunas of different ages. There is nothing like parental descent connecting them. The fishes of the Palæozoic age are in no respect the ancestors of the reptiles of the Secondary age, nor does man descend from the mammals which preceded him in the Tertiary age. The link by which they are connected is of a higher and immaterial nature; and their connection is to be sought in the view of the Creator himself, whose aim in forming the earth, in allowing it to undergo the successive changes which geology has pointed out, and in creating successively all the different types of animals which have passed away, was to introduce man upon the surface of our globe. Man is the end towards which all the animal creation has tended from the first appearance of the first Palæozoic fishes." The evolutionist school, on the contrary, maintains that different successive species of animals are in fact connected by parental descent, having become modified in the course of successive generations. Mr Darwin, with whose name and that of Mr Wallace the modern development theory is especially associated, in the preface to his *Descent of Man* (1871), gives precedence among naturalists to Lamarck, as having long ago come to the conclusion "that man is the co-descendant with other species of some ancient, lower, and extinct form." Professor Huxley, remarking (*Man's Place in Nature*, 1863, p. 106) on the crudeness and even absurdity of some of Lamarck's views, dates from Darwin the scientific existence of the development theory. The result of Darwin's application of this theory to man may be given in his own words (*Descent of Man*, part i. ch. 6):—

"The Catarhine and Platyrhine monkeys agree in a multitude of characters, as is shown by their unquestionably belonging to one and the same Order. The many characters which they possess in common can hardly have been independently acquired by so many distinct species; so that these characters must have been inherited. But an ancient form which possessed many characters common to the Catarhine and Platyrhine monkeys, and others in an intermediate condition, and some few perhaps distinct from those now present in either group, would undoubtedly have been ranked, if seen by a naturalist, as an ape or a monkey. And as man under a genealogical point of view belongs to the Catarhine or Old World stock, we must conclude, however much the conclusion may revolt our pride, that our early progenitors would have been properly thus designated. But we must not fall into the error of supposing that the early progenitor of the whole Simian stock, including man, was identical with, or even closely resembled, any existing ape or monkey."

The problem of the origin of man cannot be properly discussed apart from the full problem of the origin of species. The homologies between man and other animals which both schools try to account for; the explanation of the intervals, with apparent want of intermediate forms, which seem to the creationists so absolute a separation between species; the evidence of useless "rudimentary organs," such as in man the external shell of the ear, and the muscle which enables some individuals to twitch their ears, which rudimentary parts the evolutionists claim to be only explicable as relics of an earlier specific condition,—these, which are the main points of the argument on the origin of man, belong to general biology. The philosophical principles which underlie the two theories stand for the most part in strong contrast, the theory of evolution tending toward the supposition of ordinary causes, such as "natural selection," producing modifications in species, whether by gradual accumulation or more sudden leaps, while the theory of creation is prone to have recourse to acts of supernatural intervention (see the Duke of Argyll, *Reign of Law*, ch. v.) A theory has been propounded by Mr Mivart (*Genesis of Species*, 1871) of a natural evolution of man as to his body, combined with a supernatural creation as to his soul; but this attempt to meet the difficulties on both sides seems at present not to have satisfied either. Anthropology waits to see whether the discovery of intermediate forms, which has of late years reduced so many asserted species to mere varieties, will go on till it produces a disbelief in any real separation between neighbouring species, and especially whether geology can furnish traces of the hypothetical animal, man's near ancestor, but not as yet man. In the present state of the argument it may here suffice to have briefly indicated the positions held on either side. (Among other works relating to the development theory as applied to man, see Vogt, *Lectures on Man*; Haeckel, *Natürliche Schöpfungsgeschichte*, 2d ed., 1871.)

Permanent hereditary varieties or races.

III. *Races of Mankind.*—The classification of mankind into a number of permanent varieties or races, rests on grounds which are within limits not only obvious but definite. Whether from a popular or a scientific point of view, it would be admitted that a Negro, a Chinese, and an Australian, belong to three such permanent varieties of men, all plainly distinguishable from one another and from any European. Moreover, such a division takes for granted the idea which is involved in the word race, that each of these varieties is due to special ancestry, each race thus representing an ancient breed or stock, however these breeds or stocks may have had their origin. The anthropological classification of mankind is thus zoological in its nature, like that of the varieties or species of any other animal group, and the characters on which it is based are in great measure physical, though intellectual and traditional peculiarities, such as moral habit and language, furnish important aid. Among the best-marked race-characters are the following:—

Colour of skin, &c.

The colour of the skin has always been held as specially distinctive. The coloured race-portraits of ancient Egypt remain to prove the permanence of complexion during a lapse of a hundred generations, distinguishing coarsely but clearly the types of the red-brown Egyptian, the yellow-brown Canaanite, the comparatively fair Libyan, and the Negro (see Wilkinson, *Ancient Eg.*; Brugsch, *Geogr. Inschr. Altägypt. Denkm.*, vol. ii.) These broad distinctions have the same kind of value as the popular terms describing white, yellow, brown, and black races, which often occur in ancient writings, and are still used. But for scientific purposes greater accuracy is required, and this is now satisfactorily attained by the use of Dr Broca's graduated series of colours as a standard (*Mémoires de la Société d'Anthropologie de Paris*, ii.) By this table the varieties of the human skin may be followed from the fairest hue of the Swede and the darker tint of the Provençal, to the withered-leaf brown of the Hottentot, the chocolate brown of the Mexican, and the brown-black of the West African. The colour of the eyes and hair is also to be defined accurately by Broca's table. This affords, however, less means of distinction, from the extent in which dark tints of hair and iris are common to races whose skins are more perceptibly different; yet some varieties are characteristic, such as the blue eyes and flaxen hair of the fair race of Northern Europe.

Structure and arrangement of hair.

As to the hair, its structure and arrangement is a better indication of race than its tint. The hair differs in quantity between scantiness on the body of the Mongol and profusion on the body of the Aino; while as to the arrangement on the scalp, the tufts of the Bushman contrast with the more equal distribution on the European head. The straight hair of the North American or Malay is recognisable at once as different from the waving or curling hair of the European, and both from the naturally frizzed hair of the Negro. These marked differences are due to the structure of the hair, which, examined in sections under the microscope, varies from the circular section proper to the straight-haired races, to the more or less symmetrically oval or reniform sections belonging to races with curled and twisted hair (see Pruner-Bey in *Mém. de la Soc. Anthrop.*, vol. ii.)

Stature and proportions.

Stature is by no means a general criterion of race, and it would not, for instance, be difficult to choose groups of Englishmen, Kafirs, and North American Indians, whose mean height should hardly differ. Yet in many cases it is a valuable means of distinction, as between the tall Patagonians and the stunted Fuegians, and even as a help in minuter problems, such as separating the Teutonic and Keltic ancestry in the population of England (see Beddoe, "Stature and Bulk of Man in the British Isles," in *Mem. Anthrop. Soc. London*, vol. iii.) Proportions of the limbs, compared in length with the trunk, have been claimed as constituting peculiarities of African and American races; and other anatomical points, such as the conformation of the pelvis, have speciality. But inferences of this class have hardly attained to sufficient certainty and generality to be set down in the form of rules.

Shape of skull.

The conformation of the skull is second only to the colour of the skin as a criterion for the distinction of race. The principal modes of estimating the differences of skulls are the following:—The skull being seen from above, the proportions of the two diameters are estimated on the principle employed by Retzius: taking the longer diameter from front to back as 100, if the shorter or cross diameter falls below 80, the skull may be classed as long (dolichocephalic); while if it exceeds 80, the skull may be classed as broad (brachycephalic); or a third division may be introduced between these as intermediate (mesocephalic), comprehending skulls with a proportionate breadth of 75 to 80, or thereabout. The percentage of breadth to length measured in this manner is known as the cephalic index; thus, the cephalic index of a Negro or Australian may be as low as 72, and that of a Tatar as high as 88, while the majority of Europeans have an index not departing in either direction very far from 78. The cephalic height is measured in the same way as a percentage of the length. The back view (norma occipitalis) of the skull is distinguished as rounded, pentagonic, &c., and the base view of the skull shows the position of the occipital foramen and the zygomatic arches. The position of the jaws is recognised as important, races being described as prognathous when the jaws project far, as in the Australian or Negro, in contradistinction to the orthognathous type, which is that of the ordinary well-shaped European skull. On this distinction in great measure depends the celebrated "facial angle," measured by Camper as a test of low and high races; but this angle is objectionable as resulting partly from the development of the forehead and partly from the position of the jaws. The capacity of the cranium is estimated in cubic measure by filling it with sand, &c., with the general result that the civilised white man is found to have a larger brain than the barbarian or savage.

Classification of races on cranial measurements has long been attempted by eminent anatomists, such as Blumenbach and Retzius, while the later labours of Von Baer, Welcker, Davis, Broca, Busk, Lucae, and many others, have brought the distinctions to extreme minuteness. In certain cases great reliance may be placed on such measurements. Thus the skulls of an Australian and a Negro would be generally distinguished by their narrowness and the projection of the jaw from that of any Englishman; while, although both the Australian and Negro are thus dolichocephalic and prognathous, the first would usually differ perceptibly from the second in its upright sides and strong orbital ridges. The relation of height to breadth may furnish a valuable test; thus both the Kafir and the Bushman are dolichocephalic, with an index of about 72, but they differ in the index of height, which may be 73 and 71 respectively, in the one case more than the width and in the other less. It is, however, acknowledged by all experienced craniologists, that the shape of the skull may vary so much within the same tribe, and even the same family, that it must be used with extreme caution, and if possible only in conjunction with other criteria of race.

Features.

The general contour of the face, in part dependent on the form of the skull, varies much in different races, among whom it is loosely defined as oval, lozenge-shaped, pentagonal, &c. Of particular features, some of the most marked contrasts to European types are seen in the oblique Chinese eyes, the broad-set Kamchadal cheeks, the pointed Arab chin, the snub Kirghis nose, the fleshy protuberant Negro lips, and the broad Kalmuk ear. Taken altogether, the features have a typical character which popular observation seizes with some degree of correctness, as in the recognition of the Jewish countenance in a European city.

Constitution and character.

The state of adaptation in which each people stands to its native climate forms a definite race-character. In its extreme form this is instanced in the harmful effect of the climate of India on children of European parents, and the corresponding danger in transporting natives of tropical climates to England. Typical instances of the relation of race-constitutions to particular diseases are seen in the liability of Europeans in the West Indies to yellow fever, from which Negroes are exempt, and in the habitation by tribes in India of so-called "unhealthy districts," whose climate is deadly to Europeans, and even to natives of neighbouring regions. Even the vermin infesting different races of men are classified by Mr A. Murray (*Trans. R. Soc. Edin.*, vol. xxii.) as distinct.

The physical capabilities of different races are known to differ widely, but it is not easy to discriminate here between hereditary race-differences and those due to particular food and habit of life. A similar difficulty has hitherto stood in the way of any definite classification of the emotional, moral, and intellectual characters of races. Some of the most confident judgments which have been delivered on this subject have been dictated by prejudice or wilful slander, as in the many lamentable cases in which slave-holders and conquerors have excused their ill-treatment of subject and invaded races on the ground of their being creatures of bestial nature in mind and morals. Two of the best-marked contrasts of mental type recorded among races are Mr A. R. Wallace's distinction between the shy, reserved, and impassive Malay and the sociable and demonstrative Papuan (*Tr. Eth. Soc.*, vol iii. p. 200), and the very similar difference pointed out by Spix and Martius between the dull and morose natives of the Brazilian forests, and the lively sensuous African Negroes brought into contact with them (*Reise in Brasilien*, vol. i.) In general, however, descriptions of national or racial character are so vitiated by the confusion of peculiarity of natural character with stage of civilisation, that they can only be made use of with the greatest reserve.

The relation of language to race is discussed below. (Section V.)

General classification of races.

Were the race-characters indicated in the foregoing paragraphs constant in degree or even in kind, the classification of races would be an easy task. In fact it is not so, for every division of mankind presents in every character wide deviations from a standard. Thus the Negro race, well marked as it may seem at the first glance, proves on closer examination to include several shades of complexion and features, in some districts varying far from the accepted Negro type; while the examination of a series of native American tribes shows that, notwithstanding their asserted uniformity of type, they differ in stature, colour, features, and proportions of skull. (See Prichard, *Nat. Hist. of Man;* Waitz, *Anthropology*, part i. sec. 5.) Detailed anthropological research, indeed, more and more justifies Blumenbach's words, that "innumerable varieties of mankind run into one another by insensible degrees." This state of things, due partly to mixture and crossing of races, and partly to independent variation of types, makes the attempt to arrange the whole human species within exactly bounded divisions an apparently hopeless task. It does not follow, however, that the attempt to distinguish special races should be given up, for there at least exist several definable types, each of which so far prevails in a certain population as to be taken as its standard.

Quetelet's method.

M. Quetelet's plan of defining such types will probably meet with general acceptance as the scientific method proper to this branch of anthropology. It consists in the determination of the standard, or typical "mean man" (*homme moyen*) of a population, with reference to any particular quality, such as stature, weight, complexion, &c. In the case of stature, this would be done by measuring a sufficient number of men, and counting how many of them belong to each height on the scale. If it be thus ascertained, as it might be in an English district, that the 5 ft. 7 in. men form the most numerous group, while the 5 ft. 6 in. and 5 ft. 8 in. men are less in number, and the 5 ft. 5 in. and 5 ft. 9 in. still fewer, and so on until the extremely small number of extremely short or tall individuals of 5 ft. or 7 ft. is reached, it will thus be ascertained that the stature of the mean or typical man is to be taken as 5 ft. 7 in. The method is thus that of selecting as the standard the most numerous group, on both sides of which the groups decrease in number as they vary in type. Such classification may show the existence of two or more types in a community, as, for instance, the population of a Californian settlement made up of Whites and Chinese might show two predominant groups (one of 5 ft. 8 in., the other of 5 ft. 4 in.) corresponding to these two racial types. It need hardly be said that this method of determining the mean type of a race, as being that of its really existing and most numerous class, is altogether superior to the mere calculation of an average, which may actually be represented by comparatively few individuals, and those the exceptional ones. For instance, the average stature of the mixed European and Chinese population just referred to might be 5 ft. 6 in.—a worthless and, indeed, misleading result. (For particulars of Quetelet's method, see his *Physique Sociale*, 1869, and *Anthropométrie*, 1870.) The measurement and description of the various races of men are now carried to great minuteness (the tables in Scherzer and Schwarz, *Reise der Novara*, and those of Fritsch, *Die Eingeborenen Sud-Afrika's*, 1872, may be cited as examples of modern method), so that race-classification is rapidly improving as to both scope and accuracy. Even where comparatively loose observations have been made, it is possible, by inspection of considerable numbers of individuals, to define the prevalent type of a race with tolerable approximation to the real mean or standard man. It is in this way that the subdivision of mankind into races, so far as it has been done to any purpose, has been carried out by anthropologists.

These classifications have been numerous, and though, regarded as systems, most of them are now seen at the first glance to be unsatisfactory, yet they have been of great value in systematising knowledge, and are all more or less based on indisputable distinctions. Blumenbach's division, though published nearly a century ago (1781), has had the greatest influence. He reckons five races, viz., Caucasian, Mongolian, Ethiopian, American, Malay (see the collected edition of his *Treatises*, p. 264, published by the Anthropological Society). The ill-chosen name of Caucasian, used by Blumenbach to denote what may be called white men, is still current; it brings into one race peoples such as the Arabs and Swedes, although these are scarcely less different than the Americans and Malays, who are set down as two distinct races. Again, two of the best-marked varieties of mankind are the Australians and the Bushmen, neither of whom, however, seem to have a natural place in Blumenbach's series. The yet simpler classification by Cuvier into Caucasian, Mongol, and Negro, corresponds in some measure with a division by mere complexion into white, yellow, and black races; but neither this threefold division, nor the ancient classification into Semitic, Hamitic, and Japhetic nations can be regarded as separating the human types either justly or sufficiently (see Prichard, *Natural History of Man*, sec. 15; Waitz, *Anthropology*, vol. i. part i. sec. 5). Schemes which set up a larger number of distinct races, such as the eleven of Pickering, the fifteen of Bory de St Vincent, and the sixteen of Desmoulins, have the advantage of finding niches for most well-defined human varieties; but no modern naturalist would be likely to adopt any one of these as it stands. In criticism of Pickering's system, it is sufficient to point out that he divides the white nations into two races, entitled the Arab and the Abyssinian (Pickering, *Races of Man*, chap. i.) Agassiz, Nott, Crawfurd, and others who have assumed a much larger number of races or species of man, are not considered to have satisfactorily defined a corresponding number of distinguishable types. On the whole, Professor Huxley's recent scheme (*Journal of the Ethnological Society*, vol. ii. p. 404, 1870) probably approaches more nearly than any other to such a tentative classification as may be accepted in definition of the principal varieties of mankind, regarded from a zoological point of view, though anthropologists may be disposed to erect into separate races several of his widely-differing sub-races. He distinguishes four principal types of mankind, the Australioid, Negroid, Mongoloid, and Xanthochroic, adding a fifth variety, the Melanochroic.

Schemes of Blumenbach, Cuvier, &c.

Huxley's classification.

The special points of the Australioid are a chocolate-brown skin, dark brown or black eyes, black hair (usually wavy), narrow (dolichocephalic) skull, brow-ridges strongly developed, projecting jaw, coarse lips, and broad nose. This type is best represented by the natives of Australia, and next to them, by the indigenous tribes of Southern India, the so-called coolies. The Egyptians to some degree approach this type; they are, however, held by good authorities to be a modified African race.

The Negroid type is primarily represented by the Negro of Africa, between the Sahara and the Cape district, including Madagascar. The skin varies from dark brown to brown-black, with eyes of similar dark hue, and hair usually black, and always crisp or woolly. The skull is narrow (dolichocephalic), with orbital ridges not prominent, prognathous, with depressed nasal bones, causing the nose to be flat as well as broad; and the lips are coarse and projecting. Two important families are classed in this system as special modifications of the Negroid type. First, the Bushman of South Africa is diminutive in stature, and of yellowish-brown complexion; the Hottentot is supposed to be the result of crossing between the Bushman and ordinary Negroid. Second, the Negritos of the Andaman Islands, the peninsula of Malacca, the Philippines and other islands, to New Caledonia and Tasmania, are mostly dolichocephalic, with dark skins and woolly hair. In various districts they tend towards other types, and show traces of mixture.

The Mongoloid type prevails over the vast area lying east of a line drawn from Lapland to Siam. Its definition includes a short, squat build, a yellowish brown complexion, with black eyes and black straight hair, a broad (brachycephalic) skull, usually without prominent brow-ridges, flat small nose, and oblique eyes. The dolichocephalic Chinese and Japanese in other respects correspond. Various other important branches of the human species are brought into connection with the Mongoloid type, though on this view the differences they present raise difficult problems of gradual variation, as well as of mixture of race; these are the Dyak-Malays, the Polynesians, and the Americans.

The Xanthochroi, or fair whites — tall, with almost colourless skin, blue or grey eyes, hair from straw colour to chestnut, and skulls varying as to proportionate width—are the prevalent inhabitants of Northern Europe, and the type may be traced into North Africa, and eastward as far as Hindostan. On the south and west it mixes with that of the Melanochroi, or dark whites, and on the north and east with that of the Mongoloids.

The Melanochroi, or dark whites, differ from the fair whites in the darkening of the complexion to brownish and olive, and of the eyes and hair to black, while the stature is somewhat lower and the frame lighter. To this class belong a large part of those classed as Kelts, and of the populations of Southern Europe, such as Spaniards, Greeks, and Arabs, extending as far as India; while endless intermediate grades between the two white types testify to ages of intermingling. Professor Huxley is disposed to account for the Melanochroi as themselves the result of crossing between the Xanthochroi and the Australioids. Whatever ground there may be for his view, it is obviously desirable to place them in a class by themselves, distinguishing them by an appropriate name.

In determining whether the races of mankind are to be classed as varieties of one species, it is important to decide whether every two races can unite to produce fertile offspring. It is settled by experience that the most numerous and well-known crossed races, such as the Mulattos, descended from Europeans and Negroes—the Mestizos, from Europeans and American indigenes—the Zambos, from these American indigenes and Negroes, &c., are permanently fertile. They practically constitute sub-races, with a general blending of the characters of the two parents, and only differing from fully established races in more or less tendency to revert to one or other of the original types. It has been argued, on the other hand, that not all such mixed breeds are permanent, and especially that the cross between Europeans and Australian indigenes is almost sterile; but this assertion, when examined with the care demanded by its bearing on the general question of hybridity, has distinctly broken down. On the whole, the general evidence favours the opinion that any two races may combine to produce a new sub-race, which again may combine with any other variety. (See Waitz, *Anthropology*, vol. i. part i. sec. 3; Darwin, *Descent of Man*, part i. ch. 7; Prichard, *Nat. Hist. of Man*, sect. 5; on the other hand, Broca, *Phenomena of Hybridity in the Genus Homo*, 1864.) Thus, if the existence of a small number of distinct races of mankind be taken as a starting-point, it is obvious that their crossing would produce an indefinite number of secondary varieties, such as the population of the world actually presents. The working out in detail of the problem, how far the differences among complex nations, such as those of Europe, may have been brought about by hybridity, is still, however, a task of almost hopeless intricacy. Among the boldest attempts to account for distinctly-marked populations as resulting from the intermixture of two races, are Professor Huxley's view that the Hottentots are hybrid between the Bushmen and the Negroes, and his more important suggestion, that the Melanochroic peoples of Southern Europe are of mixed Xanthochroic and Australioid stock.

Origin of races.

The problem of ascertaining how the small number of races, distinct enough to be called primary, can have assumed their different types, has been for years the most disputed field of anthropology, the battle-ground of the rival schools of monogenists and polygenists. The one has claimed all mankind to be descended from one original stock, and generally from a single pair; the other has contended for the several primary races being separate species of independent origin. It is not merely as a question of natural history that the matter has been argued. Biblical authority has been appealed to, mostly on the side of the monogenists, as recording the descent of mankind from a single pair. (See, for example, Horne's *Introduction to the Scriptures;* the Speaker's Commentary, Gen. i.) On the other hand, however, the polygenists not less confidently claim passages from which they infer the existence of non-Adamite, as well as Adamite races of man. (See, for example, R. S. Poole, *Genesis of the Earth and Man.*) Nor have political considerations been without influence, as where, for instance, one American school of ethnologists have been thought to have formed, under the bias of a social system recognising slavery, their opinion that the Negro and the white man are of different species. (See Morton, *Crania Americana;* Nott and Gliddon, *Types of Mankind.*) Of the older school of scientific monogenists, Blumenbach and Prichard are eminent representatives, as is Quatrefages of the more modern. The great problem of the monogenist theory is to explain by what course of variation the so different races of man have arisen from a single stock. In ancient times little difficulty was felt in this, authorities such as Aristotle and Vitruvius seeing in climate and circumstance the natural cause of racial differences, the Ethiopian having been blackened by the tropical sun, &c. Later and closer observations, however, have shown such influences to be, at any rate, far slighter in amount and slower in operation than was once supposed. M. de Quatrefages brings forward (*Unité de l'Espèce Humaine*, Paris, 1861, ch. 13) his strongest arguments for the variability of races under change of climate, &c. (*action du milieu*), instancing the asserted alteration in complexion, constitution, and character of Negroes in America, and Englishmen in America and Australia. But although the reality of some such modification is not disputed, especially as to stature and constitution, its amount is not enough to upset the counter-proposition of the remarkable permanence of type displayed by races ages after they have been transported to climates extremely different from that of their former home. Moreover, physically different races, such as the Bushmen and Negroids in Africa, show no signs of approximation under the influence of the same climate; while, on the other hand, the coast tribes of Tierra del Fuego and forest tribes of tropical Brazil continue to resemble one another, in spite of extreme differences of climate and food. Mr Darwin, than whom no naturalist could be more competent to appraise the variation of a species, is moderate in his estimation of the changes produced on races of man by climate and mode of life within the range of history (*Descent of Man*, part i. ch. 4 and 7). The slightness and slowness of variation in human races having become known, a great difficulty of the monogenist theory was seen to lie in the shortness of the chronology with which it was formerly associated. Inasmuch as several well-marked races of mankind, such as the Egyptian, Phœnician, Ethiopian, &c., were much the same three or four thousand years ago as now, their variation from a single stock in the course of any like period could hardly be accounted for without a miracle. This difficulty was escaped by the polygenist theory, which, till a few years since, was gaining ground. (See Pouchet, *Plurality of the Human Race*, 2nd ed., 1864, Introd.) Two modern views have, however, intervened which have tended to restore, though under a new aspect, the doctrine of a single human stock. One has been the recognition of man having existed during a vast period of time (see sec. IV., *Antiquity of Man*), which made it more easy to assume the continuance of very slow natural variation as having differenced even the white man and the Negro among the descendants of a common progenitor. The other view is that of the evolution or development of species, at the present day so strongly upheld among naturalists. It does not follow necessarily from a theory of evolution of species that mankind must have descended from a single stock, for the hypothesis of development admits of the argument, that several simious species may have culminated in several races of man (Vogt, *Lectures on Man*, London, 1864, p. 463). The general tendency of the development theory, however, is against constituting separate species where the differences are moderate enough to be accounted for as due to variation from a single type. Mr Darwin's summing up of the evidence as to unity of type throughout the races of mankind is as distinctly a monogenist argument as those of Blumenbach, Prichard, or Quatrefages—

Variations of human type.

"Although the existing races of man differ in many respects, as in colour, hair, shape of skull, proportions of the body, &c., yet, if their whole organisation be taken into consideration, they are found to resemble each other closely in a multitude of points. Many of these points are of so unimportant, or of so singular a nature, that it is extremely improbable that they should have been independently acquired by aboriginally distinct species or races. The same remark holds good with equal or greater force with respect to the numerous points of mental similarity between the most distinct races of man. . . . . . Now, when naturalists observe a close agreement in numerous small details of habits, tastes, and dispositions between two or more domestic races, or between nearly allied natural forms, they use this fact as an argument that all are descended from a common progenitor, who was thus endowed; and, consequently, that all should be classed under the same species. The same argument may be applied with much force to the races of man."—(Darwin, *Descent of Man*, part i. ch. 7.)

Time of fixture of race-types

A suggestion by Mr A. R. Wallace has great importance in the application of the development theory to the origin of the various races of man; it is aimed to meet the main difficulty of the monogenist school, how races which have remained comparatively fixed in type during the long period of history, such as the white man and the Negro, should have, in even a far longer period, passed by variation from a common original. Mr Wallace's view is substantially that the remotely ancient representatives of the human species, being as yet animals too low in mind to have developed those arts of maintenance and social ordinances by which man holds his own against influences from climate and circumstance, were in their then wild state much more plastic than now to external nature; so that "natural selection" and other causes met with but feeble resistance in forming the permanent varieties or races of man, whose complexion and structure still remain fixed in their descendants. (See Wallace, *Contributions to the Theory of Natural Selection*, p. 319.) On the whole, it may be asserted that the doctrine of the unity of mankind now stands on a firmer basis than in previous ages. It would be premature to judge how far the problem of the origin of races may be capable of exact solution; but the experience of the last few years countenances Mr Darwin's prophecy, that before long the dispute between the monogenists and the polygenists will die a silent and unobserved death.

Chronology deficient.

IV. *Antiquity of Man.*—It was until of late years commonly held among the educated classes, that man's first appearance on earth might be treated on a historical basis as matter of record. It is true that the schemes drawn up by chronologists differed widely, as was naturally the case, considering the variety and inconsistency of their documentary data. On the whole, the scheme of Archbishop Usher, who computed that the earth and man were created in 4004 B.C., was the most popular. (See early editions of the *Encyclopædia Britannica*, art. "Creation.") It is no longer necessary, however, to discuss these chronologies, inasmuch as new evidence has so changed the aspect of the subject, that the quasi-historical schemes of the last century would now hardly be maintained by any competent authority of any school. Geology, notwithstanding the imperfection of its results, has made it manifest that our earth must have been the seat of vegetable and animal life for an immense period of time; while the first appearance of man, though comparatively recent, is positively so remote, that an estimate between twenty and a hundred thousand years may fairly be taken as a minimum. This geological claim for a vast antiquity of the human race is supported by the similar claims of prehistoric archæology and the science of culture, the evidence of all three departments of inquiry being intimately connected, and in perfect harmony.

Evidence of Prehistoric Archæology.

During the last half century, the fact has been established that human bones and objects of human manufacture occur in such geological relation to the remains of fossil species of elephant, rhinoceros, hyæna, bear, &c., as to lead to the distinct inference that man already existed during the ancient period of these now extinct mammalia. The not quite conclusive researches of MM. Tournal and Christol in limestone caverns of the south of France date back to 1828. About the same time Dr Schmerling of Liége was exploring the ossiferous caverns of the valley of the Meuse, and satisfied himself that the men whose bones he found beneath the stalagmite floors, together with bones cut and flints shaped by human workmanship, had inhabited this Belgian district at the same time with the cave-bear and several other extinct animals whose bones were imbedded with them (*Recherches sur les Ossements fossiles découverts dans les Cavernes de la Province de Liége*, Liége, 1833–4). This evidence, however, met with little acceptance among scientific men. Nor, at first, was more credit given to the discovery by M. Boucher de Perthes, about 1841, of rude flint hatchets in a sand-bed containing remains of mammoth and rhinoceros at Menchecourt near Abbeville, which first find was followed by others in the same district (see Boucher de Perthes, *De l'Industrie Primitive, ou les Arts à leur Origine*, 1846; *Antiquités Celtiques et Antédiluviennes*, Paris, 1847, &c.); between 1850 and 1860 competent French and English geologists, among them Rigollot, Falconer, Prestwich, and Evans, were induced to examine into the facts, and found the evidence irresistible that man existed and used rude implements of chipped flint during the Quaternary or Drift period. Further investigations were now made, and overlooked results of older ones reviewed. In describing Kent's Hole, near Torquay, Mr Godwin-Austen had maintained, as early as 1840 (*Proc. Geo. Soc. London*, vol. iii. p. 286), that the human bones and worked flints had been deposited indiscriminately together with the remains of fossil elephant, rhinoceros, &c.; a minute exploration of this cavern has since been carried on under the superintendence of Messrs Vivian, Pengelly, and others, fully justifying Mr Godwin-Austen's early remark, that "there is no *a priori* reason why man and the several animals whose remains occur in caves and in gravel should not have lived here at some remote time" (see Pengelly, "Literature of Kent's Cavern," in *Trans. Devonshire Association*, 1868). Especially certain caves and rock-shelters in the province of Dordogne, in central France were examined by a French and an English archæologist, Mons. Edouard Lartet and Mr Henry Christy, the remains discovered showing the former prevalence of the rein-deer in this region, at that time inhabited by savages, whose bone and stone implements indicate a habit of life similar to that of the Esquimaux. Moreover, the coexistence of man with a fauna now extinct or confined to other districts was brought to yet clearer demonstration, by the discovery in these caves of certain drawings and carvings of the animals done by the ancient inhabitants themselves, such as a group of rein-deer on a piece of rein-deer horn, and a sketch of a mammoth, showing this elephant's long hair, on a piece of a mammoth's tusk from La Madeleine (Lartet and Christy, *Reliquiæ Aquitanicæ*, ed. by T. R. Jones, London, 1865, &c.) These are among the earliest and principal of a series of discoveries of human relics belonging to what may be termed geological antiquity, with which should be mentioned Mr Boyd Dawkins's examination of the hyæna den of Wokey Hole, Dr Lund's researches in the caves of Brazil, those in the south of France by the Marquis de Vibraye and MM. Garrigou and Filhol, those in Sicily by Dr Falconer, and Mr Bruce Foote's discovery of rude quartzite implements in the laterite of India. Fuller details of the general subject will be found in Sir C. Lyell's *Antiquity of Man*, 4th ed., London, 1873; Sir John Lubbock's *Prehistoric Times*, 3d ed., London, 1873; Dr H. Falconer's *Palæontological Memoirs*, London, 1868; the volumes of *Proceedings of the International Congress of Prehistoric Archæology*; and the periodical *Matériaux pour l'Histoire Primitive et Naturelle de l'Homme*, edited at first by De Mortillet, and since by Trutat and Cartailhac.

Cave period.

Drift period.

Antiquity of Quaternary Man

This evidence is now generally accepted by geologists as carrying back the existence of man into the period of the post-glacial drift, in what is now called the Quaternary period. That this indicates an antiquity at least of tens of thousands of years may be judged in several ways. The very position in which these rude instruments were found showed that they belonged to a time quite separate from that of history. Thus, at St Acheul flint hatchets occur in a gravel-bed immediately overlying the chalk, which bed is covered by some 12 feet of sand and marl, capped by a layer of soil, which is shown by graves of the Gallo-Roman period to have been hardly altered during the last 1500 years. This distinction between the drift deposits and those containing relics of historic ages is, as a general rule, evident at a glance. Next, the succession of ages to which different classes of remains belong is well marked; the drift implements belong to the palæolithic or old stone age, when as yet the implements were extremely rude, and not ground or polished; above these in deposit, and therefore later in time, come the artistically shaped and polished celts of the neolithic or new stone age; above these, again, relics of the bronze and early iron ages, with which historical antiquity in Europe begins. Again, the animals of the Quaternary period, whose bones are found with the rude stone implements, comprise several species of mammalia which have since become extinct, such as the mammoth, the hairy rhinoceros, and the Irish elk, while others, such as the rein-deer and musk-ox, now only inhabit remote districts. It is generally considered that such a fauna indicates, at any rate during part of the Quaternary period, a severer climate than now prevails in France and England. This difference from the present conditions seems to confirm the view, that the twenty centuries of French and English history form but a fraction of the time which has elapsed since the stone implements of prehistoric tribes were first buried under beds of gravel and sand by the rivers now represented by the Thames or the Somme. Still vaster, however, is the idea of antiquity suggested by the geographical conformation of such valleys as these in which these rivers flow. The drift-beds lie on their sides often 100 to 200 feet, and even more, above the present flood-levels. As such highest deposits seem to mark the time when the rivers flowed at heights so far above the present channels, it follows that the drift-beds, and the men whose works they enclose, must have existed during a great part of the time occupied by the rivers in excavating their valleys down to their present beds. Granting it as possible that the rivers by which this enormous operation was performed were of greater volume and proportionately still greater power in flood-time than the present streams, which seem so utterly inadequate to their valleys, and granting also, that under different conditions of climate the causing of debâcles by ground-ice may have been a powerful excavating agent, nevertheless, with all such allowances the reckoning of ages seems vastly out of proportion to historical chronology. It is not convenient to discuss here Mr Prestwich's division of the drift gravels into high and low level beds, nor Mr A. Tylor's argument against this division, nor the latter's theory of a Pluvial period succeeding the Glacial period (see *Quart. Journ. Geol. Soc.*, vol. xxiv. part 2, vol. xxv. part 1). The geology of the Quaternary or Post-tertiary gravels, on which the geological argument for the high antiquity of man mainly rests, has been especially treated by Prestwich in the *Philos. Trans.*, 1860, p. 277, and 1864, p. 247; see also J. Evans, *Ancient Stone Impts.*, ch. 25; references to the writings of other geologists will be found in the already mentioned works of Lyell and Lubbock.

Depth of deposits of human age.

Beside these arguments, which suggest high antiquity rather than offer means of calculation, certain inferences (accounts of which are also given in the last-named works) have been tentatively made from the depth of mud, earth, peat, &c. which has accumulated above relics of human art imbedded in ancient times. Among these is Mr Horner's argument from the numerous borings made in the alluvium of the Nile valley to a depth of 60 feet, where down to the lowest level fragments of burnt brick and pottery were always found, showing that people advanced enough in the arts to bake brick and pottery have inhabited the valley during the long period required for the Nile inundations to deposit 60 feet of mud, at a rate probably not averaging more than a few inches in a century. Another argument is that of Professor von Morlot, based on a railway section through a conical accumulation of gravel and alluvium, which the torrent of the Tinière has gradually built up where it enters the Lake of Geneva near Villeneuve. Here three layers of vegetable soil appear, proved by the objects imbedded in them to have been the successive surface-soils in two prehistoric periods and in the Roman period, and which now lie 4, 10, and 19 feet underground; on this it is computed that if 4 feet of soil were formed in the 1500 years since the Roman period, we must go 5000 years farther back for the date of the earliest human inhabitants. Calculations of this kind, loose as they are, deserve attention

Lake habitations.

The interval between the Quaternary or Drift period and the period of historical antiquity is to some extent bridged over by relics of various intermediate civilisations, mostly of the lower grades, and in some cases reaching back to remote dates. The lake dwellings of Switzerland are perhaps among the more recent of these. They were villages of huts built on piles in the water at some distance from the shore, for security from attack—in fact, fortified water settlements of the same nature as those of Lake Prasias in the time of Herodotus, and as those still inhabited in New Guinea and West Africa. The remains of these Swiss villages are found with the stumps of the piles still standing, often imbedded in an accumulation of mud or growth of peat which has preserved a kind of illustrative museum of the arts and habits of the lake men. From examination of the sites, it appears that the settlements are of various dates, from the neolithic or polished stone period, when instruments of metal were still unknown, to the time when bronze was introduced, and beyond this into the later age marked by the use of iron. A few of the lake villages lasted on till the Roman dominion, as is proved by the presence of Roman coins and pottery, but they were soon afterwards abandoned, so that their very existence was forgotten, and their rediscovery only dates from 1853, when the workmen excavating a bed of mud on the shore of the Lake of Zurich found themselves standing among the piles of a lake settlement. In Germany, Italy, and other countries, similar remains of a long pre-Roman civilisation have been found. (The special works on lake habitations are Dr Keller's *Lake Dwellings*, translated by J. E. Lee, London, 1866; and Troyon's *Habitations Lacustres*). Indications of man's antiquity, extending farther back into prehistoric times, are furnished by the Danish shell-heaps or "kjökkenmödding," which term, meaning "kitchen refuse-heap," has been Anglicised in "kitchen midden" (the word "midden," a dung-heap, being still current in the north of England). Along the shores of nearly all the Danish islands extensive beds or low mounds, like raised beaches, may be seen, consisting chiefly of innumerable cast-away shells, intermingled with bones, &c. Such shell-heaps are found in all quarters of the globe by the sea-shore, and may be sometimes seen in process of formation; they are simply the accumulations of shells and refuse thrown away near the huts of rude tribes subsisting principally on shell-fish. The Danish kitchen middens, however, are proved to belong to a very ancient time, by the remains of the quadrupeds, birds, and fish, which served as the food of these rude hunters and fishers; among these are bones of the wild bull, beaver, seal, and great auk, all now extinct or rare in this region. Moreover, a striking proof of the antiquity of these shell-heaps is, that the shells of the common oyster are found of full size, whereas it cannot live at present in the brackish waters of the Baltic except near its entrance, so that it is inferred that the shores where the oyster at that time flourished were open to the salt sea. Thus, also, the eatable cockle, mussel, and periwinkle abounding in the kitchen middens are of full ocean size, whereas those now living in the adjoining waters are dwarfed to a third of their natural size by the want of saltness. It thus appears that the connection between the ocean and the Baltic has notably changed since the time of these rude stone-age people. (See the reports by Forchhammer, Steenstrup, and Worsaae on the kjökkenöddings, made to the Copenhagen Academy of Sciences.) Various other evidence is adduced in this part of the argument, such as that from the Danish peat-mosses, which show the existence of man at a time when the Scotch fir was abundant; at a later period the firs were succeeded by oaks, which have again been almost superseded by beeches, a succession of changes which indicate a considerable lapse of time. For further references to special accounts, the reader may consult the already mentioned general works on the antiquity of prehistoric man.

Shell-heaps

Historical antiquity.

Lastly, chronicles and documentary records, taken in connection with archæological relics of the historical period, carry back into distant ages the starting-point of actual history, behind which lies the evidently vast period only known by inferences from the relations of languages and the stages of development of civilisation. Thus, Egypt affords some basis for estimating a minimum date for its ancient population. The hieroglyphic inscriptions, the most ancient written records of the world, preserve direct memorials of a time which can hardly be less, and may be much more, than 3000 years before the Christian era. With all the doubt which besets the attempt to extract a definite chronology from the Egyptian names of kings and lists of dynastics (see EGYPT), their salient points fit with the historical records of other nations. Thus, the great Ramesside dynasty, known among Egyptologists as the 19th dynasty, corresponds with the mention of the building of the city of Raamses in Exod. i. 11; Amenophis III., called by the Greeks Memnon, belongs to the previous 18th dynasty; while the three pyramid kings, whom Herodotus mentions as Cheops, Chephren, and Mykerinos, and whose actual Egyptian names are read in the hieroglyphic lists as Chufu, Chafra, and Menkaura, are set down in the 4th dynasty. Lepsius may not be over-estimating when he dates this dynasty back as far as 3124 B.C., and carries the more dubious previous dynasties back to 3892 B.C. before reaching what are known as the mythical dynastics, which probably have their bases rather in astronomical calculations than in history (Lepsius, *Königsbuch der alten Ægypter*, Berlin, 1858; compare the computations of Brugsch, Bunsen, Hincks, Wilkinson, &c.)

The Greeks of the classic period could discuss the Egyptian chronologies with priests and scribes who perpetuated the languages and records of their earliest dynasties; and as the Septuagint translation of the Bible was made at Alexandria, it is not impossible that its giving to man a considerably greater antiquity than that of the Hebrew text may have been due to the influence of the Egyptian chronology. Even if the lowest admissible calculations be taken, this will not invalidate the main fact, that above 4000 years ago the Egyptian nation already stood at a high level of industrial and social culture. The records of several other nations show that as early or not much later than this they had attained to a national civilisation. The Bible, whose earliest books are among the earliest existing chronicles, shows an Israelite nation existing in a state of patriarchal civilisation previous to the already mentioned time of contact with Egypt. In ancient Chaldæa, the inscribed bricks of Urukh's temples probably belong to a date beyond 2000 years B.C. (G. Rawlinson, *Five Great Monarchies of the Ancient Eastern World*, London, 1862, &c., vol. i. ch. 8).

The Chinese dynasties, like those of Egypt, begin with an obviously mythical portion, and continue into actual history, the difficulty is to draw the line where genuine record begins. Those who reckon authentic history only from the dynasty of Chow, beginning about 1100 B.C., during which Confucius lived, will at any rate hardly deny the existence of the earlier dynasty of Shang, previous to which the yet earlier dynasty of Hea is recorded; so that, though much that is related of these periods may be fabulous, it seems certain that there was a Chinese nation and a Chinese civilisation reaching back beyond 2000 B.C. (see Sir John Davis, *The Chinese*; Pauthier, *Livres Sacrés de l'Orient*; Shu-King, &c.)

Time of development of culture and language.

Till of late it was a commonly received opinion that the early state of society was one of comparatively high culture, and those who held this opinion felt no difficulty in assigning the origin of man to a time but little beyond the range of historical records and monuments. At present, however, the view has become paramount that the civilisation of the world has been gradually developed from an original stone-age culture, such as characterises modern savage life. To hold this opinion necessitates the adding to the 4000 or 5000 years to which the ancient civilisations of Egypt, Babylon, and China date back, a probably much greater length of time, during which the knowledge, arts, and institutions of these countries attained to their remarkably high level. The evidence of comparative philology corroborates this judgment. Thus, Hebrew and Arabic are closely related languages, neither of them the original of the other, but both sprung from some parent language more ancient than either. When, therefore, the Hebrew records have carried back to the most ancient admissible date the existence of the Hebrew language, this date must have been long preceded by that of the extinct parent language of the whole Semitic family; while this again was no doubt the descendant of languages slowly shaping themselves through ages into this peculiar type. Yet more striking is the evidence of the Aryan or Indo-European family of languages. The Hindus, Medes, Persians, Greeks, Romans, Germans, Kelts, and Slaves make their appearance at more or less remote dates as nations separate in language as in history. Nevertheless, it is now acknowledged that at some far remoter time, before these nations were divided from the parent stock, and distributed over Asia and Europe by the Aryan dispersion, a single barbaric people stood as physical and political representative of the nascent Aryan race, speaking a now extinct Aryan language, from which, by a series of modifications not to be estimated as possible within many thousands of years, there arose languages which have been mutually unintelligible since the dawn of history, and between which it was only possible for an age of advanced philology to trace the fundamental relationship.

From the combination of these considerations, it will be seen that the farthest date to which documentary record extends, is now generally regarded by anthropologists as but the earliest distinctly visible point of the historic period, beyond which stretches back a vast indefinite series of prehistoric ages.

Evidence of philology

V. *Language*.—In examining how the science of language bears on the general problems of anthropology, it is not necessary to discuss at length the critical questions which arise, the principal of which are considered elsewhere. (See LANGUAGE.) Philology is especially appealed to by anthropologists as contributing to the following lines of argument. A primary mental similarity of all branches of the human race is evidenced by their common faculty of speech, while at the same time secondary diversities of race-character and history are marked by difference of grammatical structure and of vocabularies. The existence of groups or families of allied languages, each group being evidently descended from a single language, affords one of the principal aids in classifying nations and races. The adoption by one language of words originally belonging to another, proving as it does the fact of intercourse between two races, and even to some extent indicating the results of such intercourse, affords a valuable clue through obscure regions of the history of civilisation.

Faculty of language.

Communication by gesture-signs, between persons unable to converse in vocal language, is an effective system of expression common to all mankind. Thus, the signs used to ask a deaf and dumb child about his meals and lessons, or to communicate with a savage met in the desert about game or enemies, belong to codes of gesture-signals identical in principle, and to a great extent independent both of nationality and education; there is even a natural syntax, or order of succession, in such gesture-signs. To these gestures let there be added the use of the interjectional cries, such as *oh! ugh! hey!* and imitative sounds to represent the cat's *mew*, the *click* of a trigger, the *clap* or *thud* of a blow, &c. The total result of this combination of gesture and significant sound will be a general system of expression, imperfect but serviceable, and naturally intelligible to all mankind without distinction of race. Nor is such a system of communication only theoretically conceivable; it is, and always has been, in practical operation between people ignorant of one another's language, and as such is largely used in the intercourse of savage tribes. It is true that to some extent these means of utterance are common to the lower animals, the power of expressing emotion by cries and tones extending far down in the scale of animal life, while rudimentary gesture-signs are made by various mammals and birds. Still, the lower animals make no approach to the human system of natural utterance by gesture-signs and emotional-imitative sounds, while the practical identity of this human system among races physically so unlike as the Englishman and the native of the Australian bush, indicates extreme closeness of mental similarity throughout the human species.

Variety of language.

When, however, the Englishman and the Australian speak each in his native tongue, only such words as belong to the interjectional and imitative classes will be naturally intelligible, and as it were instinctive to both. Thus the savage, uttering the sound *waow!* as an explanation of surprise and warning, might be answered by the white man with the not less evidently significant *sh!* of silence, and the two speakers would be on common ground when the native indicated by the name *bwirri* his cudgel, flung *whirring* through the air at a flock of birds, or when the native described as a *jakkal-yakkal* the bird called by the foreigner a *cockatoo*. With these, and other very limited classes of natural words, however, resemblance in vocabulary practically ceases. The Australian and English languages each consist mainly of a series of words having no apparent connection with the ideas they signify, and differing utterly; of course, accidental coincidences and borrowed words must be excluded from such comparisons. It would be easy to enumerate other languages of the world, such as Basque, Turkish, Hebrew, Malay, Mexican, all devoid of traceable resemblance to Australian and English, and to one another. There is, moreover, extreme difference in the grammatical structure both of words and sentences in various languages. The question then arises, how far the employment of different vocabularies, and that to a great extent on different grammatical principles, is compatible with similarity of the speakers' minds, or how far does diversity of speech indicate diversity of mental nature? The obvious answer is, that the power of using words as signs to express thoughts with which their sound does not directly connect them, in fact as arbitrary symbols, is the highest grade of the special human faculty in language, the presence of which binds together all races of mankind in substantial mental unity. The measure of this unity is, that any child of any race can be brought up to speak the language of any other race.

Difference of vocabulary and grammatical structure.

To ascertain the causes to which languages owe their unlikeness in material and structure, how far to essential differences of mental type among the races of mankind, and how far to minor causes of variation, which may be called secondary, is a problem of extreme difficulty, towards the precise solution of which little has yet been done. One of the most remarkable of linguistic differences is the tendency of some languages to isolate their words, and of others to form elaborate inflexions. The extremes may be seen, on the one hand, in an ordinary Chinese sentence of isolated monosyllables, such as "*yu tsze nien chiu tsin, tung chu*," &c., *i.e.*, "in this year autumn ended, winter begun," &c.; and, on the other hand, in one of the monstrous polysyllables into which the Greenlanders will agglutinate a whole phrase, *inilertorniarpatdlăsarqôrpâ*, *i.e.*, "he will probably try too much to get it done soon." Among languages which form grammatical combinations or inflexions, the modes of so doing are as various as possible. Thus, in Africa, the Hottentot noun forms its plural by a suffix, as *khoi*, "man;" *khoin*, "men:" while the Zulu employs prefixes to distinguish its numbers, as *umu-ntu*, "a man;" *aba-ntu*, "men." The Dinka may supply examples of forming the plural by internal change, *ran*, "man;" *ror*, "men." Nor are the differences of syntax in different tongues less absolute. In non-inflecting languages one of the most vital points is the relative position of two nouns, of which the one stands as substantive, and the other as defining it by an attribute. This may be illustrated by English compounds, such as *work-house* and *house-work*. Here our rule is to place the attribute-noun first, while, of two neighbouring languages of Asia, the Burmese and the Siamese, the one settles this question in our way, the other in exactly the opposite. The Siamese expression for sailors, *luk rua*, means "sons of the ship," just as the Burmese expression for villagers, *rwa tha*, means "children of the village;" but in the first case the construction is "sons ship," whereas in the second it is "village children." Again, for reasons not yet fully explained, some languages place the adjective before the substantive, as Chinese *pe ma*, "white horse;" while other languages reverse this construction, as Maori, *rakau roa*, "tree long" (*i.e.*, tall tree). These are but examples of possible divergences in linguistic structure, and no prudent ethnologist would assert that racial peculiarities have nothing to do with such various tendencies. At the same time, there is no proof but that they may have resulted from historical circumstances more or less independently of race. Our own Aryan family of nations and languages affords what must always be prominent evidence in this argument. It is acknowledged that Sanskrit, Russian, Greek, Latin, Welsh, English, &c., are, philologically speaking, dialects of a single Aryan speech, which no doubt at some ancient period was spoken by a single tribe or nation. Yet the languages sprung from this original Aryan tongue, by various courses of development and accretion, are mutually unintelligible. If a Greek sentence be taken at random, such as this, "Οὐ χρὴ παννύχιον εὕδειν βουληφόρον ἄνδρα," and it be translated even too verbally into English, "A counsel-bearing man ought not to sleep all night," the traces of linguistic connection between the Greek and English words (*phoros*, *bear; nux*, *night*) are hardly perceptible except to philologists. Even the essential character of the two languages is seen to be different, for the construction of the Greek sentence depends mainly on the inflexions of the words, while in English such inflexions are almost discarded, and their effect is produced by the syntax and the auxiliary particles. Moreover, as to some most important points of syntax, Aryan languages differ widely from one another; thus, to use a familiar instance, French and English take contradictory lines as to the relative position of the adjective and substantive, as also of the object-pronoun and verb,—"*c'est un cheval blanc, je le vois*," "it is a white horse, I see him." So Hindustani and English, though both Aryan tongues, reverse the positions of the verb and object, as "*ghorā lāo*" ("horse bring"), *i.e.*, "bring the horse!" Thus on the whole, the endless variety in vocabulary and structure among the languages of the world affords important evidence as to the mental diversities of the nations speaking those languages. But the unity of the faculty of speech in man stands as the primary fact, while the character of the grammar and dictionary belonging to any one nation represents only a secondary fact, such as might be fairly set down as resulting from their particular stage and circumstances of linguistic development.

Families of language.

The principles of the development of a family of languages from a single parent tongue are laid down elsewhere. (See LANGUAGE.) It has here to be noticed that the evidence on which such linguistic groups may be treated as allied by descent is of various degrees of fulness and strength. The most perfect available case is that of the

Romance languages, comprising Italian, Spanish, French, &c.; inasmuch as not only does the classic Latin remain substantially the representative of their common original, but the very stages of their development from it are preserved in documents of successive ages. Thus, in comparing the vocabularies of Italian and French, it is, in the first place, seen that they to a great extent correspond,—this correspondence extending to words which one language is least likely to borrow from another, viz., pronouns, the lower numerals, and names of the most universal and familiar objects. It is only, however, by etymological analysis that their depth of correspondence comes fully into view, it being seen that the ultimate elements or roots are largely common to the two languages, as are also the grammatical affixes by which words are formed from these roots, while general similarity of linguistic structure pervades both tongues. Such intimate correspondence could only result from derivation from a common parent language, which in this case exists in Latin. In other groups of languages the existence of the common parent may be inferred from correspondence of this highest order. Thus there must have existed, at some period, what may be called the parent Slavonic, whence descend the Russian, Polish, Bohemian, &c.; and the parent Keltic, whence descend Welsh, Gaelic, Breton, &c., while behind the various branches of the whole Aryan family are dimly to be discerned the outlines of a primitive Aryan speech. In like manner, a comparison of the Arabic, Hebrew, Syriac, &c., shows that these must be all derived from a primitive Semitic speech, containing many of the simple root forms, which still exist in its modern descendants, and being already characterised by the principle of internal inflexion. Beyond the limits of these two, the most important linguistic families, various others have been satisfactorily made out, though hardly with the same completeness of proof. In the Turanian or Tatar family are included the Turkish, Mongol, Hungarian, Finnish, Ostyak, &c.; the Dravidian family takes in the Tamil, Telugu, and various other South Indian dialects; the Polynesian family comprises the languages of the higher race of the South Sea Islands; the Negro-Kafir family consists of the prefixing languages spoken by most African tribes from the equatorial regions southward; the Guarani family in South America, the Algonquin and Athapascan families in North America, and the Australian family, each includes a number of tribes ranging over a vast extent of territory, and so on. As to smaller divisions, it is common for languages to occur in groups of several connected dialects, though not forming part of one of the wider linguistic families; thus the Aztec and Nicaraguan are closely related dialects, as are the Quichua and Aymara, while what philologists describe as isolated languages, as the Basque appears to be, are rather isolated groups of dialects, with no known analogues beyond a limited district.

If the present state of the philological classification of mankind be compared with that of half a century ago, it will be seen that much progress has been made in referring groups of languages each to a common ancestral tongue. At the same time, greater cogency of proof is now demanded in such classification. The method of comparing a short vocabulary of twenty words or so in two languages is now abandoned, for where an extensive connection really exists, this is much better proved by a systematic comparison, while a few imperfect resemblances in the two lists might be due to accident, or the adoption of words. Nothing short of a similarity in the roots or elements of two languages, as well as in their grammatical structure, too strong to be explained by any independent causes, is now admitted as valid proof of common descent. This limitation, however, by no means amounts to a denial of the possibility of such descent. Thus it is often argued, on the strength of some similarities between Hebrew and Indo-European roots, that the two so distinct Semitic and Aryan families of language are themselves sprung from some yet more remotely ancient tongue. Thus also it has been attempted to connect the Malay and Tatar groups of languages. Either or both of these opinions may be true; but the general verdict of philologists is, that they are not satisfactorily made out, and therefore cannot be recognised.

Primitive languages

Under the present standard of evidence in comparing languages and tracing allied groups to a common origin, the crude speculations as to a single primeval language of mankind, which formerly occupied so much attention, are acknowledged to be worthless. Increased knowledge and accuracy of method have as yet only left the way open to the most widely divergent suppositions. For all that known dialects prove to the contrary, on the other hand, there may have been one primitive language, from which the descendant languages have varied so widely, that neither their words nor their formation now indicate their unity in long past ages, while, on the other hand, the primitive tongues of mankind may have been numerous, and the extreme unlikeness of such languages as Basque, Chinese, Peruvian, Hottentot, and Sanskrit, may arise from absolute independence of origin.

Language and race.

The language spoken by any tribe or nation is not of itself absolute evidence as to its race-affinities. This is clearly shown in extreme cases. Thus the Jews in Europe have almost lost the use of Hebrew, but speak as their vernacular the language of their adopted nation, whatever it may be; even the Jewish-German dialect, though consisting so largely of Hebrew words, is philologically German, as any sentence shows: "*Ich hab noch hojom lo geachelt,*" "I have not yet eaten to-day." The mixture of the Israelites in Europe by marriage with other nations is probably much greater than is acknowledged by them; yet, on the whole, the race has been preserved with extraordinary strictness, as its physical characteristics sufficiently show. Language thus here fails conspicuously as a test of race, and even of national history. Not much less conclusive is the case of the predominantly Negro populations of the West India Islands, who, nevertheless, speak as their native tongues dialects of English or French, in which the number of intermingled native African words is very scanty: "*Dem hitti netti na ini watra bikasi dem de fisiman,*" "They cast a net into the water, because they were fishermen." (Surinam Negro-Eng.) "*Bef pas ca jamain lasse poter cones li;*" "Le bœuf n'est jamais las de porter ses cornes." (Haytian Negro-Fr.) If it be objected that the linguistic conditions of these two races are more artificial than has been usual in the history of the world, less extreme cases may be seen in countries where the ordinary results of conquest-colonisation have taken place. The Mestizos, who form so large a fraction of the population of modern Mexico, numbering several millions, afford a convenient test in this respect, inasmuch as their intermediate complexion separates them from both their ancestral races, the Spaniard, and the chocolate-brown indigenous Aztec, or other Mexican. The mother-tongue of this mixed race is Spanish, with an infusion of Mexican words; and a large proportion cannot speak any native dialect. In most or all nations of mankind, crossing or intermarriage of races has thus taken place between the conquering invader and the conquered native, so that the language spoken by the nation may represent the results of conquest as much or more than of ancestry. The supersession of the Keltic Cornish by English, and of the Slavonic Old-Prussian by German, are but examples of a process which has for untold ages been supplanting native dialects, whose very names have mostly disappeared. On the other hand, the language of the warlike invader or peaceful immigrant may yield, in a few generations, to the tongue of the mass of the population, as the Northman's was replaced by French, and modern German gives way to English in the United States. Judging, then, by the extirpation and adoption of languages within the range of history, it is obvious that to classify mankind into races, Aryan, Semitic, Turanian, Polynesian, Kafir, &c., on the mere evidence of language, is an intrinsically unsound method. From the earliest times in which nations have been classified by languages, its unrestricted use has vitiated sound ethnology.

Nevertheless, under proper restrictions, speech affords information as to the affinities of races only second in value to that derived from physical characteristics. As a rule, language at least proves some proportion of ancestry. It could hardly happen that one people should come into so close a relation to another as to supplant its language, without strong intermixture of race in the next generation. This is true in the extreme case of the West Indian coloured population, among whom the majority are now crossed with European blood, so that in each succeeding generation the proportion of absolutely pure Negro families becomes less. Still more fully is it true of coloured races in Mexico or Brazil, whose Spanish or Portuguese language represents at least a large European element of ancestry. Thus in India many millions of people, whose blood is predominantly that of the darker indigenous race, nevertheless speak dialects of the languages of the fairer Aryans; but then they are for the most part distinctly mixed races of partly Aryan ancestry. With these facts before us, it is not difficult to determine the principles on which the ethnologist may use language as partial evidence of race. In the first place, it strengthens the evidence of bodily characters. Thus in South Africa the Zulu seems by colour, features, shape of skull, &c., to be, if not an absolute Negro, of a mixed and modified Negro type. This view of his origin is strengthened by the fact that the Zulu language belongs to the peculiar prefixing family which extends so widely among the Negro nations farther north. So the Hottentot language, in its evident connection with that of the Bushmen, adds its weight to the physical argument, that these two are descendants more or less mixed and varied from a single race, small, yellow, crisp-haired, and speaking an inflectional monosyllabic language, articulated with clicks. In the second place, language may prove race-connection where bodily characteristics, though they do not contradict, do not suffice. Thus, comparing the dark Andalusian with the fair Swede, we ask the question, whether there is distinguishable common parentage between these two varieties of the white man? The anatomist might hesitate here. Nor, indeed, is the physical problem nearly solved, but at least a partial solution is involved in the philologist's proof that the two peoples speak languages inherited at some remote period from a common Aryan tongue, and must therefore have had a common element in their ancestry of at least sufficient strength to carry language with it. Thus each linguistic family affords at least partial evidence of race, proving, for instance, the existence of a common ancestry of the Irishman and the Russian, of the Jew and the Maltese, of the Tahitian and the Malagasy, though in such pairs of races the actual amount of common ancestry may be less than that of the different race-elements with which it has combined.

Language and culture.

As regards political nationality and the history of civilisation, the evidence of speech is of still greater weight. In many cases of the mixture of nations the language of the dominant civilisation prevails, as where Latin dialects superseded the native tongues in Western Europe, and Germanic languages encroached on Turanian in Finland, on Slavonic in Russia, and on Keltic in the Scotch Highlands. In other cases, where one nation has received elements of civilisation from another, language is apt to keep record of the process by adopting foreign words and ideas together. Thus the language of the barbarian Turks has absorbed masses of Arabic, which itself had in like manner absorbed Persian, when Persia was the fountain-head of early Moslem culture. In the same manner Dravidian languages of South India have been saturated with words and phrases from Sanskrit and its related dialects, so that a page of Tamil literature is of itself the proof of a non-Aryan race having received from an Aryan race a whole system of religion, philosophy, and social order. The most extreme cases of such verbal indication of foreign influence are to be found in languages of low races of America and the Pacific, which have adopted from European languages not only terms for imported arts and ideas, but names of such numerals as 6 and 7, previously expressed by more clumsy native combinations. Thus the language of any people, though less effective than was once believed as a means of determining its place in the classified order of mankind, does, to some extent, indicate its physical, and, to a still greater extent, its intellectual ancestry.

Stages of civilisation.

VI. *Development of Civilisation.*—The conditions of man at the lowest and highest known levels of culture are separated by a vast interval; but this interval is so nearly filled by known intermediate stages, that the line of continuity between the lowest savagery and the highest civilisation is unbroken at any critical point. The Australians and forest Indians of Brazil may be taken as the lowest modern savages whose thought and life have been investigated with any thoroughness; while other less accurately-studied tribes are in some respects inferior even to these. An examination of the details of savage life shows not only that there is an immeasurable difference between the rudest man and the highest lower animal, but also that the least cultured savages have themselves advanced far beyond the lowest intellectual and moral state at which human tribes can be conceived as capable of existing, when placed under favourable circumstances of warm climate, abundant food, and security from too severe destructive influences. In fact, the Australian or Brazilian savage has already attained to rudimentary stages in many of the characteristic functions of civilised life. His language, expressing thoughts by conventional articulate sounds, is the same in essential principle as the most cultivated philosophic dialect, only less exact and copious. His weapons, tools, and other appliances, such as the hammer, hatchet, spear, knife, awl, thread, net, canoe, &c., are the evident rudimentary analogues of what still remains in use among Europeans. His structures, such as the hut, fence, stockade, earthwork, &c., may be poor and clumsy, but they are of the same nature as our own. In the simple arts of broiling and roasting meat, the use of hides and furs for covering, the plaiting of mats and baskets, the devices of hunting, trapping, and fishing, the pleasure taken in personal ornament, the touches of artistic decoration on objects of daily use, the savage differs in degree but not in kind from the civilised man. The domestic and social affections, the kindly care of the young and the old, some acknowledgment of marital and parental obligation, the duty of mutual defence in the tribe, the authority of the elders, and general respect to traditional custom as the regulator of life and duty, are more or less well marked in every savage tribe which is not disorganised and falling to pieces. Lastly, there is usually to be discerned amongst such lower races a belief in unseen powers pervading the universe, this belief shaping itself into an animistic or spiritualistic theology, mostly resulting in some kind of worship. If, again, high savage or low barbaric types be selected, as among the North American Indians, Polynesians, and Kafirs of South Africa, the same elements of culture appear, but at a more advanced stage, namely, a more full and accurate language, more knowledge of the laws of nature, more serviceable implements, more perfect industrial processes, more definite and fixed social order and frame of government, more systematic and philosophic schemes of religion, and a more elaborate and ceremonial worship. At intervals new arts and ideas appear, such as agriculture and pasturage, the manufacture of pottery, the use of metal implements, and the device of record and communication by picture-writing. Along such stages of improvement and invention the bridge is fairly made between savage and barbaric culture; and this once attained to, the remainder of the series of stages of civilisation lies within the range of common knowledge.

Development theory.

The teaching of history, during the three to four thousand years of which contemporary chronicles have been preserved, is that civilisation is gradually developed in the course of ages by enlargement and increased precision of knowledge, invention and improvement of arts, and the progression of social and political habits and institutions towards general well-being. The conditions of such races as the older Jews, Greeks, and Germans, are known to us by ancient chronicles, and by poetry and myth even more valuable than chronicle in the details they unconsciously preserve of the state of society at the time whence they have been handed down. Starting from the recorded condition of such barbaric nations, and following the general course of culture into the modern world, all the great processes of mental and social development may be seen at work. Falling back or decay also takes place, but only to a limited extent destroys the results of growth in culture. It is thus matter of actual record, that the ancestors of civilised nations were barbaric tribes, and the inference seems reasonable that the same process of development had gone on during previous ages outside the domain of direct history, so that barbaric culture itself arose out of an earlier and ruder condition of primitive culture, more or less corresponding with the state of modern savage tribes. The failure of direct record of this passage from savagery upward to barbarism was to be expected from the circumstances of the case. No people civilised enough to preserve history could have watched the age-long process of a savage tribe developing its culture; indeed, experience shows that independent progress could hardly have taken place among an uncivilised in contact with a civilised race. Nor could a barbaric nation, though it had really and independently risen from savagery within some few thousand years, give any valid account of this gradual advancement, for the very reason of its having taken place while the nation was yet in, or but little removed from, the savage state, one part of the very definition of which is that it has no trustworthy means of preserving the history of events even for a single century, much less for the long period required for so vast a development. This view of the low origin and progressive development of civilisation was already held in ancient times, as in the well-known speculations of the Epicurean school on the condition of the earliest men, who roved like wild animals, seeking their food from the uncultured earth, till arts and social laws arose among them (Lucret., *De Rerum Nat.*, v. 923; Horat., *Sat.*, i. 3); or where the like idea has taken in China the form of ancient legend, recording the time when their nation was taught to use skins for clothing, to make fire, and to dwell in houses (Pauthier, *Livres Sacrés de l'Orient*, p. 26). In opposition to such views of primeval rudeness, traditions of a pristine state of human excellence have long been cherished, such as the "golden age" (Hesiod., *Op. et Dies*, 108). Till of late wide acceptance has been given to arguments, partly based on theological and partly on anthropological grounds, as to man's incapability of rising from a savage state, and the consequent necessity of a supernatural bestowal of culture on the first men, from whose high level savages are supposed by advocates of this theory to have degenerated. The anthropological evidence adduced in support of this doctrine is, however, too weak for citation, and even obviously erroneous arguments have been relied on (see, for example, Archbishop Whately, *Essay on the Origin of Civilisation*, and remarks on its evidence in Tylor, *Early Hist. of Man.*, p. 163). It has been especially the evidence of prehistoric archæology which, within the last few years, has given to the natural development-theory of civilisation a predominance hardly disputed on anthropological grounds. The stone implements, which form the staple proof of man's existence at the period of the river-drift, are of extreme rudeness as compared even with ordinary savage types, so that it is obvious that the most ancient known tribes were, as to the industrial arts, at a low savage level. The remains in the caverns justify this opinion, especially where in central France more precision is given to the idea of prehistoric life by the discovery of bone weapons for hunting and fishing, which suggest a rude condition resembling that of the Esquimaux (see the preceding section IV., *Antiquity of Man*). The finding of ancient stone implements buried in the ground in almost every habitable district of the world, including the seats of the great ancient civilisations, such as Egypt, Assyria, India, China, Greece, &c., may be adduced to show that the inhabitants of these regions had at some time belonged to the stone age. This argument goes far to prove that the ancestors of all nations, high and low, were once in that uncultured condition as to knowledge, arts, and manners generally, which within our experience accompanies the use of stone implements and the want of metals. No valid refutation of this reasoning has been offered, and it is corroborated by arguments to be drawn from study of the facts of civilisation, of which some will be here mentioned for their bearing on the theory of development.

Historic development of culture.

History shows how development of the arts takes place by efforts of skill and insight, as where Phidias rose above the clumsier sculptors of the time before him, or where the earliest gnomon—a mere staff set up in order to have its shadow measured—passed into the graduated sun-dial; or adaptations of old contrivances produce new results, as when the ancient Pan's pipes, blown by a bellows, became the organ, when the earlier block-printing led up to the use of movable types, and when the magnetic-needle was taken out of the mariner's compass to find a new office on the telegraph-dial; or lastly, more absolutely original inventions arise, the triumphs of the scientific imagination, such as the pendulum and the steam-engine. In the evolution of science the new knowledge ever starts from the old, whether its results be to improve, to shift, or to supersede it. The history of astronomy extends far enough back to show its barbaric stages, when the earth was regarded as a flat surface, over-arched by a solid dome or firmament; and when not only was the sun considered to move round the earth, but its motions, as well as the moon's, were referred to the guidance and even the impulse of personal deities. Beginning with this first stage of the science, there lies before us the whole record of the exacter observation and closer reasoning which have gradually replaced these childlike savage conceptions by the most perfect of physical theories. Thus, again, the history of medicine shows improvement after improvement on the rude surgical appliances and the meagre list of efficient drugs which the barbaric leech had at his disposal, while its theory has changed even more absolutely than its practice; for medical history begins with the ancient world holding fast to the savage doctrine that madness, epilepsy, fever, and other diseases, are caused by demons possessing the patient—a belief which is still that of half the human race, but which it has been the slow but successful task of scientific pathology to supersede in the civilised world. In like manner, the history of judicial and administrative institutions may be appealed to for illustrations of the modes in which old social formations are reshaped to meet new requirements, new regulations are made, and new officers are constituted to perform the more complex duties of modern society, while from time to time institutions of past ages, which have lost their original purpose, and become obsolete or hurtful, are swept away.

Prehistoric development of culture.

That processes of development similar to these had already been effective to raise culture from the savage to the barbaric level, two considerations especially tend to prove. First, there are numerous points in the culture even of rude races which are not explicable otherwise than on the theory of development. Thus, though difficult or superfluous arts may easily be lost, it is hard to imagine the abandonment of contrivances of practical daily utility, where little skill is required, and materials are easily accessible. Had the Australians or New Zealanders, for instance, ever possessed the potter's art, they could hardly have forgotten it. The inference that these tribes represent the stage of culture before the invention of pottery is confirmed by the absence of buried fragments of pottery in the districts they inhabit (Lubbock, in *Report of British Association*, Dundee, 1867, p. 121). The same races who were found making thread by the laborious process of twisting with the hand, would hardly have disused, if they had ever possessed it, so simple a labour-saving device as the spindle, which consists merely of a small stick weighted at one end; the spindle may, accordingly, be regarded as an instrument invented somewhere between the lowest and highest savage levels (Tylor, *Early Hist. of Mankind*, p. 193). Again, many devices of civilisation bear unmistakable marks of derivation from a lower source; thus the ancient Egyptian and Assyrian harps, which differ from ours in having no front pillar, appear certainly to owe this remarkable defect to having grown up through intermediate forms from the simple strung bow, the still used type of the most primitive stringed instrument (Engel, *Music of the most Ancient Nations*, pp. 17, 30). In this way the history of numeral words furnishes actual proof of that independent intellectual progress among savage tribes which some writers have rashly denied. Such words as *hand*, *hands*, *foot*, *man*, &c., are used as numerals signifying 5, 10, 15, 20, &c., among many savage and barbaric peoples; thus Polynesian *lima*, *i.e.*, "hand," means 5; Zulu, *tatisitupa*, *i.e.*, "taking the thumb," means 6; Greenlandish, *arfersanek-pingasut*, *i.e.*, "on the other foot three," means 18; Tamanac, *tevin itoto*, *i.e.*, "one man," means 20, &c., &c. The existence of such expressions demonstrates that the people who use them had originally no spoken names for these numbers, but once merely counted them by gesture on their fingers and toes in low savage fashion, till they obtained higher numerals by the inventive process of describing in words these counting-gestures (Tylor, in *Journal Royal Inst.*, March 15, 1867; *Primitive Culture*, chap. vii.)

Survival in culture.

Second, the process of "survival in culture" has caused the preservation in each stage of society of phenomena belonging to an earlier period, but kept up by force of custom into the later, thus supplying evidence of the modern condition being derived from the ancient. Thus the mitre over an English bishop's coat-of-arms is a survival which indicates him as the successor of bishops who actually wore mitres, while armorial bearings themselves, and the whole craft of heraldry, are survivals bearing record of a state of warfare and social order whence our present state was by vast modification evolved. Evidence of this class, proving the derivation of modern civilisation, not only from ancient barbarism, but beyond this, from primeval savagery, is immensely plentiful, especially in rites and ceremonies, where the survival of ancient habits is peculiarly favoured. Thus the modern Hindu, though using civilised means for lighting his household fire, retains the savage "fire-drill" for obtaining fire by friction of wood when what he considers pure or sacred fire has to be produced for sacrificial purposes; while in Europe into modern times the same primitive process has been kept up in producing the sacred and magical "need-fire," which was lighted to deliver cattle from a murrain. Again, the funeral offerings of food, clothing, weapons, &c., to the dead are absolutely intelligible and purposeful among savage races, who believe that the souls of the departed are ethereal beings, capable of consuming food, and of receiving and using the souls or phantoms of any objects sacrificed for their use. The primitive philosophy to which these conceptions belong has to a great degree been discredited by modern science; yet the clear survivals of such ancient and savage rites may still be seen in Europe, where the Bretons leave the remains of the All Souls' supper on the table for the ghosts of the dead kinsfolk to partake of, and Russian peasants set out cakes for the ancestral manes on the ledge which supports the holy pictures, and make dough ladders to assist the ghosts of the dead to ascend out of their graves and start on their journey for the future world; while other provision for the same spiritual journey is made when the coin is still put in the hand of the corpse at an Irish wake. In like manner magic still exists in the civilised world as a survival from the savage and barbaric times to which it originally belongs, and in which is found the natural source and proper home of utterly savage practices still carried on by ignorant peasants in our own country, such as taking omens from the cries of animals, or bewitching an enemy by sticking full of pins and hanging up to shrivel in the smoke an image or other object, that similar destruction may fall on the hated person represented by the symbol (Tylor, *Primitive Culture*, chap. i., iii., iv., xi., xii.; *Early Hist. of Man*, chap. vi.)

General lines of development.

To conclude, the comparative science of civilisation thus not only generalises the data of history, but supplements its information by laying down the lines of development along which the lowest prehistoric culture has gradually risen to the highest modern level. Among the most clearly marked of these lines is that which follows the succession of the stone, bronze, and iron ages. The stone age represents the early condition of mankind in general, and has remained in savage districts up to modern times, while the introduction of metals need not at once supersede the use of the old stone hatchets and arrows, which have often long continued in dwindling survival by the side of the new bronze and even iron ones. The bronze age had its most important place among ancient nations of Asia and Europe, and among them was only succeeded after many centuries by the iron age; while in other districts, such as Polynesia and Central and South Africa, and America (except Mexico and Peru), the native tribes were moved directly from the stone to the iron age without passing through the bronze age at all. Although the three divisions of savage, barbaric, and civilised man do not correspond at all perfectly with the stone, bronze, and iron ages, the classification of civilisation thus introduced by Nilsson and Thomsen has proved a guide of extraordinary value in arranging in their proper order of culture the nations of the Old World. Another great line of progress has been followed by tribes passing from the primitive state of the wild hunter, fisher, and fruit-gatherer to that of the settled tiller of the soil, for to this change of habit may be plainly in great part traced the expansion of industrial arts and the creation of higher social and political institutions. These, again, have followed their proper lines along the course of time. Among such are the immense legal development by which the primitive law of personal vengeance passed gradually away, leaving but a few surviving relics in the modern civilised world, and being replaced by the higher doctrine that crime is an offence against society, to be repressed for the public good. Another vast social change has been that from the patriarchal condition, in which the unit is the family under the despotic rule of its head, to the systems in which individuals make up a society whose government is centralised in a chief or king. In the growth of systematic civilisation, the art of writing has had an influence so intense, that of all tests to distinguish the barbaric from the civilised state, none is so generally affective as this, whether they have but the failing link with the past which mere memory furnishes, or can have recourse to written records of past history and written constitutions of present order. Lastly, still following the main lines of human culture, the primitive germs of religious institutions have to be traced in the childish faith and rude rites of savage life, and thence followed in their expansion into the vast systems administered by patriarchs and priests, henceforth taking under their charge the precepts of morality, and enforcing them under divine sanction, while also exercising in political life an authority beside or above the civil law. These illustrations may suffice to make it clear that although the science of culture is still but rudimentary and imperfect, it indicates the one sound and indispensable method for the study of human arts and institutions, that of placing each at its proper stage in a line of evolution, and explaining it by the action of new conditions upon the previous stage whence it was derived. (E. B. T.)

ANTHROPOMORPHISM is a term used in theological writings to denote the figure by which words expressing human organs and activities are applied to the divine Being; in short, it is the conception and representation of God as possessed of corporeal and human properties. Originally and literally the word implied only the ascribing to God a physical form resembling the human body, and consequently included under it all forms of expression which attribute to Him the exercise of physical organs and senses. But its meaning was soon extended so as to comprehend all representations of God which require Him either to be in himself corporeally extended, or to possess a corporeal body as the necessary condition of His activity. In this wider sense all theories were designated anthropomorphic, which identified God with light or the physical universe, or which placed alongside of Him a primeval, uncreated matter.

Primitive ideas of God are necessarily framed by man from the analogy of his own nature. He is, however, able to represent God to himself under the analogy of his mental or spiritual, as well as under that of his material nature. This more refined form was called anthropopathism, and is that mode of contemplating the divine attributes founded on the analogy of God to the human spirit. All forms of expression which ascribe to God passions, intelligence, or volition, rest ultimately upon this supposed analogy. In modern theology and philosophy, it is this mode of thought that usually receives the name of anthropomorphism.

Anthropomorphism is inseparable from early religion. The first dim intuition of God as the ruler of the universe, on whom we depend, cannot at an early time be seized in all its purity by reason. Sense and imagination are developed before reason, and in semi-barbarous intelligences completely overbalance it. The object of their faith is not God himself, but God as manifested in nature and history. It is only through ideas derived from sensible objects and elevated by the imagination that man can clothe his primitive thought of God with attributes that enable him to realise it, to bring it home to himself. He must represent God as in all respects like himself, superior only in power. The very words by which alone he can give expression to the first workings of his consciousness of God carry with them a sensible meaning, and hence react powerfully on the development of his belief. They imperceptibly fix attention upon the physical facts involved in them, and their merely symbolic use is forgotten. Hence arise myths. Even among peoples in whom the growth of the religious consciousness was extraordinarily favoured, strong traces of anthropomorphism are to be found. In the Hebrew literature there is a prevailing anthropomorphic idea of God. He is represented as seeing, hearing, smelling; as having a visible, corporeal presence; as hating, loving, and repenting. Although the pure idea of God as a spirit, as the very essence of being, is distinctly recognised and insisted upon by the prophets and lawgivers, the people demanded a visible symbol, a sensible emblem of their faith. Great part of the ceremonial law is taken up with the attempt to reconcile this desire for visible symbol with the purer requirements of their faith. Christian thought freed itself completely from the yoke of this crude anthropomorphism by its fundamental axiom that God is a spirit. Theology since then has had to steer its course with care between two opposite tendencies: one striving to attain to a living personal community with God through Christ, and thereby running the risk of introducing foreign elements into the idea of God; the other, from undue fear of anthropomorphism, tending to reduce the idea of God to a blank negation, a substance without qualities. In the history of the church these tendencies appeared at a very early period. In the Clementine homilies, but particularly in Tertullian (see *Adv. Praxean*, c. vii.; *De Carne Christi*, c. xi.) there is distinct anthropomorphism. Tertullian declares that nothing can have real being that is not extended, corporeal; God, therefore, he seems to identify with an ethereal being of light. An example of the finer form in which human affections are ascribed to God may be found in Lactantius (*De Ira Dei*, c. ii.) The Alexandrian theologians, from their philosophical training, were specially opposed to anthropomorphism, but in their hands the danger of the opposite tendency is seen. According to some of them, we know God only by negation,—we know what He is not, not what He is. Others (*e.g.*, Irenæus, Novatian) declare that all the predicates of God are only in image; and that, from the finitude of our minds, we must use terms expressing not God's nature, but our own ignorance. Phrases in Scripture which seemed to be anthropomorphic were explained by the Fathers as revelations of God in such a way as to be intelligible to us. This revelation was called (see Chrysostom, *Hom.* iii. c. 3) condescension or divine economy.

The church itself was not free from anthropomorphism of the crudest type. In the 2d century Melito, bishop of Sardis, wrote a book concerning the corporeity of God; and in the 4th century Audæus, in Mesopotamia, held similar views, and had many followers. In the Middle Ages the question gradually merged into the more philosophical one of the relation between reason and faith. In modern theology the problem again appears, but its aspect is completely philosophical. Philosophy, indeed, has never ceased to concern itself with this very question. Xenophanes mocked the anthropomorphism of his countrymen; Aristotle denied to the gods ethical virtue and the possession of emotions or passions; he allowed to them only a life of intellectual speculation. The Epicureans thought the gods lived in complete quiescence, and concerned themselves not at all with the affairs of men (see Lucretius, ii. 646). Philo exhibits very strongly the tendency to reduce the Deity to a lifeless abstraction, whose attributes are only negatively known. In modern philosophy, Descartes attempted to settle the problem, by affirming that any attributes in us which involve limitation or imperfection cannot be ascribed to God, but that attributes which do not imply imperfection can be predicated of Him. Spinoza is one of the strongest opponents of any form of anthropomorphism, and from him the modern aspect of the question may be said to proceed. He brought clearly to light the fundamental difficulty, the reconciliation of the infinite and absolute nature of God with any attribute whatsoever; for attribute, as such, implies negation, *i.e.*, limitation. Spinoza dismisses as anthropomorphic the idea of God as an intelligence, as free to act, and as ruling the world, and thus destroys the ideas of design in nature and of providence. The consequences of this theory on questions relating to the personality of God, miracles, prayer, &c., have been worked out very fully in the most recent times.

Thus the real problem at the root of the question as to the legitimacy of anthropomorphic modes of thought, is the philosophical one of the limits of human intelligence, of the relation between the divine thought in itself and in nature and human intelligence. A long line of philosophic thinkers affirm the impossibility of human intelligence penetrating the nature of the divine, and point out our inability to solve the many contradictions which arise in the attempt to do so. According to them, we can only think of God by analogy; our ideas of Him must be anthropomorphic, but they are at the same time known to be entirely symbolical. The best known representatives of this mode of thought are Bishop Browne and the late Dean Mansel.

ANTIBES, a seaport town of France, on the Mediterranean, in the arrondissement of Grasse, which formerly belonged to the department of Var, but which was transferred to the new department of Alpes Maritimes in 1860. The town is situated on the east side of a neck of land called La Garoupe, 10 miles S.E. of Grasse; it is fortified, and possesses a tolerable harbour, which accommodates a considerable fishing industry. The principal exports are dried fruits, salt fish, and oil. The surrounding country is very fertile, producing abundance of fruit and flowers. Antibes, the ancient *Antipolis*, was founded by colonists from Marseilles about 340 B.C. Population, 6004.

ANTICHRIST. Ἀντίχριστος, or ὁ ἀντίχριστος. The word occurs only in the first and second epistles of John. It signifies an opponent or adversary of Christ. The idea expressed by it had its origin in Judaism. According to prophetic anticipations, the Messianic time was to be immediately preceded by a great conflict, in which Jehovah would fight out of Zion for His own people, and defeat the concentrated opposition of the world. An Almighty leader on the one side seemed to require an antagonist on the other, a head of the army of darkness against the Prince of light. Thus Ezekiel depicts Gog proceeding out of Magog, to hazard a decisive battle against the Lord and His saints on the eve of the Messianic age (chapters xxxviii. and xxxix). The idea was subsequently embodied in Antiochus Epiphanes, who tried to eradicate Judaism with savage hatred. When we consider the insane violence he exhibited against the Jews and their temple, his prohibition of Jehovah's worship, the solemnisation of the Sabbath, and circumcision, it was natural to regard him as the representative of heathenism in its opposition to the true religion. Accordingly, the worshippers of Jehovah termed the small altar erected by him to Olympian Jove in the holy temple at Jerusalem (168 B.C.), the *abomination of desolation* (Daniel ix. 27, xi. 31, xii. 11; Mat. xxiv. 15). The apocalyptic visions of Daniel exerted an important influence upon the Jews after the time of Antiochus, animating them with hopes of the near approach of a better day, preceded, it is true, by a fearful struggle, in which a powerful prince, the impersonation of heathenism in its fiercest hate, should persecute the chosen people. The future of Israel was brightened by the visions of one whose predictions had been at least partially fulfilled. After this the idea seems to have been in abeyance till the reign of Caligula (40 A.D.), when Greeks in Alexandria and Syria attempted to introduce images of the emperor into the Jewish synagogues. The express command of Caligula addressed to the Jews, to erect his image in the temple at Jerusalem, in the form of Olympian Zeus, excited an intense commotion throughout Palestine, and must have recalled to the Jews familiar with their Scriptures the similar conduct of Antiochus, as though the prophet Daniel had foretold the blasphemy of the Roman emperor. In the discourse of Christ recorded by Matthew (chapter xxiv.), a personal opponent or antichrist does not appear, but the second advent is preceded by great affliction, the desecration of the temple, false Messiahs, and false apostles. This evangelic eschatology, however, appears in its present form to belong to a late redactor, so that it is difficult to separate Christ's own utterances from other elements probably incorporated with them. Various sayings of Jesus relative to his second appearing were evidently misapprehended or confused in the reminiscences of the early disciples.

St Paul resumes the idea of antichrist. Whatever Jewish conceptions he laid aside, and he emancipated himself from the grossest of them, he did not abandon the idea of an antichrist or terrible adversary of the true religion. The prophecies of Daniel, whether in their supposed relation to Antiochus or Caligula, and the impious command of the latter in particular to desecrate the Jewish temple, furnished him with traits for the portrait of Christ's great enemy, whose manifestation in the Roman empire the state of the world led him to suspect, especially as the empire was then identified by the Jews, as well as by Paul himself, with the fourth and last kingdom of Daniel's visions. Blending together the notions of an antichrist and false Christ, the picture which St Paul draws is that of the man of sin, "the son of perdition; who opposeth and exalteth himself above all that is called God, or that is worshipped; so that he as god sitteth in the temple of God, showing himself that he is God; the wicked one whose coming is after the working of Satan with all power and signs and lying wonders," &c. (2 Thess. ii. 3–9). Here the epithet ὁ ἄνομος appears to be borrowed from Isaiah xi. 4, the apostle coinciding with the Chaldee interpreter in understanding the passage of antichrist. The hindrance to the manifestation of the terrible enemy, to which Paul obscurely alludes, seems to be the Roman empire in one or other of its aspects; for we cannot adopt the ingenious conjecture that Claudius is meant, though the name fits the apostolic expression ὁ κατέχων, *qui claudit, Claudius.* Apart from the fact that the neuter τὸ κατέχον is used as well as the masculine it is scarcely probable that one whose reign was marked by cruel actions and bloodshed should be called the obstacle in the way of antichrist's manifestation. The apostle, not ignorant of Caligula's blasphemous edict, seems to have thought of some Cæsar in whom the persecuting power of heathenism should culminate, without pointing at either Claudius as the withholder, or Claudius's successor as the man of sin. The idea of antichrist was not historically fixed in his mind. Here we differ from Hitzig and Hausrath; though the date of the Thessalonian epistles (about 52 A.D.) presents no obstacle to the hypothesis, as De Wette thinks it does.

The author of the Revelation presents the antichrist idea in a more definite form than St Paul. Borrowing characteristic traits from Antiochus Epiphanes, perhaps too from Caligula, whose blasphemous order to set up his own image in the attitude of Olympian Zeus within the holy temple at Jerusalem created intense excitement throughout Palestine, aware of the fearful persecution which the Christians had suffered from Claudius's successor on the throne of the Cæsars, the apostle John makes the man of sin or antichrist to be Nero returning from the East, according to a report then current.[1] In his view the vicious cruelty of paganism had its incarnation in the monster who set fire to Rome, torturing the Christians there, and hesitating to commit no crime. If the capital of the heathen world had such a head, the character of the great antichrist stood forth in him. Accordingly, the writer describes Nero as the fifth head of the beast that rose out of the sea, *i.e.*, Rome, who received a deadly wound which was healed, who made war upon the saints and overcame them, who disappeared amid the wondering of the world, to return with renewed power for three years and a half. The number of the beast or head, 666, points unmistakably to Nero, for it is the equivalent of קסר נרון Kæsar Neron, נ = 50, = 200, ו = 6, נ = 50, ק = 100, ס = 60, ר = 200. He is the beast that was and is not, the fifth fallen head, one of the seven; the eighth, because he should reappear after his deadly wound was healed. The succession of emperors is Augustus, Tiberius, Caligula, Claudius, Nero, Galba. Renan has again sanctioned the reckoning of Julius Cæsar as the first of the list, on the authority of Josephus, Suetonius, Aurelius Victor,[2] &c.; but Suetonius's commencement of his lives of the Cæsars with Julius, is scarcely a valid proof of his reckoning him to be the first of the line. Tacitus, Aurelius Victor, and Sextus Rufus, not to speak of Hippolytus, favour the opinion that Augustus was the first emperor, and as the birth of Christ was under him, Christianity has nothing to do with Julius Cæsar. In the view of the apocalyptist the latter is of no importance. The apostle writing under Galba (68 A.D.), held the opinion then prevalent among Christians as well as others, that the emperor was not really dead, but was in the East, whence he would return with an army of Parthians to conquer and destroy Rome (Tacitus, *Hist.* ii. 8; Suetonius, *Nero*, cap. 57, Dio Chrysostom, *Or.* xxi.) Such belief had then taken possession of the minds not only of the Jewish Christians in Palestine, but of the Jews themselves, who were in a state of feverish excitement because Jerusalem was besieged. Terror had seized all worshippers of the true God, because of the aspect which the empire assumed (Revelation xiii. 3-8, 18, xvii. 11). The apocalyptist also states that false or antichristian prophetism was to unite with the healed beast, and cause men to worship him or be put to death (xiii. 14, 15). We assume that the second beast, which rises out of the earth as the first does out of the sea, is identical with the false prophet in xvi. 13, xix. 20, xx. 10, and that it is a personification of false or heathen prophesying with its soothsaying and auguries. But though Irenæus sanctions this view, it is not without difficulties, since the second beast ought in consistency to be historically definite like the first. It cannot be that the writer means the apostle Paul; for John, with all his Jewish tendencies, and hints unfavourable to Paul, would not speak so strongly against the latter. If John were not the author, as some incline to think, an unknown writer, with lively Judaic prepossessions, might perhaps describe the apostle Paul in such dark colours, but even then it is highly improbable. Renan supposes that some Ephesian impostor is meant, a partisan of Nero's, perhaps an agent of the pseudo-Nero, or the pseudo-Nero himself. One thing is pretty clear, that *a polity* is not represented by either of the two beasts in the Apocalypse, or by Paul's man of sin. It is remarkable how long the legend about Nero's revival continued, and how widely diffused it became, though his body was buried publicly at Rome. Not till the 5th century did it become extinct.

The author of John's first epistle has a more general and spiritual conception of antichrist, partly in consequence of the Alexandrian philosophy which had leavened thought in Asia Minor, as is perceptible in the fourth gospel. He finds antichrist *within* the church in any false teacher who corrupts the true doctrine respecting the Father and the Son through a tendency idealising away the practical basis of Christology. Such development of the idea agrees better with the general representation in the discourses of Jesus than the restricted individualising it received from Paul and John *outside* Christianity, though the latter bears the older and Judaic stamp. The author of I. John writes: "As ye have heard that antichrist shall come, even now are there many antichrists. He is antichrist, that denieth the Father and the Son. This is that spirit of antichrist, whereof ye have heard that it should come; and even now already is it in the world" (ii. 18, 22, iv. 3). He that denied the Father and the Son, that did not confess Jesus, was an antichrist in this author's opinion. Probably Gnosticism was in his view more than any other form of error. There was a tendency among the later New Testament writers, as far as we can judge from 2 Peter ii. 15, to find antichrist in erroneous doctrine rather than an individual. False teachers are called followers of Balaam. In the Apocalypse itself certain heretics are termed Nicolaitanes or Balaamites, *i.e.*, destroyers of the people.

The sibylline oracles agree with the Apocalypse in identifying antichrist and Nero. In those of Christian origin belonging to the earliest centuries, we find the current belief that Nero, having fled beyond the Euphrates, should return with an army to perpetrate farther cruelties in Rome. The descriptions in question are based, in part, on those of the apocalyptist, and the tyrant is directly identified with antichrist or Beliar.[3] When the legend about the tyrant's return from the East ceased, the true interpretation both of the fifth head and his mystic number 666 was lost. Irenæus himself did not know the interpretation of 666, and has given several conjectural words more or less suitable to the number.[4] The idea of a personal antichrist was retained by the Christian writers of the 2d and 3d centuries who held the sensuous view of Christ's speedy reappearing to set up his reign on

[1] Düsterdieck in vain disputes this fact, believing that the report in the form in which critics put it into the book, had its source in misunderstood passages of the Apocalypse combined with 2 Thess. ii. 3, &c.

[2] Aurelius Victor is erroneously cited by Renan for his view of the Cæsars. Both in the *De Cæsaribus* and the *Epitome* the narrative begins with Octavius. Julius Cæsar does not appear as emperor.

[3] See book iv. 116, &c., 134, &c.; viii. 140, &c., 70, &c., 152, &c.; and comp. Alexandre's Excursus in vol. ii. of his *Oracula Sibyllina*, 1856. The first vol., containing the poems themselves, with a translation, appeared in 1841.

[4] *Opp.*, *ed. Stieren*, vol. i. p. 801

earth for a thousand years. The figure of this great adversary in connection with the millennial reign was important for such interpreters. The Alexandrian school, however, whose method of interpretation was less literal and gross, generalised the idea in the manner of him who wrote St John's first epistle, making the principle of error or departure from the faith to be personified in antichrist. The great opponent of Christ is an abstraction, a sceptical tendency or principle, not an historical person.

The later Jews had also their antichrist or anti-Messiah, whom they furnished with peculiar attributes, and termed Armillus, ארמילוס. The name appears already in the *Turgum* of Jonathan on Isaiah xi. 4, where the godless Armillus is said to be slain with the breath of Messiah's mouth. In their description he becomes a terrible giant, golden haired, twelve ells in height, as many in breadth, having the width of a span between his deep red eyes. Born in Rome, he will assume to be the Messiah, and obtain many adherents. The first Messiah, Joseph's son, will make war upon him, but be overcome and slain at Jerusalem. After this the second Messiah, David's son, will defeat Armillus with the breath of his mouth, and then God will reassemble the dispersed of Israel, forming them into a united people, Christians and unbelievers being destroyed.[1]

In the apocryphal *Ascension of Isaiah*, published by Laurence, a Jewish-Christian production written in Greek not earlier than the 3d century, the angel Berial, prince of this world, identical with Sammael or Satan, and representing antichrist, is said to descend in the last days, in the form of an impious monarch (Nero), the murderer of his mother. The world will believe in him, and sacrifice to him; his prodigies will be displayed in every city and country, and his image set up. After exercising dominion for three years seven months and twenty-seven days, the Lord will come with His angels and drag him down into Gehenna. The writer's description is evidently moulded on that of the apocalyptist.[2]

Nor is antichrist unknown to Mohammedan theology, in which he is called al Masîh al Dajjâl, the false or lying Christ, or simply al Dajjâl. He is to be one-eyed, and marked on the forehead with the letters C. F. R., *i.e.*, Cafir, or infidel. Appearing first between Irak and Syria, or, according to others, in Khorasan, he will ride on an ass, followed by 70,000 Jews of Ispahan, and continue on earth forty days, of which one will be equal in length to a year, another to a month, another to a week, and the rest will be common days; he is to lay waste all places except Mecca, or Medina, which are guarded by angels; but at length he will be slain by Jesus at the gate of Lud, near Joppa, assisted by the Imam Mahedi, after which the Moslem religion will coalesce with the Christian into one.[3] There is a saying that Mohammed foretold several antichrists, as many as thirty, but one of greater note than the rest.

During the Middle Ages, and those which immediately followed, current opinion discovered antichrist in heretics and sects. The Apocalypse and second epistle to the Thessalonians were supposed to point at false doctrine and its leading representatives. In their zeal against such as did not belong to the same church as their own, ecclesiastics mistook the sense of the passages relating to the dreaded adversary of Christ. Thus Innocent III. (1215) declared the Saracens to be antichrist, and Mohammed the false prophet; and Gregory IX. (1234) pronounced the emperor Frederick II. to be the beast that rose up out of the sea with names of blasphemy on his head (Rev. xiii. 1–6).

As the corruption of the Romish Church increased, and the necessity of reform became more apparent, anti-ecclesiastical thought found antichrist in the Papacy; and that again naturally provoked the church to characterise all heretics as the collective antichrist. The strong language of the apostles became a polemic weapon, easily wielded against any adversary possessing worldly power inimical to the church's interests, or holding opinions incompatible with traditional orthodoxy. The Church of Rome led the way in misapplying the Apocalypse during her contest with civil powers and heretics; her opponents followed the example in turning the instrument against herself. Antichristianism could be embodied in the Papacy as well as in Protestantism. It might be in a corrupt church as well as in heretical doctrine outside it. Accordingly, the Waldenses, Wicliffe, Huss, and many others, found antichrist in the Pope. Luther hurled a powerful philippic *adversus execrabilem bullam antichristi;* and the articles of Schmalkald embody the same view, affirming: "Der Pabst aber, der allen die Seligkeit abspricht welche ihm nicht gehorchen wollen, ist der rechte antichrist."

The history of opinion respecting antichrist, or rather the interpretation of such Scriptures as present the idea, is by no means instructive. Conjectures too often supply the place of sound exegesis. Much error has arisen from mixing up portions of Daniel's vision with those of the Apocalypse, because they refer to different subjects. The apostle borrows characteristic features from Daniel's Antiochus Epiphanes to fill out his picture of Nero. The combination of St Paul's man of sin with St John's antichristian Nero has also led to misapprehension. The idea is variously developed according to the mental peculiarities and knowledge of those who entertained it. Vague and general at first, it was afterwards narrowed, somewhat in the manner of the Messianic one. Its different forms show that it was no article of faith, no dogma connected with salvation. Less definite in the second epistle to the Thessalonians, it is tolerably specific in the Revelation. The author of John's first epistle gave it a spiritual width, consistently with the pantheistic direction which he follows with feeble footsteps. In each case, however, the writers moved within their own times, their knowledge bounded by the necessary limits of the human intellect, so that their subjective views can hardly be accepted as the emanations of minds projecting themselves into the world's outer history with full intelligence of its details. Limited to the horizon of their age, they did not penetrate into the future with infallible certainty. What they express about antichrist is their development of an idea which sprang out of Jewish soil and does not harmonise well with the gradual progress of Christ's spiritual kingdom. It is not unusual, however, for men living in times of peculiar commotion, when the good are oppressed and vice triumphs, to embody rampant opposition to truth and righteousness in a person who concentrates in himself the essence of antichristian hate. If Christ is to conquer gloriously, a mighty adversary is given Him who must be finally and for ever overthrown. Then commences the universal reign of peace and purity under the benign sceptre of the Victor. Over against Christ as King is set a formidable foe, not an abstract principle,—the latter being an incongruous or less worthy adversary in the view of many. Yet it is the very individualising of the antichrist idea which removes it from the sphere of actual realisation. The extension, indeed, of the divine kingdom will encounter opposition; and the reaction of the

[1] See Eisenmenger's *Entdecktes Judenthum*, ii. p. 704, &c.; and Buxtorf's *Lexicon Chaldaicum*, s.v. ארמילוס.

[2] See Laurence's *Ascensio Isaiæ Vatis*, &c., pp. 108, 109, and general remarks, p. 157.

[3] See D'Herbelot's *Bibliothèque Orientale*, vol. i. p. 558, ed. La Haye, 1777; Sale's *Preliminary Discourse to his Translation of the Koran*, sec. 4.

world may appear, if not become, stronger as that extension is more decided; but the personality and intenseness which the apostles impart to the reaction transfer it to the region of the improbable. Humanity is not so vicious as to break away from God with the extreme insanity which the feelings of the sacred writers conjure up in times of fear for the church. (Comp. Gesenius's article "Antichrist" in Ersch and Gruber; De Wette's *Kurze Erklärung of the Second Epistle to the Thessalonians and the Revelation;* Lücke's *Versuch einer vollständigen Einleitung in die Offenbarung des Johannes*, zweite Auflage; Bleek's *Vorlesungen ueber die Apokalypse;* Ewald's *Commentarius in Apocalypsin Johannis*, and his *Die Johanneischen Schriften uebersetzt und erklärt;* Lünemann, *Ueber die Briefe an die Thessalonicher* in Meyer's *Kommentar ueber das Neue Testament;* Davidson's *Introduction to the Study of the New Testament*, vol. i.; Renan's *L'Antechrist;* Jowett's *Epistles of St Paul to the Thessalonians*, &c., vol. i.) (S. D.)

ANTICLIMAX (ἀντι and κλῖμαξ), in rhetoric, is an abrupt declension on the part of a speaker or writer from the dignity of idea which he has attained, as in the following well-known distich:—

> "The great Dalhousie, he, the god of war,
> *Lieutenant-colonel to the earl of Mar.*"

From its character it is plain that it can be intentionally employed only for a jocular or satiric purpose. It frequently partakes of the nature of antithesis, as—

> "Die and endow a *college* or a *cat.*"

From *bathos* it is distinguished by being much more decidedly a relative term. A whole speech may never rise above the level of bathos; but a climax of greater or less elevation is the necessary antecedent of an anticlimax.

ANTICOSTI, a barren island of British North America, situated in the Gulf of St Lawrence, between lat. 49° and 50° N., and between long. 61° 40′ and 64° 30′ W., with a length of 135 miles, and a maximum breadth of 40. Most of the coast is dangerous, but lighthouses have been built at different points, and there are also provision posts for shipwrecked sailors. The lighthouse keepers and other officials are the only inhabitants of the island.

ANTICYRA, in *Ancient Geography*, the name of three cities of Greece. (1.) In Phocis, on the Bay of Anticyra, in the Corinthian Gulf. Its modern name is Aspra Spitia, where some remains are still visible. It was a town of considerable importance in ancient times; was destroyed by Philip of Macedon; recovered its prosperity; and was captured by Flaminius in 198 B.C. (2.) In Thessaly, on the right bank of the River Sperchius, near its mouth. (3.) In Locris, on the left side of the entrance to the Corinthian Gulf, and not far from Naupactus. All three places are said to have been known for their hellebore; but the first was the source of the chief supply. The city was resorted to by those suffering from mental derangement, that they might the more easily obtain the curative herb; and this circumstance gave rise to a number of proverbial expressions, like Αντικίρρας σε δεῖ, or *naviget Anticyram*, and to frequent allusions in the Greek and Latin writers (Suetonius, *Cal.* 29; Persius, *Sat.* iv. 16; Juv. *Sat.* xiii. 97). Hellebore was likewise considered beneficial in cases of gout and epilepsy.

ANTIETAM, a small river of the United States, which rises in Pennsylvania, and flowing into Maryland, joins the Potomac about 50 miles from Washington. An indecisive battle between the Federals under M'Clellan and the Confederates under Lee was fought on its banks on 16th and 17th September 1862. The victory, however, practically lay with the Federals, as the Confederates retreated out of Maryland on the night of the 18th September.

ANTIGONE, the daughter of Œdipus, known in Greek legend, first, for the faithfulness with which she attended her father when he, on discovering that Jocaste, the mother of his children, was also his own mother, put his eyes out and resigned the throne of Thebes; secondly, for having, in defiance of a decree, buried with due rites the body of her brother Polynices, for which act she was sentenced to be buried alive in a vault. Her character and these incidents of her life presented an attractive subject to the Greek tragic poets, especially Sophocles, whose plays of *Antigone* and *Œdipus at Colonus* still exist; and Euripides, whose *Antigone*, though now lost, is partly known from extracts incidentally preserved in later writers, and from passages in his play of the *Phœnissæ*. In the order of the events, at least, Sophocles departed from the original legend, according to which the cremation of Polynices took place while Œdipus was yet in Thebes, not after he had died at Colonus. Possibly his having left Thebes at all is an invention of the poet. Again, in assigning Antigone the tragic end of being buried alive, Sophocles differs from Euripides, in whose play that calamity was averted by the intercession of Bacchus, and was followed by the marriage of Antigone and Hæmon, the son of her persecutor Creon, who had succeeded to the throne. In another version of the legend (Hyginus, *Fab.* 72), founded apparently (Heydemann, *Ueber eine nach Euripideische Antigone*, Berlin, 1868) on a tragedy by some follower of Euripides, Antigone, on being handed over by Creon to her lover Hæmon to be slain, was instead secretly carried off by him, and concealed among herdsmen, where she bore him a son Mæon. The boy having grown up, went to the games at Thebes, and being there recognised by the mark of a dragon on his body, the secret was discovered. Hercules pleaded with Creon in vain for Hæmon, who now slew both Antigone and himself. On a painted vase (engraved by Heydemann, *supra*) appears the scene of the intercession of Hercules. Antigone placing the body of Polynices on the funeral pile occurs on a sarcophagus in the villa Pamfili in Rome, and in the description of an ancient painting by Philostratus (*Imag.* ii. 29), in which it is stated that the flames consuming the two brothers burnt apart, as indicative of their hostility in life.

ANTIGONE (2), in Greek legend, the daughter of Eurytion, king of Phthia, who gave her in marriage to Peleus, the issue being a daughter, Polydora. Peleus having accidentally killed Eurytion in a hunt, some say the hunt of the Calydonian boar, fled and obtained expiation from Acastus, whose wife in malice, because her affection for Peleus was not returned, informed Antigone that it was, upon which Antigone took her own life.

ANTIGONUS I., called *Cyclops*, from his having lost an eye, one of the generals of Alexander the Great, was the son of Philip of Elymiotis. In the division of the provinces after Alexander's death, 323 B.C., Pamphylia, Lycia, and Phrygia Major fell to his share. But Perdiccas, having an eye to universal dominion, determined to divest him of his government, and laid plans for his life, by bringing various accusations against him. Antigonus escaped with his son Demetrius into Greece, where he obtained the favour and protection of Antipater, 321 B.C.; and when soon after, on the death of Perdiccas, a new division took place, he had the province of Susiana added to his former share. He was likewise intrusted with the command of the war against Eumenes, who had joined Perdiccas against the coalition of Antipater, Antigonus, and the other generals. Eumenes was thoroughly defeated, and was obliged to retire with only 600 men to the inaccessible castle of Nora, and a new army that was marching to his relief was also routed by Antigonus. In the interval Antipater had died (318 B.C.), and the opportunity excited the ambition of Antigonus to possess the whole of

Alexander's empire. Polysperchon succeeding Antipater in the regency, to the exclusion of Cassander his son, Antigonus resolved to set himself up as lord of all Asia. On account of the great power of Eumenes, he greatly desired to gain him over to his interest; but that faithful commander, effecting his escape from Nora, raised an army, and was appointed the royal general in Asia. He defeated Antigonus in several engagements, but was at last delivered up to him through treachery, and put to death. Upon this the governor of Upper Asia yielded to Antigonus. The latter now seized upon all the treasures at Susa, and directed his march towards Babylon, of which Seleucus was governor. Seleucus fled to Ptolemy, and entered into a league with him, together with Lysimachus and Cassander, in order to check the exorbitant power of Antigonus (315 B.C.) Notwithstanding this Antigonus made a successful attempt upon Syria and Phœnicia, though these provinces were soon after recovered by Ptolemy, who defeated his son Demetrius, while he himself was employed against Cassander in Asia Minor. They were again taken by Antigonus, who, flushed with success, sent an expedition against the Nabathæan Arabs dwelling in the deserts adjacent to Judæa. In the first enterprise his troops were cut to pieces by the Arabs; but his son commanded the second, and was more successful. Demetrius then expelled Seleucus from Babylon; and, success attending his arms wherever he went, the confederates had to make a treaty with Antigonus, stipulating that he should remain in possession of all Asia, but that the Greek cities should retain their liberty. This agreement was soon violated, under the pretence that garrisons had been placed in some of these cities by Antigonus. At first Ptolemy made a successful descent into Asia Minor, and on several of the islands of the Archipelago; but he was at length totally defeated by Demetrius, in a naval engagement off Salamis, in the island of Cyprus. On gaining this victory Antigonus assumed the title of king, and bestowed the same upon his son; and from that time (306 B.C.) his reign in Asia, and that of Ptolemy in Egypt, and of the other generals of Alexander in their respective provinces, properly commence. Antigonus now prepared a large army, and a formidable fleet, the command of which he gave to Demetrius, and hastened to attack Ptolemy in his own dominions. His invasion of Egypt, however, proved a failure; a battle with Ptolemy at Mount Casius gained Antigonus no advantage, and, after a few other fruitless efforts, he was obliged to retire (306 B.C.) Demetrius attempted the reduction of Rhodes; but, meeting with obstinate resistance, he was obliged to make a treaty upon the best terms that he could, in order to join his father in crushing a confederacy that had been formed between Cassander, Seleucus, and Lysimachus. Father and son advanced with their united forces into Phrygia, and met the enemy at Ipsus. A decisive battle was fought, in which Antigonus fell, in the 81st year of his age, 301 B.C., and with him fell the fortunes of his house.

ANTIGONUS (GONATAS), son of Demetrius Poliorcetes, and grandson of the former Antigonus, was born at Gouni in Thessaly about 319 B.C. On the death of his father in Asia, 283 B.C., he assumed the title of king of Macedonia, but did not obtain possession of the throne till 277, after it had been successively in the hands of Pyrrhus, Lysimachus, Seleucus, and Ptolemy Ceraunus. Antigonus repelled the invasion of the Gauls, and continued in undisputed possession of Macedonia till 273, when Pyrrhus returned from Italy and dethroned him. Pyrrhus fell, 272 B.C., at Argos, and Antigonus was again restored to power. The latter part of his reign was comparatively peaceful, and he gained the affection of his subjects by his mildness of disposition and his cultivation of the arts. He resisted the formation of the Achæan league, but did not resort to arms to enforce his opposition. He died, leaving his kingdom in peace, in the 80th year of his age, and the 44th of his reign, 239 B.C.

ANTIGUA, one of the West Indian Islands, in the British Leeward group, situated 50 miles E. of St Christopher, in lat. 17° 6′ N., and long. 61° 45′ W.; with an area of 108 square miles, and a circumference of about 50 miles. There is often a great scarcity of water in the island, which has also suffered severely from hurricanes; but it is on the whole healthy and its soil is very fertile, producing large quantities of sugar, and usually enough of grain for home consumption, as well as some cotton and tobacco. Its high and rocky coast is much indented by bays and arms of the sea, several of which form excellent harbours; that of St John's, the capital, is safe and commodious, but is much inferior to English Harbour, which is capable of receiving vessels of the largest size. Goods to the value of £234,011, and including sugar, molasses, rum, and cotton, were exported in 1870, being an increase of £33,038 as compared with 1869; the value of the imports, on the other hand, had increased during the same period from £174,357 to £164,178. In 1870, 422 ships of 25,228 tons entered, and 425 of 24,977 tons cleared the ports of the island. The government of Antigua is vested in a governor and executive and legislative councils, while four of the ten elective members of the general legislative council of the Leeward Islands, are chosen from, and by, the legislative council of Antigua, in addition to one non-elective member nominated from the same body by the Queen. In 1870 the revenue amounted to £41,136, the expenditure to £31,315, and the public debt to £52,195. The chief source of revenue is the import duty, which amounted to about £20,000 in the same year. Antigua was discovered in 1493 by Columbus, who is said to have named it after a church in Seville, called Santa Maria la Antigua. It however remained uninhabited until 1632, when a body of English settlers took possession of it, and in 1663 another settlement of the same nation was effected under the direction of Lord Willoughby, to whom the entire island was granted by Charles II. It was ravaged by the French in 1666, but was soon after reconquered by the British, and was formally restored to them by the treaty of Breda. Since then it has been a British possession. Population in 1871, 35,157.

ANTILEGOMENA (ἀντιλεγόμενα, contradicted or disputed), an epithet applied by the early Christian writers to denote those books of the New Testament which, although sometimes publicly read in the churches, were not for a considerable time admitted to be genuine, or received into the canon of Scripture. These books are so denominated in contradistinction to the *Homologoumena*, or universally acknowledged writings. The following is a catalogue of the *Antilegomena:—the Epistle to the Hebrews, the Epistle of St James, the Second Epistle of St Peter, the Second and Third Epistles of St John, the Epistle of St Jude, the Apocalypse, or Revelation of St John.* The earliest notice which we have of this distinction is contained in the *Ecclesiastical History* of Eusebius (iii. 25), who flourished A.D. 270–340; but the meaning of the passage is by no means clear, and it has accordingly given rise to considerable controversy.

ANTILLES, a name that is usually, although by no means uniformly, applied to the whole of the West Indian Islands, with the exception of the Bahamas; it has also, on the one hand, been employed to designate smaller portions of the same group, and, on the other, it has been extended so as to comprehend the whole archipelago, inclusive of the Bahamas. The traditional derivation of the word Antilles itself from Antilla, a continent supposed to lie to the west of the Azores, and for which Cuba, or some other West Indian island, was mistaken, is too doubtful and too vague in its application to be of any value in determining the proper use of the term; the weight of authority seems to be in favour of the first acceptation. In this sense the Antilles have been divided into two groups:—the Greater Antilles, including Cuba, Jamaica, Hayti, and Porto Rico; and the Lesser Antilles, forming the remainder of the islands. See WEST INDIES.

ANTIMACHUS, the Colophonian, a Greek poet who was honoured by the Alexandrine grammarians with the second place in their epic canon. Of his works nothing remains to us but the merest fragments; and of his life, we know little more than that he was born at Claros; was beaten by a rival in a poetical competition at Samos; met, either then or in equally discouraging circumstances, with Plato; fell in love with a lady called Lyde; lost her by death; bewailed her in an elegy of extreme erudition, if not of extraordinary pathos; and celebrated in his epic the seven heroes of Thebes. Schellenberg collected his fragmentary remains at Halle in 1786; and Roll at Dillenberg, in 1845. H. G. Stoll published at Göttingen in 1841 *Animadversiones in Antimachi Fragmenta;* and the remains of the *Thebais* are to be found in Düntzer, *Fragm. des Episch. Poes. der Griech.*

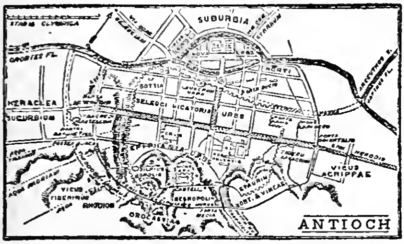
ANTIMONY, a metal found native to a small extent in many of the localities from which its ores are derived. It has been obtained at Sahlberg, near Sahl in Sweden, at Andreasberg in the Harz, at Allemont in Dauphiny, Przibram in Bohemia, besides being brought from Borneo, Chili, Mexico, New Brunswick, &c. It also occurs in nature alloyed with other metals; allemontite being arsenical antimony; dyscrasite, antimonial silver; and breithauptite, a native alloy of antimony and nickel. Among the ores of antimony may be enumerated valentinite, or white antimony, and cervantite, or antimony ochre, both oxides of antimony; and kermesite, red antimony, or antimony blende, an oxysulphide of the metal. Various sulphantimonites of other metals are also met with, but they possess only a mineralogical interest. The antimony of commerce is derived almost entirely from the sulphide, stibnite, or grey antimony ore (Sb_2S_3), which is found in great abundance in Borneo, in Nevada, and at Prince William antimony mine, New Brunswick. It is also mined at Schemnitz and Kremnitz in Hungary, at Przibram in Bohemia, at Wolfsberg in the Harz, and at Braunsdorf, near Freiberg, Bavaria. Formerly it was largely produced in Cornwall, but it is no longer worked on a commercial scale in Great Britain. Stibnite occurs generally in veins, and has a leaden grey colour, with a metallic, sometimes iridescent lustre; it fuses with great facility, and produces a grey streak. It is the *στίμμι* or stibium of the ancients, who applied to it the epithet *πλατυόφθαλμον*, from its having been used by women in Eastern countries to give increased lustre to their eyes, by darkening the eye-lashes, a practice still pursued in some parts. The *paint* said in the Holy Scriptures to have been used by Jezebel, seems to have been this substance; for St Jerome, who knew the manners of Eastern women, has, in the Vulgate, rendered the passage "*oculos ejus posuit stibio.*" Stibnite was the *lupus metallorum* of the alchemists, and Basil Valentin was able to show that it contained sulphur. That famous alchemist was acquainted with metallic antimony, and by him and his successors it was known as *regulus*, or regulus of antimony, from the readiness with which it acted on the royal metal gold. The tradition that the name antimony was given to the sulphide on account of a preparation of it having proved fatal to the monks (hence *anti-monachos*) in a German religious house will hardly bear investigation. Crude antimony of commerce is the ore separated from its associated earthy gangue—an operation effected by simple fusion. The sulphide is then reduced to an oxide by roasting in a reverberatory furnace. From this oxide metallic antimony is obtained by fusion with charcoal, which has been saturated with a solution of carbonate of sodium. The metal may also be prepared direct from the sulphur ore by roasting with a mixture of cream of tartar and nitre, or with iron filings. Antimony is a brilliant silver-grey metal, having a foliated texture and a strong tendency to assume a crystalline structure, which causes the cakes of metal to present a characteristic stellate surface. Its specific gravity is 6·715; it melts at 842° Fahr., and when heated to redness takes fire, burning with a brilliant white flame. It is brittle, and can be easily pulverised. Antimony is chiefly valuable for the alloys it yields with other metals. Britannia metal is an alloy largely used, containing usually about 81 parts of tin, 16 of antimony, 2 of copper, and 1 of zinc. Type metal contains varying proportions of lead and antimony, ranging from 17 to 20 per cent. of the latter, or even more, according to the hardness desired; with sometimes small proportions of other metals for stereotype plates, &c. Babbitt's anti-friction metal for the bearings of machinery is composed of 83·3 parts of tin, 8·3 parts of copper, and 8·3 of antimony. Antimony alloys with lead and tin, separately or in combination, are also used in place of gun metal for the bushes of heavy machinery. Antimonial preparations are of great value in pharmacy, and for such purposes it is essential that they should be absolutely free from the arsenical and other impurities which commercial antimony and its ores always contain. The principal preparation used medicinally is tartarated antimony, or tartar emetic, a tartrate of potash and antimony. Taken in small doses, from $\frac{1}{16}$th to $\frac{1}{6}$th of a grain, tartar emetic acts as diaphoretic, renders mucous surfaces moist, and promotes secretion of urine. In larger doses it excites nausea, and, as its name indicates, vomiting. It is also prepared in the form of an ointment for external application as a counter-irritant, producing a painful pustular eruption. Antimonial wine is a preparation of tartar emetic, used as a diaphoretic and expectorant. Butter of antimony, or the liquor of chloride of antimony, is used as a powerful caustic, and antimonial powder, or James's powder, is employed as a diaphoretic in fevers and rheumatism. Other officinal preparations containing antimony are—oxide of antimony; black antimony, or the native sulphide, prepared; sulphurated antimony; and compound calomel pills. Crude antimony sulphide is used in the manufacture of black lead pencils. For the action of antimony as a poison, see POISONS.

ANTINOMIANS (ἀντί, against, and νόμος, law), a term first employed by Luther as a designation of the followers of John Agricola, who maintained that the moral law was not binding, as such, upon Christians (see AGRICOLA, JOHANNES). In this, as in many other cases, however, the thing existed long before the name. From the 1st century of the Christian era downwards, there have been those who, on one ground or other, denied that the law was of use or obligation under the gospel dispensation, and the term Antinomian is, accordingly, applied with sufficient propriety to many who lived at an earlier date than the sect or school to describe whom Luther invented it. It would seem, from several passages in the New Testament (Rom. iii. 8, 31, vi. 1; Eph. v. 6; 2 Pet. ii. 18, 19), in which the apostles warn their followers against perversions of their doctrine as an excuse for licentiousness, that Antinomianism, in its grosser form, found a place even in the primitive church. It is to be noticed that this first manifestation of the heresy seems to have been due to the same cause as that which operated in the case of Agricola,—a mistaken interpretation of the doctrine of justification by faith. The Gnostic sects, several of whom are classed as Antinomian, seem to have proceeded on the principle, that being spiritual their nature could not be corrupted whatever their moral conduct might be. Gnostic Antinomianism seems, therefore, to have been in this respect analogous to that of the High Calvinists, some of whom went so far as to maintain that an elect person did not sin even when he committed actions in themselves wicked. Such were the Antinomians in England during the Protectorate. A doctrine so extreme, and sanctioning so unmistakably an immoral life, is to be carefully distinguished from the Antinomianism combated by Luther, which was a matter of theory not necessarily affecting conduct. It is not easy to apprehend or to state with clearness the precise views of Agricola as to the relation between the Christian and the moral law. His own statements were more than once modified or retracted in the course of discussion, and there can be no doubt that Luther made him responsible for opinions which he did not hold. The exaggeration characteristic of all controversies seems to have prevailed in this case to an unusual extent on both sides, and neither disputant should always be taken literally at his word, whether he speaks for himself or for his opponent. It was probably a desire to establish Luther's negation of the Roman Catholic doctrine of good works on some firm ground of principle, that first led Agricola to insist as he did on the essential incompatibility between the law and the gospel. The law of Moses, he taught, was for the Jews alone, and was not a rule of life to Christians, who might with safety altogether neglect it. On the other hand, he never denied that the Christian was under a moral government with an adequate sanction, which laid him under obligation to lead a holy life. What he maintained was that the New Testament furnished all that was necessary for impulse and guidance in the path of Christian duty, not in the form of positive precepts so much as of principles and motives. Thus explained, the difference between the orthodox and Agricola's party reduces itself within a comparatively narrow compass, though, after the fullest explanation, it remains a real difference and a standing subject of controversy.

ANTINOMY is the word employed by Kant, in the Critical Philosophy, to mark the inevitable conflict or contradiction into which, according to his view, speculative reason falls with itself, when it seeks to conceive the complex of external phenomena, or nature, as a world or cosmos. Literally the word means a conflict or opposition of laws (*Widerstreit der Gesetze*). It is used by Kant both in a generic and in a specific sense; the fate that lies upon the speculative endeavour of human reason taking the form of four special contradictions. For the generic sense Kant also has the word Antithetic, each antinomy being set forth in the shape of thesis and antithesis, with corresponding demonstrations, the perfect validity of which, in all cases, he most positively guarantees. The conflicting propositions, or the cosmological ideas involved in them, are intimately, though somewhat obscurely, related to the four heads of categories of the understanding in the Kantian system, but this is not the place to enter into such details. Expressed in the shortest form, the theses run thus:—The world (1) is limited in space and time, (2) consists of parts that are simple, (3) includes causality through freedom, (4) implies the existence of an absolutely necessary being. To these answer the antitheses:—The world (1) is without limits in space or time, (2) consists of parts always composite, (3) includes no causality but that of natural law, (4) implies the existence of no absolutely necessary being. The theses were taken by Kant from the speculative cosmology of the Wolffian school; the antitheses are the not less dogmatic assertions made or suggested by empirical thinkers. Since, according to Kant, equally valid arguments can be adduced on each side, while, as mutually contradictory in their dogmatic sense, the two sets of propositions cannot both be true, it is plain that reason must have gone beyond its powers in seeking for a speculative knowledge of that which can be given in no experience. But the function of a true philosophy does not stop short with the detection of this internal strife of speculative reason; the strife must be composed, and Kant holds that none but his own critical doctrine is equal to the task. The first two antinomies he overcomes by showing that theses and antitheses, when critically understood of mere phenomena, are both alike false; the others, by showing that the opposed members, when understood, again critically, of noümena and phenomena respectively, may both be true. This amounts to saying, that in neither of the two sets of cases (though in different ways) is the contradiction real, however really it has been intended by the opposing partizans, or must appear to the mind without critical enlightenment. It is wrong, therefore, to impute to Kant, as is often done, the view that human reason is, on ultimate subjects, at war with itself, in the sense of being impelled by equally strong arguments towards alternatives contradictory of each other. Hamilton's Law of the Conditioned—that all positive knowledge lies between two extremes, neither of which we can conceive as possible, but yet, as mutual contradictories, the one or other of which we must recognise as necessary—while suggested by the Kantian doctrine of the Antinomy of Pure Reason, is distinctly at variance with it. In the realm of phenomenal experience, actual or possible, when it is properly conceived, Kant allows of no conflict; and, though he denies that we can have speculative knowledge of a realm transcending experience, he is satisfied of this at least, that knowledge of the one realm may go forward without prejudice to moral conviction of another. (G. C. R.)

ANTINOUS, a beautiful youth, who was page to the emperor Hadrian, and greatly beloved by him. After his mysterious death by drowning in the Nile (130 A.D.) Hadrian—for whose sake, according to one account, he had offered himself a voluntary victim to destiny—caused the most extravagant respect to be paid to his memory by ceremony and monument. Not only were cities called after him, medals struck with his effigy, and statues erected to him in all parts of the empire, but he was raised to the rank of the gods, temples were built for his worship, festivals celebrated in his honour, and oracles delivered in his name. The cities that showed most zeal for the new divinity were Bithynium (Antinoopolis) his birth-place, Besa (Antinoopolis) in Egypt, Mantinea in Arcadia, and Athens. It was in Athens that his greatest festivals were held—the Αντινόεια ἐν ἄστει (in the city) and the Αντινόεια ἐν Ἐλευσῖνι (at Eleusis). A remarkable impulse was given to the art of sculpture by the endeavour to produce an idealised representation of the deified page. We still possess a colossal bust in the Vatican, a bust in the Louvre, a bas-relief from the Villa Albani, a statue in the Capitol, another in Berlin, another in the Lateran, and many more. The medals with his head are equally numerous. (Levezow, *Ueber den Antinous*; O. Müller, *Handbuch der Archäologie*; Müller-Wieseler, *Denkmäler der alten Kunst*.)

ANTIOCH (Ἀντιόχεια), a city in Syria, long. 36° 10′ E., lat. 36° 11′ N., described as "Epidaphnes" (ἡ ἐπὶ Δαφνῃς, or ἐπὶ Δάφνῃ), or as "on the Orontes," to distinguish it from the fifteen other Greek towns which, like itself, owed their foundation to Seleucus Nicator, and their names to his father Antiochus. While the wide-spread notoriety of Daphne, with its beautiful grove, compared to the vale of Tempe, and with its extraordinary excesses of pleasure, rendered it available as a local designation for Antioch, the river Orontes also seems to have served the same purpose with more than usual interest, owing, perhaps, to its fabulous history. Originally it had been called Typhon, from the snake-legged giant of that name (Strabo, p. 750), who here struck by the thunderbolt of Jupiter, and seeking escape under the earth, formed the bed of the river by his trail, and its source by his descent. Orontes, it was said, was the name of a man who had built a bridge over the river, and when in Roman times the course of the stream was partly changed, a tomb (*soros*) was found in the old bed containing the bones of a man of colossal size,



which the oracle declared to be those of Orontes (Pausanias, viii. 29, 3). On the coins of Antioch struck by Tigranes, and frequently on those of later times, the city is personified as a female figure seated on a high rock or hill, from under which issues the Orontes in the form of a youth in the attitude of swimming. The same representation occurs in a marble statue in the Vatican, and in a silver statuette in the British Museum; and in each case there can be little doubt that the original model was the celebrated statue of Antioch by Eutychides, a pupil of Lysippus.

On the dismemberment of the Eastern empire founded by Alexander the Great, it fell to Seleucus to make himself master of that portion of it included in Syria. It was an age remarkable for the building of new towns more or less on the plan of Alexandria, and accordingly Seleucus, instead of establishing himself at Antigonia, the newly-built capital of his defeated rival, chose a site a little further down the Orontes, about 20 miles from its mouth, for the capital of his new kingdom, the task of laying out and building it being entrusted to the architect Xenæus. On Mount Silpius was placed the citadel, and on the slope towards the river the town. Seleucus destroyed Antigonia, transferred its inhabitants to Antioch, and perhaps, as has been said, utilised its building material. In addition to this new population there were the old inhabitants of the village of Iopolis or Ione, which had before occupied the citadel, and which traced its origin to Ione, an Argive fugitive from Egypt, in search of whom Triptolemus had been sent from Eleusis. Though this legend appears to have originated simply from the name Ione, the people of Antioch yet boasted of a common descent with the inhabitants of Attica, struck coins with the head of Pallas and an owl, precisely like coins of Athens, and maintained the traditions of Triptolemus as of a sort of ancestral hero. Besides Iopolis, the villages of Meroe, afterwards a suburb, and Bottia, on the banks of the Orontes, where Alexander dedicated a temple to Jupiter Bottiæus, claimed to have furnished the original inhabitants of Antioch. But the town founded by Seleucus, 300 B.C., soon became insufficient for the influx of population, and a new district had to be enclosed, the original walls being allowed to remain. For the same purpose a third addition was made in the time of Seleucus Callinicus (246–226 B.C.), and a fourth under Antiochus Epiphanes (175–164 B.C.), to whom the city owed also many new buildings of great splendour. From its four parts, each separately walled, Antioch was now called a *tetrapolis*, and in point of situation, architectural magnificence, and resources of enjoyment, ranked after Rome and Alexandria as the next city of its time. The chief retreat of pleasure was the cypress grove of Daphne, at a distance of between 4 and 5 miles, but connected with the city by a suburb called Heraclea, the road passing among beautiful villas, gardens with fountains, hot springs, medicinal wells, brooks, and, in short, if we may trust the ancient writers who speak from personal observation, every combination of salubrity and beauty. Seleucus Nicator had laid out the grove of Daphne, and erected in it a temple of Apollo and Diana, to which deities an annual festival was held in August, attended by all the people of the neighbourhood. Round the temple was an enclosure or asylum within which refugees were safe. In the temple of Apollo was a colossal statue of that god, the work, it was said, of the sculptor Bryaxis, of which, apparently, there is a copy on the coins of Antiochus Epiphanes. While the emperor Julian was at Antioch preparing for the Parthian war, this temple was burned, but whether the fire was due to the antipathy of the Christians, or to accident, was never ascertained. The city itself, abounding in fine buildings, seems to have been for nothing so remarkable in this direction as for its streets and porticoes, which were styled "golden," with reference to the splendour of the columns, and perhaps, more literally, to the application of gold as a means of ornamentation. The principal street traversed the entire length of the city from east to west, a distance of about 4 miles, having four parallel rows of columns, forming a broad road in the middle open to the sky, and at each side a narrower covered way or portico. The road in the middle was laid with granite in the time of Antoninus Pius. From this main street others branched off at intervals up to the higher part of the town on the one hand, and down towards the river on the other. Where such junctures occurred, the porticoes of the main street were carried over in the form of arches. Among the buildings of which particular mention is made, are—(1), a temple to Jupiter Capitolinus, in imitation of the temple to the same deity in Rome, situated probably on Mount Silpius; (2), the theatre, begun by the Seleucidæ kings, enlarged by Agrippa and Tiberius, and finished by Trajan; and (3), the great Christian church begun by Constantine and completed by Constantius, which stood until 526 A.D., when it was destroyed by an earthquake and fire. Its dome-shaped roof is said to have been of immense height, while many parts of the building glistened with precious stones and ornaments of gold. The altar within it faced the west. From the description it is thought to have resembled St Vitalis at Ravenna. The necropolis appears to have been situated on Mount Casius, above Antioch, where are still sepulchres cut in the rock, afterwards used as cells by anchorites, among them Zeno, who died about 420 A.D. With a plentiful supply of water for private purposes from the wells and fountains in the city, it was yet necessary to maintain the public baths, which in Roman times became numerous, by aqueducts conveying water for some distance. The ruins of one of these aqueducts still remain, admired for the solidity of the masonry and the colossal scale of the structure (see AQUEDUCT). But with all its charms Antioch was beset by a danger which, often threatening, several times succeeded in laying its fairest aspect waste. The first recorded earthquake occurred 148 B.C., but the myths of the giants Pagres and Typhon there struck by the thunderbolts of Jupiter seem to refer to similar commotions at a remoter period. A second earthquake, 37 A.D., in the reign of Caius Cæsar, caused so much damage that the emperor sent two senators to look to the affairs of the city. A third followed in the time of Claudius. One effect of these disturbances was to increase the tendency to superstition, of which there was an instance in the magician Dabbonius, who placed a bust on a purple column in the centre of the city, and inscribed it ἀσειστα ἄπτωτα, but in vain, for the next earthquake cast it down. Much more severe was the earthquake 115 A.D., while the city was full of the Roman army which Trajan was to lead against the Parthians. The rivers changed their courses, Mount Casius shook, and it was only by taking shelter for several days in the circus that Trajan himself escaped danger from the falling buildings. The city being restored partly by the aid of Trajan and Hadrian, was spared any serious calamity of this kind till 526 A.D. when it was entirely destroyed, the loss of life, all the greater because of an assembly of Christians then met, being reckoned at 250,000 persons. There had before been two shocks, 341 and 457–8 A.D., the latter attended with considerable loss. Again, on Nov. 29, 528 A.D., occurred another earthquake, through which 5000 lives were lost. There appears to have been a violent shock, 587 A.D., followed on the last day of October 588 by another, attended with a terrible destruction of life. But the people of Antioch were not without troubles of their own making, as when, by their disaffection towards the king Demetrius, they caused him to seek the aid of a body of Jews, with whom he fell upon his subjects, slaying a vast number, and setting fire to the city. In 83 B.C. Tigranes, either by invitation or by force, took Antioch, but was compelled to leave it by Lucullus, who placed on the throne Antiochus Philopator. Syria became a Roman province in the time of Pompey, who (64 A.D.) enlarged the temple at Daphne, and conceded to Antioch autonomy. In 47 A.D. Cæsar visited Antioch on his expedition from Alexandria against Pharnaces, and was regarded as a benefactor, and styled dictator, because he allowed the town to retain its freedom, and added several public works of importance. Augustus was no less favourably inclined to the famous Eastern city, which on the news of the defeat of Antony at Actium, hastened to espouse the cause of the emperor, and even instituted an era from the day of that battle, which, however, was not long retained. The usual era from which reckonings were made in Antioch, and over a great part of the East, down to the 10th century, was 312 B.C., in which year Seleucus took Babylon. It was known as the era of the Seleucidæ. Successive emperors showed their favour for the city by visits or the erection of public works. Germanicus died at Antioch 19 A.D.; his body was burned in the forum, and a monument erected over his ashes. Titus, it is said by Malala, placed the cherubim which he removed from Jerusalem on one of the gates of Antioch, and there seems to be confirmation of this statement in the fact, that one of the gates continued long to be named after these figures. Hadrian built an aqueduct for the town with a reservoir (*castellum*) at Daphne, in the form of a temple to the nymphs and naiads. Under Commodus a new splendour was given to Antioch by the celebration of the Olympic games at Daphne. Buildings were erected for the practice of athletic feats generally, and in particular for the use of those who competed in the games. In 266 A.D. the Persians invaded Antioch, appearing suddenly on the hills while the people were assembled in the theatre, where many were slain by the enemy's arrows before escape was possible. The Christian church, partly built by Constantine, and finished by his son, has already been mentioned, and from its great size it may be assumed that the Christian population of Antioch was already considerable. In the time of Theodosius the entire population is given by Chrysostom at 200,000, of which number about the half were orthodox Christians,—a name which was here first applied to the disciples of Christ (Acts xi. 26). From 252 to 380 A.D. ten assemblies of the church were held at Antioch. It had been the residence of the apostle Peter, as it was afterwards that of the Patriarch of Asia. But in the history of Christianity at Antioch no period is so memorable as the reign of the emperor Julian, whose measures directed against the new religion—such as closing the church and allowing the temple of the Jews to be restored—brought upon himself an amount of odium which was far from being counterbalanced by success in his efforts to revive the old rites of Apollo and Jupiter. Valens, though not orthodox, was yet liberal in the erection of new buildings in Antioch,—among them a forum surrounded by four basilicas, and with a high column in the centre surmounted by a statue of Valentinianus. This he did after having made peace with the Persians, Nov. 10, 371 A.D. The reign of Theodosius the Great was signalised by a fierce sedition in Antioch, caused by a tax which he had imposed in 387 or 388 A.D., a year of famine. The statues of the emperor and the imperial family were thrown down, and a tumult raised which was suppressed with difficulty. Many of the offenders were punished with great severity, while the town itself was deprived of its privileges as a metropolis. In the time of Leon a temple was erected in Antioch to Simeon Stylites, whose body was conveyed to the city from the hill, between 30 and 40 miles to the east, where, on the top of a column 40 or 60 feet high, he had lived in self-imposed martyrdom for thirty years. Under Zeno great efforts were made to restore the city to its original splendour before the earthquakes of 526 and 528 A.D. Its name was now changed to Theopolis, but the change was of short duration, as were also the new buildings; for in 538 A.D. Chosroes, the king of Persia, took the town, and, after removing all the plunder, even that of the church, gave it over to his soldiers, by whom the greater part of it was set on fire. It was again partly revived by Justinian, but from this time gradually sank from its high position of queen of the East. Under Heraclius (635 A.D.) it fell into the hands of the Saracens, who held it till 969 A.D., when it was restored to the Roman dominion by Michael Burza and Peter the Eunuch, and so retained till 1084 A.D., when it fell into the power of the Turks, from whom again it was captured by the Crusaders, 1098 A.D. In 1268 A.D. it was taken by the sultan of Egypt, and never revived from the destruction which it then suffered. Of the ancient city little now remains except a great aqueduct bridge and part of the massive walls, which are still to be seen scaling step by step the precipitous hills. At one place the wall is carried over a deep ravine with an arch about 60 feet high. Across the Orontes is a bridge of nine arches, with two towers having gates plated with iron, whence the bridge is known as the iron bridge. Neither the harbour nor the ancient walls which divided the four parts of the city can now be traced. As in the case of many other Greek cities in Asia, once famous for their beauty, the site of Antioch is now studded with squalid hovels of mud and straw. The people live by the produce of the mulberry trees and by growing tobacco, which is of a fine quality. It is still called (Antioch) Antakie, and is sometimes, as in 1822, reminded of its ancient calamities arising from earthquakes. In 1835 it contained 5600 inhabitants, with 6000 Egyptian soldiers under Ibrahim Pasha, who had then his headquarters there. (C. O. Müller, *Antiquitates Antiochenæ*, Göttingen, 1839, from which the plan of Antioch has been here adapted; Bishop Pococke, *Description of the East*, Lond. 1743–5; Taylor, *La Syrie, la Palestine, et la Judée*, Paris, 1855; and *Voyage Pittoresque de Syrie.*) The ancient writers, from whom most of our information concerning Antioch is derived, are—(1) Malala (Johannes), Antiochenus, *Historia Chronica*, Oxon., 1691; (2) Libanius, the Sophist, who had a school in Antioch in the time of the emperor Julian; and, (3) Chrysostom (John), patriarch of Constantinople. (A. S. M.)

ANTIOCH IN PISIDIA, another of the many cities founded by Seleucus Nicator, was situated on the south side of the range of mountains between Phrygia and Pisidia Its remains, which were identified by Arundel in 1833, are close to the modern Yalobatch, in lat. 38° 18′ N., and long. 31° 23′ E., and include the ruins of several temples, a theatre, and a magnificent aqueduct. It was against the Jewish inhabitants of this Antioch that Paul and Barnabas "shook off the dust of their feet" (Acts xiii. 51).

ANTIOCHUS I. (SOTER, the Deliverer) succeeded his father Seleucus Nicator, the founder of the Syrian kingdom, in 280 B.C. He maintained for a time his father's Macedonian policy, but at length came to terms with Antigonus Gonatas. Successful at first against the Gauls, who had invaded Asia Minor, he was finally slain by them in battle (261 B.C.)

ANTIOCHUS II. (THEOS, the God), the son and successor of Antiochus I. Under him Syria was troubled with a long Egyptian war, and lost Parthia and Bactria, which became independent. He was forced by Ptolemy of Egypt to put away his wife and marry an Egyptian princess, Berenice; but on Ptolemy's death Berenice was discarded, and Laodice restored. The latter, however, out of revenge or mistrust, procured the death of her husband, her rival, and their son, 246 B.C.

ANTIOCHUS III., surnamed the Great, was the son of Seleucus Callinicus, and ascended the Syrian throne at the age of fifteen, on the death of his brother, Seleucus Ceraunus. His reign embraced a series of wars against revolted provinces and neighbouring kingdoms, in the prosecution of which his disasters and successes were equally great. His march to India; his agreement with Philip of Macedonia for the partition of Egypt; his conquest of Palestine and Cœle-Syria; his occupation of Asia Minor and the Thracian Chersonese; his collision with the Romans; his expedition into Greece, with the defeat at Thermopylæ by Acilius Glabrio, and at Mount Sipylus (in Asia Minor) by Scipio; and his dearly purchased peace in 188 B.C., are the chief events of his life. He was killed in an attempt to plunder a temple at Elymais, 187 B.C., and was succeeded by his son Seleucus Philopator.

ANTIOCHUS IV. (EPIPHANES, the Illustrious, and by parody, EPIMANES, the Insane), who had been a hostage in Rome from 187 B.C., ascended the Syrian throne on the death of Seleucus, 175 B.C., and soon made himself famous by his conquest of Cœle-Syria, Palestine, and Egypt itself, with the exception of Alexandria, which would likely have also been his if the Romans had not interfered and forbidden him the country. During his Egyptian campaigns he twice took Jerusalem (170 and 168 B.C.); but he appears to have seen that he could never hope to subdue Judæa until he had rooted out the peculiar Jewish religion. He accordingly promulgated a decree, enjoining uniformity of worship throughout his dominions; and, on the refusal of the Jews to obey it, he went in person to Jerusalem and endeavoured to force on them the worship of the Greek deities. This persecuting policy stirred up the successful resistance of the Maccabees; and it was while hastening to quell this revolt that he fell ill of a loathsome disease, and died, raving mad, at Tabæ, in Persia, 164 B.C. His death was thought by the Jews to be an appropriate punishment for his persecution of them.

ANTIOCHUS VIII., king of Syria, was the second son of Demetrius Nicator. During his reign (125–96 B.C.) those discords and wars began between the princes of the royal house of Syria, which form almost its sole history, till the kingdom was reduced to a Roman colony in 65 B.C.

ANTIOCHUS, OF ASCALON, a philosopher of the 1st century before Christ, who, coming under the influence of Philo the Academic and of Mnesarchus the Stoic, was led to attempt a reconciliation between their antagonistic doctrines, and thus gave rise to what has been called the Fifth Academy In regard to the great question of the degree of certainty attainable by man, he held, in opposition to the scepticism of Philo, that the human intellect has in itself a sufficient test of truth; and in regard to the question wherein happiness consists, he maintained that, while virtue was the greatest essential, the circumstances of life were not a matter of indifference. Of his writings none have been preserved to us; and for the greater part of our information we are indebted to Cicero, who had studied under him at Athens, and continued to keep up a friendly intercourse with him afterwards. He visited Alexandria and Rome, and lectured on philosophy in both cities.

ANTIOPE (1), in Greek legend, the mother of Amphion and Zethus, was, according to the *Odyssey* (xi. 260), a daughter of the river god Asopus. In later poems, as in the *Cypria*, she is described as the daughter of Lycurgus, who appears as a king of Thebes. Her beauty attracted Jupiter, who, assuming the form of a satyr, took her by force. After this she was carried off by Epopeus, king of Sicyon, who would not yield his possession of her till compelled by her uncle Lycus. On the way home she gave birth, in the neighbourhood of Eleutheræ, to the twins Amphion and Zethus, of whom the former, some supposed, was the son of the god, the other the son of Epopeus. Both were left to be brought up by herdsmen. At Thebes Antiope now suffered from the persecution of Dirce, the wife of Lycus, but at last escaped towards Eleutheræ, and there found shelter, unknowingly, in the house where her two sons were living as herdsmen. Here she was discovered by Dirce, who ordered the two young men to tie her to the horns of a wild bull. They were about to obey, when the old herdsman, who had brought them up, revealed his secret, and they now carried out the punishment on Dirce instead. For this, it is said, Bacchus, to whose worship Dirce had been devoted, visited Antiope with madness, which caused her to wander restlessly all over Greece till she was cured, and thereafter married by Phocus of Tithorea, on Mount Parnassus, where at last both were buried. Their tomb is mentioned by Pausanias, ix. 17, 4, x. 32, 7.

ANTIOPE (2), an Amazon who bore to Theseus a son, Hippolytus. As to how Theseus became possessed of her there are various reports. Either she gave herself up to him out of love, when with Hercules he captured Themiscyra, the seat of the Amazons, or she fell to his lot then as a captive. Or again, Theseus himself invaded the dominion of the Amazons and carried her off, the consequence of which was a counter-invasion of Attica by the Amazons. After four months of war peace was made, and Antiope left with Theseus as a peace-offering. In another account she had joined the Amazons against him because he had been untrue to her in desiring to marry Phædra. Antiope is said to have been killed by another Amazon, Molpadia, a rival in her affection for Theseus. Elsewhere it was believed that he had himself killed her, and fulfilled an oracle to that effect.

ANTIPAROS, the ancient *Oliaros*, an island of the kingdom of Greece, one of the Cyclades, in the modern eparchy of Naxos, situated on the west of Paros, from which it is separated by a strait about a mile and a half wide at the narrowest point. It is 7 miles long by 3 broad, and contains about 500 inhabitants, most of whom are collected in Kastro, a village on the north coast; their chief employments are agriculture and fishing. The only remarkable feature in the island is a stalactite cavern, which is situated near the south coast, and is reached by a narrow passage, that is broken by several steep and somewhat dangerous descents. The grotto itself, which is supposed to be about 80 feet high, and more than 300 in length and breadth, presents a scene of the most dazzling brilliance and splendour. M. de Nointel discovered it in 1673, but there is reason to believe that it had been known to the ancients.

ANTIPAS, Herod. See Herod Antipas.

ANTIPATER, regent of Macedonia during Alexander's Eastern expedition, 334 B.C. He gained this distinguished position by his faithful attachment and his prudence. In 330 he had to subdue the rebellious tribes of Thrace; but even before this insurrection was quelled, the Spartan king Agis had risen against Macedonia. Having settled affairs in Thrace as well as he could, Antipater hastened to the south, and in a battle near Megalopolis, gained a complete victory over the insurgents. His regency was greatly molested by the arrogance and ambition of Olympias, the mother of Alexander. The repeated complaints which both parties sent to Alexander induced the latter to invite Antipater to Asia, and to appoint Craterus regent in his instead. But before this could be effected, Alexander died at Babylon. In the first partition of the empire among the Macedonian generals, Antipater and Craterus had allotted to them the administration of the dominions in Europe with the exception of Thrace, which was given to Lysimachus. The death of Alexander tempted the Greeks to assert their independence, but the prudence and valour of Antipater crushed all attempts in the Lamian war, and established the Macedonian rule in Greece on a firm footing. At the same time Craterus was engaged in a war against the Ætolians, when news arrived from Asia which induced Antipater to conclude peace with them; for Antigonus reported that Perdiccas contemplated making himself sole master of the empire. Antipater and Craterus accordingly prepared for war against Perdiccas, and allied themselves with Ptolemy the governor of Egypt. Antipater crossed over into Asia in 321; and while still in Syria, he received information that Perdiccas had been murdered by his own soldiers. Antipater now, as sole regent, made several new regulations, and having commissioned Antigonus to continue the war against Eumenes and the other partisans of Perdiccas, returned to Macedonia, where he arrived in 320. Soon after he was seized by an illness which terminated his active career 319 B.C. Passing over his son Cassander, he appointed Polysperchon regent, a measure which gave rise to much confusion and ill feeling.

ANTIPHILUS, a painter of the 4th century before Christ, who was placed by the ancient critics in the highest rank after Apelles and Protogenes. He was born in Egypt, taught by Ctesidemus, and patronised by Philip of Macedon, and Ptolemy, son of Lagus. Jealousy is said to have led him to bring a false accusation against Apelles, which resulted, according to the story, in his being handed over to his rival as a slave. In style the two artists were strongly opposed; Antiphilus being remarkable for a certain quickness of conception, facility of execution, and lightness of treatment.

ANTIPHON, the most ancient of the ten Athenian orators contained in the Alexandrine canon. He was born 480 B.C. at Rhamnus. During the Peloponnesian war he was several times entrusted with the command of detachments of the Athenian forces, and took an active part in the political affairs of Athens. He had a hand in the overthrow of the democracy, and the establishment of the oligarchy of the Four Hundred, 411 B.C.; but as the new government was soon after changed, Antiphon was accused of high treason, and put to death. He must be regarded as the founder of political oratory at Athens, for he was the first that reduced the art of the orator to definite rules and principles. He wrote speeches for others, but never addressed the people himself except at his own trial. Seventeen orations bearing his name are extant, but two or three of them may be spurious. They are printed in the various collections of the Greek Orators. From this Antiphon the orator we must distinguish two others: the one a philosopher, mentioned by Xenophon (*Memor.*, i. 6), who is said to have written about dreams; and the other, a tragic poet, who lived at the court of the elder Dionysius.

ANTIPHONY (ἀντί, and φωνή, a voice), a species of psalmody in which the choir or congregation, being divided into two parts, sing alternately. The peculiar structure of the Hebrew psalms renders it probable that the antiphonal method originated in the service of the ancient Jewish Church. According to the historian Socrates, its introduction into Christian worship was due to Ignatius (died, 115 A.D.), who in a vision had seen the angels singing in alternate choirs. In the Latin Church it was not practised until more than two centuries later, when it was introduced by Ambrose, bishop of Milan, who compiled an *antiphonary*, or collection of words suitable for antiphonal singing. The antiphonary still in use in the Roman Catholic Church was compiled by Gregory the Great (590 A.D.)

ANTIPODES, a word of Greek derivation (ἀντί, against, opposed to, πόδες, feet),—from the inhabitants walking feet to feet,—is a relative term applied to any two peoples or places on opposite sides of the earth, so situated that a line drawn from the one to the other passes through the centre of the globe and forms a true diameter. Thus, the North Pole is exactly antipodal to the South. Any two places having this relation—as London and, approximately, Antipodes Island, near New Zealand—must be distant from each other by 180° degrees of longitude, and the one must be as many degrees to the north of the equator as the other is to the south. Noon at the one place is midnight at the other, the longest day corresponds to the shortest, and mid-winter is contemporaneous with mid-summer. In the calculation of days and nights, midnight on the one side may be regarded as corresponding to the noon either of the *previous* or of the *following* day. If a voyager sail eastward, and thus anticipate the sun, his dating will be twelve hours in advance, while the reckoning of another who has been sailing westward will be as much in arrear. There will thus be a difference of twenty-four hours between the two. In this way the Portuguese in Macao are a day before their Spanish neighbours in the Philippine Islands.

ANTIQUE, denoting etymologically anything that is ancient, is conventionally restricted to the remains of Greek and Roman art, such as sculptures, gems, medals, seals, &c. In this limited sense it does not include the artistic remains of other ancient nations, or any product of classical art of a later date than the fall of the Western Empire.

ANTIQUITIES. In keeping with its derivation, the word "antiquities" had for long a wide and general acceptation, embracing everything belonging to the knowledge of the remoter past. The range of the term has been gradually lessened, and a distinction has grown up between history on the one hand and antiquities on the other, though the line of demarcation is not of the most definite kind. Dr Arnold made the distinction between the historian and the antiquary to consist in this, that the historian studied the past for the sake of its bearing on the present, while the antiquary was content to investigate it for its own sake alone. It might rather be said, however, that the historian is concerned with the activities of the past, the antiquary with the products—the one with the progress and variation of the creative processes, the other with the perceptible and permanent results. In the vast range of subjects with which both classes of inquirers have to do,—religious rites, social customs, legal forms, architectural remains, sculptures, paintings, and so on,—it is plain that the more decidedly anything takes outward form the more undoubtedly it is the property of the antiquary rather than of the historian; and thence it has happened that the antiquary is not unfrequently thought of as having little concern with anything beyond purely material relics.

With respect to its treatment of the past three periods in a nation's history may be roughly distinguished—the period of emotional interest, the period of neglect, and the period of scientific attention. To the last of these the true antiquarian spirit belongs. Of the prevalence of this spirit in the classical ages of Greece and Rome we have but little evidence, though a considerable interest in archæological subjects was manifested by the greater historical intellects, such as Thucydides, Polybius, or Livy. But in the Alexandrian school there was a great, though somewhat irregular, development of antiquarianism, which acquired more of a scientific character from its being rather cosmopolitan than national.

At the revival of learning, when such enthusiasm was felt for everything classical, the relics of Greece and Rome were carefully collected and preserved; but it was some time before a transition took place from classical to national antiquarianism; and hence it is that the earliest literature of archæology is almost solely confined to the classical area. Manutius the younger (1511–1574), Sigonius (1520–1584), Meursius (1579–1639), Gruter (1560–1627), Gronovius (1645-1716), Graevius (1632–1703), Pitiscus (1637–1727), &c., kept up the line of laborious scholarship which laid the massive foundations of our present archæological erudition. The discoveries at Herculaneum (1713) and Pompeii (1755) gave a great impulse to such studies in general, besides supplying a special field of inquiry for such men as Venuti, Jorio, Bayardi, Rossini, and Ciampitto, Mazois, Gau, Gell, Barré, Fiorelli, Overbeck, Dyer, Monier, Garrucci, &c. The names of Heeren, Muller, Niebuhr, Creuzer, Boeckh, Hartung, and Zumpt are well known to all who are familiar with the subject of classical antiquities; and to these may be added Curtius, Waddington, Braun, Lasaulx, Le Bas, Roulez, Rangabé, Schömann, Canina, Panofka, Becker, Marquardt, and Lange. The results of their labours have been collected in such books as Pauly's *Encyclopädie der classischen Alterthumswissenschaft;* Smith's *Dictionary of Greek and Roman Antiquities;* and Daremberg and Saglio's *Dictionnaire des Antiquités grecques et romaines.* The capitals of Greece and Italy have naturally attracted particular attention to themselves. On Rome we have the special works of Desgodetz (1682), Piranesi (1784), Overbeck, Rossini, Reber, Dyer, Reumont, Nibby, besides the famous *Beschreibung* by Bunsen, Platner, Gerhard, Röstell, &c.; on Athens those of Leake, Forchhammer, Wordsworth, Stuart and Revett, Beulé, Laborde, &c. In connection with Etruscan antiquities, Micali, Dempster, Inglirami, Dennis, Hamilton, Heyne, Lanzi, and Raoul-Rochette are well known. The mysteries of the Egyptian monuments have found interpreters in Young, Champollion, Bunsen, Letronne, Lenoir, Leemans, Sharpe, &c.; while the marvels of Assyria have employed the energies of such men as Botta, Layard, Rawlinson, Munter, Grotefend, Rask, Burnouf, Lassen, Westergaard, Hincks, De Saulcy, Holtzmann, Haug, Spiegel. The antiquities of the northern nations of Europe have been treated by Mallet, Thorlacius, Nyerup, Werlauff, Worsaae, Thomsen, Brunius, Grupen, Heineccius, Roessig; those of France by Montfaucon, Caylus, Martin, Sauvagère, Ramé, Lajard, Renouvier, Didron, Gailhabaud, Gilbert, Beugnot, Cochet, and a multitude of others. The Russian antiquities have been magnificently represented in a great work issued by order of the Government.

In our own country the names of Leland, Camden, Hearne, Dugdale, Grose, and Roy, are not forgotten in the newer fame of Fosbrooke, Palgrave, Ellis, Wright, Stuart, Wilson, Brand, Lodge, Laing, Bateman, &c. For a knowledge of American antiquities we are largely indebted to Davies, Squier, Lapham, Haven, Rosny, Stephens; and for those of Mexico to Ranking.

In what are called ecclesiastical antiquities, besides the older works of Ugolinus, Canisius, and Bingham, we may mention Buchon, Bourassé, Martigny, Guenebault. The names of Lubbock and Tylor are especially famous in those inquiries which relate to the general condition of primeval humanity.

Associations of various kinds have naturally been formed by scholars interested in archæological pursuits for the promotion of their favourite studies, and a large number of periodical publications have been established, partly in connection with such associations, and partly as matters of commercial speculation.

As early as 1572, in our own country, a sort of society was formed by Bishop Parker, Sir Robert Cotton, William Camden, and a few kindred spirits, for the preservation of the national antiquities, and it continued to exist till 1604, when it was broken up by James I., who was afraid that it might degenerate into a political association. Papers on subjects discussed by them have been preserved in the Cottonian library, and were printed by Hearne, in 1720, as *A Collection of Curious Discourses*, and again, in 1771, by Sir Joseph Ayloffe, with considerable additions. In 1707 Humphry Wanley and a number of other gentlemen began to meet together for a similar purpose, and next year they received the co-operation of the brothers Gale, Dr Stukeley, Rymer, &c. In 1717 they were reconstituted, and in 1750 they obtained a charter from George II. as the *Society of Antiquaries of London.* In 1780 they were presented by George III. with apartments in Somerset House in the Strand. The council consists of twenty members and a president, who, during his tenure of office, is one of the trustees of the British Museum.

The *Society of Antiquaries of Scotland* was founded in 1780, and has the management of a large national Antiquarian Museum in Edinburgh. In Ireland there is a *Royal Historical and Archæological Association*, which holds its meetings at Kilkenny. The *Société des Antiquaires de France* was formed, in 1813, by the reconstruction of the *Académie Celtique*, which had been in existence since 1805 In Germany there are a large number of societies that, under the name of *Historische Vereine*, embrace the study of antiquarian subjects, and keep up a connection with each other through the *Correspondenzblatt des Gesammtvereins der deutschen Geschichts- und Alterthumsvereine*, published since 1853 at Stuttgart. There is a well-known *Société Royale des Antiquaires du Nord* at Copenhagen. Similar associations, far too numerous to mention, have been formed in all countries of European civilisation.

The word *antiquarius* first appears in the later Roman classics (Tacitus, Suetonius, Juvenal), with the signification of an affecter of old words and phrases. In the Middle Ages it was employed as the designation of one who was skilled in copying ancient manuscripts; and in modern German it has kept, in the form *Antiquar*, the cognate meaning of a dealer in old books.

ANTISEPTICS (ἀντί, against, and σηπτός, putrid, from σήπω, to make rotten), substances which have the property of preventing or arresting putrefaction in dead animal or vegetable matter. The access of air, together with a moderate amount of warmth and of moisture, are necessary to the occurrence of the putrefactive changes, which consist essentially in the breaking up of the complex organic material, and the formation of new and simpler combinations among its constituent elements. During the process various gases and vapours are evolved, and the lower forms of animal and vegetable life are observed to grow and multiply in the putrefying substance. The exciting causes of putrefaction have long formed a subject of scientific discussion, two widely-different theories being maintained respecting them. By the one, the changes which occur during the process are held to be from the first the result of chemical decomposition in the organic substance, whose atoms are in a state of motion or activity, which is capable of being communicated by catalytic action to other organic material in contact with it (Liebig); while, further, it is asserted that minute living organisms may be evolved from the dead material as the result of these chemical transformations. By the other theory, which is founded mainly upon the researches of Pasteur, the putrefactive changes are ascribed to the agency of organised germs ever present in the atmosphere, which, finding a suitable nidus in the putrescible material, grow and multiply, producing the chemical decompositions as the result of their action. Putrefaction, it is further maintained, may be entirely prevented by means which exclude the access of germs. The subject derives much interest and importance from its relation to the doctrines of the origin of life, as well as to questions concerning the sources of contagion and epidemic disease, and continues to the present time a matter of keen inquiry and experiment among physiologists. (See BIOLOGY.)

Putrefaction may be prevented by removing one or more of the conditions essential to its occurrence. Thus, by exclusion of the atmosphere, dead matter, which would speedily undergo decomposition, may be kept intact for an indefinite length of time, as shown in the method of preserving meat by hermetically sealing the jars after the expulsion of the air by heat. Again, the preservative influence of a low temperature is well known; and extreme cold is a powerful antiseptic, as proved in the case of the frozen mammoths of northern Asia. Furthermore, the abstraction of moisture will prevent corruption in dead matter. In warm and dry climates animal food may be preserved by exposure to the sun. In the ancient practice of embalming the dead, which is the earliest illustration of the systematic use of antiseptics, the moister portions of the body were removed before the preservative agents were added. (See EMBALMING.) Numerous chemical substances have the power of counteracting the putrefactive process. Many of these have been long known and used for this purpose. In embalming, besides the application of various aromatics and resins, the body was washed with cedar oil and natron (soda), and pitch or tar were used as antiseptics. Pitch was used by the Romans in wine-making to control the fermentive process. The fumes of sulphur were largely employed by the ancients for purposes of purification, while common salt has been known and used for ages as one of the best preservatives from decay. The mineral acids possess antiseptic properties, as do also many of the metallic salts—the chloride of zinc, in the form of Sir W. Burnet's disinfecting fluid, being one of the most potent of them. Alcohol is well known for its power of preserving animal substances from decay. Quinine has been found to possess strong antiseptic properties. The tar products, notably carbolic acid, are among the most approved and extensively used of all antiseptic agents. The various substances named possess the power of preventing putrefaction in dead animal or vegetable matter, and to a greater or less degree of arresting it where already begun. They likewise exert a similar action on the analogous process of fermentation. They differ from mere disinfectants, which destroy the emanations from putrescent material, but do not necessarily arrest the progress of decay. (See DISINFECTANTS.) Some antiseptics, however, such as sulphurous acid, are powerful disinfectants also; while others, such as quinine, have no disinfectant properties at all. Various opinions are entertained regarding the *modus operandi* of antiseptics. By those who hold the purely chemical theory of putrefaction they are believed to operate in different ways according to their chemical properties; thus, sulphurous acid is said to act by deoxidising the putrescible matter; the mineral acids and metallic salts by combining with the substance, and forming a permanent compound; and the tar acids in a similar manner. On the other hand, the supporters of the germ theory maintain that carbolic acid, and indeed all true antiseptics, produce their effect by acting as poisons to the infusorial organisms which are held to be essential to the occurrence of the putrefactive process.

One of the most important applications of antiseptics has been their introduction into medical and surgical practice. Although their internal administration, with the view of counteracting diseases believed to be due to morbid poisons, has not hitherto yielded any marked practical result, their employment in the treatment of wounds has, in the hands of Professor Lister of Edinburgh, attracted much interest, and has exercised an important influence on surgical practice during the past ten years. Professor Lister, adopting the germ theory of putrefaction, and regarding many of the evils arising in connection with open wounds as the result of putrid discharges, produced by the agency of atmospheric germs, seeks to exclude the access of these to wounded surfaces by the employment of antiseptics, particularly carbolic acid, the power of which in destroying living organisms is undoubted. Dressings of gauze, made antiseptic by previous treatment with strong carbolic acid, are applied to wounds. The acid well diluted with water is likewise employed as a lotion, and, during the dressing of wounds and the performance of operations, is also applied in the form of spray to the surrounding atmosphere, with the object of preventing all access of germs. Boracic acid is also employed by Mr Lister as an antiseptic. The chief benefits claimed for this method of treatment are, that wounds, however extensive, may heal without the occurrence of putrefaction in the discharges, and that thereby the risks of blood poisoning (pyæmia, &c.) are reduced to a minimum. Although the antiseptic system in surgery is but on its trial, and its practical advantages over the methods of treatment in general use are still questioned by many high authorities, it has already obtained wide repute, and is extensively employed by surgeons both in this and other countries. (J. O. A.)

ANTISTHENES was the earliest Greek expositor of a philosophy and mode of life to which the name Cynicism soon came to be applied. Though a native of Athens, he was the son of a Thracian mother; and it was in the gymnasium of Cynosarges, to which the half-breeds were restricted, that he is said to have taught. From that place he and his followers probably received the name Cynic; but the popular derivation of the word connected it with the dog, whose shamelessness and importunity many of their actions seemed to imitate. In the time of Diogenes the name was firmly fixed as a nickname, and even adopted by the Cynics themselves.

Antisthenes was apparently born some years before the Peloponnesian war began, and from his remark on the rejoicings after the battle of Leuctra (371 B.C.)—that the Thebans were like a pack of schoolboys who had thrashed their master—it may be inferred that he lived on nearly to the middle of the 4th century B.C. He may be regarded as an elder contemporary of Plato. In youth he studied rhetoric under Gorgias, perhaps also under Prodicus and Hippias. These studies bore fruit, not merely in the stylistic ability which made his writings eulogised by later critics, but more especially in the doctrine he afterward held, that the study of names was the first step in education. He opened a school of his own, and was on the way to distinguish himself in the usual course of oratory, when he met with Socrates, and his views of life underwent a change. From that time he became the inseparable admirer of Socrates, to hear whom he walked every morning from Piræus to Athens, a distance of about 5 miles.

Antisthenes was poor, and lived in the midst of a commercial population which had suffered severely from the disasters attending the downfall of the Athenian empire. He became the philosopher of the proletariate, carrying into the haunts of the indigent and the vicious those principles which had been spreading in wealthier circles, and modifying them to suit altered circumstances. His earlier culture had always been more literary and rhetorical than strictly philosophical, and he never attained a mastery over metaphysical problems. Aristotle speaks of him as uneducated and simple-minded; and Plato has been understood, in more places than one, to refer to the zeal without knowledge with which he dwelt upon the difficulties of dialectic. Words and names were to him more important than thoughts The puzzle of the one and the many, which then was so prominent, led him to the strange conclusion that we can never say that one thing (or name) is another, as that a tree is green, but only that a tree is a tree. Such an adhesion to identical propositions as the sole form of judgment led him to deny the possibility of contradiction altogether. He objected to the Platonic theory of the substantive existence of relative and qualitative terms, such as good or beauty The dramatising legend shows him putting out his criticism thus: "Plato," he said, "I can see a horse, and I can see a man; but humanity and horsehood I cannot see." "True," replied Plato, "you have the eye which sees a horse and a man, but the eye which can see horsehood and manhood you have not." The idea expressed by the so-called abstract term was to Antisthenes merely subjective—a bare conception (ψιλὴ ἔννοια) in the mind. Antisthenes, in short, opposes a crude Realism to the Idealism of Plato The attitude of Antisthenes towards intellectual philosophy is in the main negative, and the general result he comes to is that logical or metaphysical investigations which go beyond name are unfruitful and frivolous.

A certain training is, however, necessary before a man can become what Antisthenes wishes him to be—his own master, independent of all external goods and social ties. This preparation consists in the laborious endeavour (πόνος) to raise himself above those external circumstances of human life which reflection shows to be useless and vain show (τῦφος). We must separate what we really are by nature from our artificial surroundings, so as to discover the minimum of real wants in life; and then fixing our mind on that standard, we must discard whatever is desirable only because popular opinion calls for it. Seeing that nature needs but little, and that this little is easily attained, if we do not insist on the delusions which attend it, the wise man will, it is true, gratify the natural cravings, but will not do more. These inevitable appetites of sex and food being satisfied, without the additions and refinements which art and fashion require, he will renounce pleasure as such. In the paradoxical language of Antisthenes, he would rather plunge into insanity than into pleasure. His aim must be to become, as much as may be, independent of everything outside, using it as needful, but not desiring it as a gratification. Such a mastery of self is what is called virtue, and is enough for happiness. It is hard to win, but once attained it can never be lost. The Cynic is one who surrenders the city of human life, with its varied scenes, on account of the difficulty of keeping his ground, and who is content if he can hold out the barren rock of the citadel as a soldier, constantly on the watch and *in procinctu*. Unfortunately this conception of a minimum of needs is somewhat vague, and allows many degrees. Diogenes could criticise and improve upon Antisthenes, and the Indian gymnosophists pointed out that Diogenes himself exceeded the strict demands of nature.

Antisthenes, though he did not encourage the formality of a school, and drove away the curious or enthusiastic with his staff, taught others by his example and by his caustic words. The Cynic was something of a missionary. He adopted a peculiar garb, at first perhaps for reasons of economy, but subsequently as a symbol of his profession. A rough cloak, which could be doubled to counterfeit an inner garment, and served the purposes of a night covering; a wallet, in which provisions could be carried; a staff to support his steps, and perhaps something from which to drink, constituted the property of the bare-footed Cynic; and to these was afterwards added a long beard. The successors of Antisthenes lived, like mendicant friars, on the alms of the public, and wandered from place to place, sleeping by night on the steps of public buildings, or occupying any vessel or tub which might suit their purpose. Antisthenes himself seems not to have been specially extravagant in conduct; but the later Cynics, who were without his early culture, made it a point to disregard all decency and social conventions. Whatever they had to do they deemed it their duty to do in public—at least such is the tenor of many tales. The wise man, they held, would follow another law than that of his city; he was a citizen of the world. Sexual desires he would unquestionably have to satisfy, but in the most convenient way, without regard to sentimental objections or to beauty—the uglier the better. Some, at least, of the Cynics maintained the advisability of a community of wives. They allowed to no ceremonies more than a relative force. According to Diogenes, the practice of cannibalism among certain tribes shows that the prohibition against eating human flesh is no part of the code of nature.

So far the Cynics taught practically. But they were also great in repartee and sarcasm. The fine touch of Socratic irony, which had given offence by talking occasionally about pots and pans, was succeeded by a rough and sometimes gross satire, which scrupled not to deal with matters viler still. Antisthenes, it is said, had some powers of social attraction, but if it were so, his successors were more marked by the severity of their rebukes. From the Homeric poems, the Bible of the Greeks, they drew many of the weapons of their warfare, parodying its language, and applying it to suit their own circumstances. Public manners, men, and measures were assailed in no merciful spirit. Antisthenes compared the cry of democratic politicians to the speech in which the hares demanded equality of rights from the lion. He was equally at odds with the æsthetic and literary tendencies of his time. Aristippus, Plato, and Isocrates were among his literary enmities. Nor was he less trenchant in his criticisms of popular superstitions, of soothsayers, and mystery-mongers. When the priest dilated in his sermon on the blessedness of the other world for the initiated, Antisthenes interrupted him with the words: "Why don't you die, then?"

Antisthenes was a voluminous writer; his works according to Diogenes Laertius, filled ten volumes. Of these scarcely anything is left. They seem to have been on various subjects, many of them being apparently a moralising interpretation of the poems of Homer. We can base our estimate of Antisthenes only on the sayings attributed to him, and, above all, to his follower Diogenes.

The great age of Cynicism in Greece is the century from 400 to 300 B.C. Diogenes, who succeeded Antisthenes, carried the exaggeration still further, and yet, in the story of the education of the children of Xeniades by him, there are traits which anticipate the educational theory of Rabelais and Rousseau. Crates, who succeeded Diogenes, voluntarily abandoned his possessions; and Hipparchia was so enamoured of Cynical life, that she refused her wealthy suitors, and married the landless and ill-favoured Crates. They were both notable features in the school, which includes the names of Monimus (a slave who was attracted by the fame of Diogenes), Onesicritus, Metrocles, and Menippus. In Menedemus the Cynical succession disappears, perhaps combining with the Megaric. For more than three centuries the name continued a tradition, when in the 1st and 2d centuries of the Christian era it was revived. The majority of the Cynics of that date were a worthless set of vagabonds, who used the garb and the name as a cover for all iniquities. They may be compared to the mendicant orders in the worst days of their corruption. But amongst them two or three names have a brighter light thrown upon them. Demetrius is lauded by his contemporary Seneca, and about a hundred years later Demonax is enthusiastically presented to the world by Lucian. There is much of the old Cynic in these descriptions; but the men were more eclectic, and had in some respects followed the advance of the general culture. Cynicism lasted for a few centuries longer, but never contributed anything to philosophy properly so called. It was a mode of life rather than a theory; and it sank before the monasticism and asceticism which marked certain directions in the history of the Christian church. (W. W.)

ANTITHESIS (ἀντίθεσις) is, in rhetoric, the bringing out of a contrast in the meaning by an obvious contrast in the expression, as in the following:—"When there is need of silence, you speak, and when there is need of speech, you are dumb; when present, you wish to be absent, and when absent, you desire to be present; in peace you are for war, and in war you long for peace; in council you descant on bravery, and in the battle you tremble." Antithesis is sometimes double or alternate, as in the appeal of Augustus:—"Listen, young men, to an old man to whom old men were glad to listen when he was young." The force of the antithesis is increased if the words on which the beat of the contrast falls are alliterative, or otherwise similar in sound, as—"The fairest but the falsest of her sex." There is nothing that gives to expression greater point and vivacity than a judicious employment of this figure; but, on the other hand, there is nothing more tedious and trivial than a pseudo-antithetical style. Among writers in our own language who have made the most abundant use of antithesis, are Pope, Young, Johnson, and Gibbon; and, to an egregious extent, Lily in his *Euphues*. It is, however, a much more common feature in French than in English; while in German, with some striking exceptions, it is conspicuous by its absence.

ANTITYPE (ἀντίτυπος) denotes a type or figure corresponding to some other type. It is in this sense of *copy* or *likeness* that the word occurs in the New Testament (Heb. ix. 24; 1 Peter iii. 21). By theological writers *antitype* is employed to denote the reality of which a *type* is the prophetic symbol. Thus, Christ is the antitype of many of the types of the Jewish ritual. By the fathers of the Greek Church antitype is employed as a designation of the bread and wine in the sacrament of the Lord's supper.

ANTIUM, a city on the Italian coast, about 33 miles S. from Rome. Its site is now occupied by the village *Porto d'Anzio*, or *d'Anzo*. Founded, it is supposed, by Pelasgians, it became connected with the Latin League, and about the beginning of the 4th century before Christ passed into the hands of the Volsci. As the chief city of this people it continued, in spite of repeated defeat, to carry on, with intervals of peace, a pertinacious war against the Romans till the year 338 B.C., when it was finally subdued, and garrisoned by a Roman colony, its ships being destroyed, and their *rostra* or beaks sent to ornament the speaker's platform in the Forum. Towards the close of the republic it was again a beautiful and flourishing town, greatly resorted to by the wealthier Romans. There was a magnificent temple to Fortune, and others to Æsculapius, to Venus, and to Apollo. It was patronised by the emperor Augustus, and became the birth-place of Caligula and Nero. The latter enriched it with a fine artificial harbour, and it was afterwards indebted to Antoninus Pius for an aqueduct. It seems to have fallen into decay about the 5th century; and the attempts made in the 17th by Innocent XII. to restore it had only a temporary success. It is now the property of the Borghese family, and is a favourite bathing-place in the early summer months. Among the ancient remains that have been discovered here are the *Apollo Belvedere*, and the *Borghese* or *Fighting Gladiator*.

ANTIVARI, or BAR, a town of Turkey, in Albania, situated on the Adriatic Sea, 18 miles N.W. of Scutari. It possesses a castle that is now of no value as a fortification, and a good harbour for vessels of light draught, which accommodates a considerable trade in the products of Albania. It is the seat of a Roman Catholic bishop. Population about 6000.

ANTONELLO DA MESSINA. Of the events of this celebrated painter's life we know little more than that he was probably born at Messina about the beginning of the 15th century; lived and laboured at his art for some time in his native country; happening to see at Naples a painting in oil by Jan Van Eyck, belonging to Alfonso of Aragon, was struck by the peculiarity and value of the new method; set out for the Netherlands to acquire a knowledge of the process from Van Eyck's disciples; spent some time there in the prosecution of his art; returned with his secret to Messina about 1465; probably visited Milan; removed to Venice in 1472, where he painted for the Council of Ten; and died there about 1493. His style is remarkable for its union—not always successful—of Italian simplicity with Flemish love of detail. His subjects are frequently single figures, upon the complete representation of which he bestows his utmost skill. There are still extant—besides a number more or less dubious—twenty authentic productions of his pencil, consisting of "Ecce Homos," Madonnas, saints, and half-length portraits, many of them painted on wood. The finest of all is said to be the nameless picture of a man in the Berlin Museum. Antonello exercised an important influence on Italian painting, not only by the introduction of the Flemish invention, but also by the transmission of Flemish tendencies.

ANTONIDES, HANS [JAN VAN DER GOES], a Dutch poet, was born April 3, 1647, at Goes, in Zealand, of poor but respectable parents. They removed to Amsterdam when he was about four years old, and he there enjoyed the tuition of Hadrian Junius, and James Coccceius. He was only nineteen when he attracted attention by his tragedy, *Trazil, of overrompelt Sina*—Trazil, or the Conquest of China. The venerable Vondel called him his son, and said he would have been proud of being the author of his *Bellone aan Band*. His parents designed him for an apothecary; but Buisero, one of the lords of the admiralty at Amsterdam, defrayed his college expenses, and enabled him to take the degree of doctor of physic. He practised with success, and established his poetic fame by his *Y-stroom*, an epic on the river Y. He died on the 18th of September 1664. His writings are remarkable for their warmth of fancy and vigour of expression, which sometimes degenerate into extravagance and bombast. His complete works were printed at Amsterdam in 1714, 4to, with a sketch of his life.

ANTONINI ITINERARIUM, a valuable register, still extant, of the stations and distances along the various roads of the Roman empire, seemingly based on official documents, which were probably those of the survey organised by Julius Cæsar, and carried out under Augustus. The work has plainly undergone various revisions down to the end of the 3d century. What connection any of the Antonines may have had with it is unknown. The whole Itinerary was printed by H. Stephens at Paris, 1512, and by Wesseling at Amsterdam, 1735. The part relating to Britain appeared at London, 1799, as *Iter Britanniarum*, with a new commentary, by Thomas Reynolds.

ANTONINUS LIBERALIS, a Greek grammarian, who probably lived about 147 A.D. His work, *μεταμορφώσεων συναγωγή*, consists of forty-one tales of mythical metamorphoses, and is chiefly valuable for the study of Greek mythology. One of the best editions is that of Koch, Leipsic, 1832, 8vo.

ANTONINUS, MARCUS AURELIUS. See AURELIUS, MARCUS.

ANTONINUS, TITUS AURELIUS FULVUS BORONIUS ARRIUS, surnamed PIUS, was the son of Aurelius Fulvus, a Roman consul, whose family had originally belonged to Nemausus (Nismes). He was born near Lanuvium, 86 A.D., and, having lost his father, was brought up under the care of Arrius Antoninus, his maternal grandfather, a man of integrity and culture, and on terms of friendship with the younger Pliny. Having filled with more than usual success the offices of quæstor and prætor, he obtained the consulship in 120 A.D.; was next chosen one of the four consulars for Italy; greatly increased his reputation by his conduct as proconsul of Asia; acquired much influence with the emperor Hadrian, by whom he was at length adopted as his son and successor in February 138 A.D.; and a few months afterwards, on Hadrian's death, was enthusiastically welcomed to the throne by the Roman people, who, for once, were not disappointed in their anticipation of a happy reign. For Antoninus came to his new office with simple tastes, kindly disposition, extensive experience, a well-trained intelligence, and the sincerest desire for the welfare of his subjects. Instead of plundering the provinces to support his prodigality, he emptied his private treasury to assist the provinces. Instead of exaggerating into treason whatever was susceptible of unfavourable interpretation, he turned the very conspiracies that were formed against him into opportunities of signalising his clemency. Instead of stirring up the persecution of the Christians, and gloating over the sufferings of their martyrs, he extended to them the strong hand of his protection through all the empire. Rather than give occasion to that oppression which he regarded as inseparable from an emperor's progress through his dominions, he was content to spend all the years of his reign in Rome, or its neighbourhood. Under his patronage the science of jurisprudence was cultivated by men of high ability, and a number of enactments were passed in his name that are equally characteristic of his humanity and his justice. Of the public transactions of this period we have but scant information, but, to judge by what we possess, those twenty-two years were not remarkably eventful. No conquests of importance were attempted, and there were no very dangerous attacks to repel, though all round the frontiers a kind of simmering hostility produced a succession of minor invasions and revolts. The one military result which is of interest to us now is the building of the wall of Antoninus from the Forth to the Clyde. In his domestic relations Antoninus was not so fortunate. His wife, Faustina, has almost become a by-word for her lack of womanly virtue, though, either through his ignorance of her conduct, or in spite of his being aware of it, she seems to have kept her hold on his affections to the last. On her death he did honour to her memory in many ways; but in none more remarkable than by the foundation of a charity for orphan girls, who bore the title of *Alimentariæ Faustinianæ*. He had by her two sons and two daughters; but they all died before his elevation to the throne, except Annia Faustina, who became the wife of his successor, Marcus Aurelius, and deepened the infamy of the name she inherited from her mother. Antoninus died of fever on the 7th of March 161, giving, as we are told, the key-note to his life in the last word that he uttered when the tribune of the night-watch came to ask the password—*Æquanimitas*. The only account of his life handed down to us is that of Julius Capitolinus.

Antoninus Pius.

ANTONINUS, WALL OF, called GRAHAM'S DYKE by the natives of the district through which it passed, is the name given by historians to that series of defensive posts, connected by a rampart and a wall, which at one time extended across the island from the Firth of Clyde on the west to the Firth of Forth on the east. The former of these appellations it has received from the Roman emperor in whose reign it was erected; the origin of the latter is more doubtful, a probable opinion being that which regards it as a corruption of the Celtic *greim*, a place of strength, and *diog*, a trench or rampart.

We are informed by Tacitus that Agricola, during his fourth summer in Britain (81 A.D.), occupied himself in consolidating his previous conquests, and that for this purpose he caused a series of detached forts to be built on the isthmus that joins the two firths as a barrier against the still unconquered Caledonians of the north. It was along, or almost along, the same line, that one of his successors in the command of the Roman troops in Britain raised the more permanent military work known as Antonine's wall.

The writer of the life of the emperor Antoninus Pius in the *Historiæ Augustæ Scriptores Sex*, usually supposed to have been Julius Capitolinus, expressly states that Lollius Urbicus, a legate of that emperor, erected, after several victories over the Britons, "another rampart of turf" to check their inroads. No locality is specified, but a fragment of a stone, now in the museum of the university of Glasgow, has an inscription in which the name of this Lollius seems to occur. This fragment, and the numerous monumental records bearing the name of Antonine that have been discovered along its course, identify beyond all reasonable doubt the wall between the Forth and Clyde as that spoken of by the annalist, and furnish satisfactory proof of the correctness of its best-known name. And if a small pillar figured by Gordon, and at one time in the library of the university of Edinburgh, was found, as is probable, near the wall, it fixes the year 140 A.D. as the exact date at which the portion of the work connected with the pillar was executed.

In addition to the annalist just mentioned, several other ancient historians are supposed to allude to Antonine's wall, but their brief statements are so vague that further reference to what they say is unnecessary. Of mediæval writers Bede is almost the only one who notices it, but he erroneously ascribes its erection to the natives of the south acting according to advice given them by the Romans. Timothy Pont, who early in the 16th century personally surveyed a large portion of Scotland while gathering materials for his projected *Scottish Atlas*, drew the attention of antiquaries to this memorial of Roman times, though to him, as well as to his successors in antiquarian research for nearly a century, it was known as "Agricola's vallum, or Graham's Dike." It is to Gordon that the merit must be awarded of having been the first to give to the world a satisfactory account of the "wall of Antoninus Pius." A chapter of the *Itinerarium Septentrionale* is devoted to it, and plans are given of the principal forts, as well as engravings of the legionary tablets and other objects of interest that had, up to the author's day, been dug out of its ruins. Gordon was followed by Horsley and Roy, the latter of whom made in 1755 a new survey of it, which enabled him to correct Gordon in some particulars. Lastly, in the *Caledonia Romana* of Stuart, we have a complete and, on the whole, accurate description of the wall, with figures of all the sculptured stones found near its course up to the date at which he wrote.

The nature and appearance of the wall when perfect have been described by all these writers in very similar terms, though they differ somewhat as to the measurement of its several parts. "It consisted," says Stuart, "in the first place, of an immense fosse or ditch—averaging about 40 feet in width, by some 20 in depth—which extended over hill and plain in one unbroken line from sea to sea. Behind this ditch on its southern side, and within a few feet of its edge, was raised a rampart of intermingled stone and earth, strengthened by sods of turf, which measured, it is supposed, about 20 feet in height, and 24 in thickness at the base. This rampart was surmounted by a parapet, behind which ran a level platform for the accommodation of its defenders. To the southward of the whole was situated the military way—a regular causewayed road about 20 feet wide—which kept by the course of the wall at irregular distances, approaching in some places to within a few yards, and in others receding to a considerable extent." Along the entire line there were at least eighteen principal stations or forts, with smaller watchtowers in the intervening spaces. The rampart seems to have consisted for the most part of earth or turf, as stated by the annalist; but stone was, no doubt, employed in the building of the forts and watchtowers as well as in certain portions of the rampart itself.

Although in many parts of its course all traces of Antonine's wall have long been obliterated, the line along which it stretched has been mapped out by Gordon and others with sufficient accuracy. Commencing in the west on a height called Chapel Hill, near the village of Old Kilpatrick in Dumbartonshire, and now distant from the River Clyde about 150 yards, it ran eastwards, passing in succession Kirkintilloch, Croy, Castlecary, and Falkirk, and terminated at Bridgeness, a rocky promontory that projects into the Firth of Forth south of Borrowstounness in Linlithgowshire. Its eastern termination was long supposed to have been near the kirk of Carriden. In 1869, however, a sculptured legionary tablet, since deposited in the museum of the Society of Antiquaries of Scotland, was found at Bridgeness, in such a position that it is impossible to avoid the conclusion that the wall actually terminated there. Its entire length may be set down at about 36 English miles.

Of the sculptures found near or on the site of this wall a considerable number are records of the different portions of the work executed by the legionaries employed on it, and who mainly belonged to the second, sixth, and twentieth legions. Some of these tablets are in the museum of the university of Glasgow, and are of much interest, but the finest of them all is the Bridgeness one already referred to. From the number of Roman paces mentioned on the inscriptions, Horsley and others have attempted to determine the exact length of the work. Unfortunately for their purpose, the paces on the stones already discovered considerably exceed its whole length, and as we cannot suppose that all the monuments of this kind that were erected by the legionaries have been preserved and brought to light, we must conclude with Stuart that they had raised more than one memorial of the same piece of work.

How many years Antonine's wall continued to be the boundary of the Roman territories in Britain it is impossible to say, but there is every reason for believing that it was so for only a brief period.

ANTONIO, NICOLAO, a Spanish bibliographer, was born at Seville in 1617. After finishing his studies at Salamanca, he returned to Seville, and shut himself up in the royal monastery of Benedictines, where he devoted several years to writing his *Bibliotheca Hispanica*, a work in four vols. folio, two of which he published at Rome in 1672. The work consists of two parts: the one containing the Spanish writers who flourished before the end of the 15th century; the other—the part published by Antonio himself—treating of later writers. He was recalled to Madrid by Charles II., and died in 1684, leaving nothing but a magnificent library of over 30,000 volumes. The earlier volumes of his *Bibliotheca* were published in 1696 at the expense of Cardinal d'Aguirre, and under the superintendence of his librarian, Marti, who added notes in the name of the cardinal. An improved edition of the entire work, by F. P. Bayer, was published at Madrid in four vols. folio, in 1783–8.

ANTONIUS, MARCUS, the Roman orator, was born 143 B.C. After having filled the office of quæstor (113), he was appointed prætor in 104, and proprætor in the following year, the province of Cilicia being assigned to him. Here he was so successful in the war against the pirates, that a naval triumph was awarded him in 102. He was consul along with A. Postumius Albinus in 99, when he successfully opposed the agrarian law of the tribune Titius. He was censor 97, and held a command in the Marsic war in 90. Belonging as he did to the party of Sulla, he was put to death by order of Marius and Cinna when they obtained possession of Rome (87 B.C.). Antony's reputation for eloquence rests on the authority of Cicero, none of his orations being extant.

ANTONIUS, MARCUS [MARK ANTONY], grandson of Antonius the orator, and son of Antonius Creticus, seems to have been born about 83 B.C. While still a child he lost his father, whose example, however, had he been spared, would have done little for the improvement of his character. Brought up under the influence of the disreputable Cornelius Lentulus Sura, whom his mother had married, Antony spent his youth in profligacy and extravagance. For a time he co-operated with the reprobate Clodius in his political plans, chiefly, it is supposed, through hostility to Cicero, who had caused Lentulus, his stepfather, to be put to death as one of the Catiline conspirators; but he soon withdrew from the connection, on account of a disagreement which, appropriately enough, arose in regard to his relations to his associate's wife, Flavia. Not long after, in 58 B.C., he fled to Greece, to escape the importunity of his creditors; and at length, after a short time spent in attendance on the philosophers at Athens, found an occasion for displaying some of the better features of his character in the wars that were being carried on by Gabinius against Aristobulus in Palestine, and in support of Ptolemy Auletes in Egypt. A new chapter in his life was opened by the visit which he made to Julius Cæsar in Gaul (54 B.C.) Welcomed by the victorious general as a valuable assistant in his ambitious designs, and raised by his influence to the offices of quæstor, augur, and tribune of the plebs, he displayed admirable boldness and activity in the maintenance of his patron's cause, in opposition to the violence and intrigues of the oligarchical party. At length his antagonists prevailed, and expelled him from the curia; and the political contest became a civil war The Rubicon was crossed, Cæsar was victorious, and Antony shared in his triumph. Deputy-governor of Italy during Cæsar's absence in Spain (49), second in command in the decisive battle of Pharsalia (48), and again deputy-governor of Italy while Cæsar was in Africa (47), Antony was now inferior in power only to the dictator himself, and eagerly seized the opportunity of indulging in the most extravagant excesses of luxurious licentiousness,—excesses which Cicero depicted in the *Philippics* with all the elaborate eloquence of political hatred. In 46 he seems to have taken offence at Cæsar, because he insisted on payment for the property of Pompey which Antony professedly had purchased, but had merely appropriated. But the estrangement was not of long continuance; for we find Antony meeting the dictator at Narbo the following year, and rejecting the advances of Trebonius, who endeavoured to discover if there was any hope of getting Antony to join in the conspiracy that was already on foot. In 44 he was consul along with Cæsar, and seconded his ambition by the famous offer of the crown on the 15th of February, thus unconsciously preparing the way for the tragedy of the 15th of March. To the sincerity of his adherence to Cæsar the conspirators themselves bore witness on that memorable day, by the care which they took to keep him engaged without while the daggers were doing their work within. This was the second great epoch in Antony's life. A brighter prospect than ever was then opened to his ambition. By his eloquence—a hereditary gift—he managed to stir up the minds of the populace against the assassins of Cæsar, and drove them from the city. He made peace with the remaining representatives of the senatorial party, and almost seemed to have succeeded to the power and position of his unfortunate patron. But the youthful Octavius, whom Cæsar had adopted as his son, arrived from Illyria, and claimed the inheritance of his "father." Agreement was impossible, and war ensued. Octavius obtained the support of the senate and of Cicero; and the veteran troops of the dictator flocked to his standard. Antony was denounced as a public enemy; and the city gave its loudest applause to the tirades of his most eloquent accuser. His cause gradually lost ground, and at last seemed to be totally ruined when his army was defeated in the siege of Mutina (43 B.C.) But escaping to Cisalpine Gaul, he formed a junction with Lepidus, and they marched towards Rome with 17 legions and 10,000 cavalry. The wily Octavius now betrayed his party, and entered into terms with Antony and Lepidus. It was agreed that they three should adopt the title—so beautifully ironical—of *Triumviri reipublicæ constituendæ*, and share the power and the provinces among them. Gaul was to be Antony's; Spain fell to the lot of Lepidus, and Africa, Sardinia, and Sicily were to belong to Octavius. A conjunct proscription followed, each of the partners in the villanous design bartering the life of his friends for the pleasure of destroying his foes. The detested author of the *Philippics* was given up to Antony's revenge; and, according to Appian, the number of the victims amounted to 300 senators and 2000 knights. In the following year Antony and Octavius proceeded against the conspirators Cassius and Brutus, who still maintained themselves in Macedonia; and, in the battles of Philippi, stamped out the last embers of republican Rome. While Octavius returned to Italy, Antony proceeded to Greece, and thence to Asia Minor, for the sake of recruiting his funds, completing the subjugation of the eastern provinces, and obtaining satisfaction about the conduct of the Egyptian queen during the recent contest. On his passage through Cilicia in 41 he was visited by Cleopatra, who came to answer the charges in person. She sailed up the Cydnus in a gorgeous bark, with a fantastic and brilliant equipage, and brought all her allurements to bear on the heart of the voluptuous Roman. Her success was complete, and he who was to have been her judge, was led captive to Alexandria as her slave. All was forgotten in the fascination and delight of the passing hour; and feasting and revelry found perpetual and ever-varying renewal. At length Antony was aroused by the Parthian invasion of Syria, and the report of an outbreak between Fulvia his wife and Lucius his brother on the one hand and Octavius on the other. On arriving in Italy he found that the war was over, and Octavius the victor; and the chief cause of disagreement being soon after removed by the death of Fulvia, a reconciliation was speedily effected between the triumvirs, and cemented by the marriage of Antony with Octavia, the sister of his colleague. A new division of the Roman world was agreed on at Brundusium, Lepidus receiving Africa, Octavius the west, and Antony the east. Returning to his province, Antony was for a time successful; his general, Ventidius, beating the Parthians, and Socius, capturing Jerusalem and conquering Antigonus. But after another visit to Italy, during which the triumvirate was prolonged for five years, Antony sent away his wife, yielded himself completely to the evil influence of Cleopatra, indulged not only in licentiousness, but in tyranny, and allowed his affairs to be neglected or delayed. An expedition against the Parthians was a failure; but for this his success against Artavasdes, the Armenian king, in some measure compensated. Octavius at length determined to get rid of Antony, and had little need of invention to bring charges sufficient against him. About two years were spent in preparations and delays on both sides, and it was not till the year 31 that the fate of Antony was decided by the battle of Actium. Defeated and deserted, he once more sought refuge and repose in the society of Cleopatra, but was followed even there by his relentless rival. At first he made a gallant effort to defend himself, and partially succeeded. But convinced of the hopelessness of his position, and assured of the suicide of his mistress, he followed the example which he was falsely informed she had given (30 B.C.) Antony had been married in succession to Fadia, Antonia, Fulvia, and Octavia, and left behind him a number of children. A short but vivid sketch of Antony is given by De Quincey in his "Essay on the Cæsars," see his *Works*, ix. 57-59

ANTONOMASIA (ἀντονομασία) is, in rhetoric, the substitution of any epithet or phrase for a proper name; as "Pelides," or "the son of Peleus," for Achilles; "the Stagyrite" for Aristotle; "the author of *Paradise Lost*" for Milton; "the little corporal" for Napoleon the First; "Macedonia's madman" for Alexander the Great, &c. &c. Besides gratifying the taste for variety, it affords the opportunity of bringing indirectly into view facts or feelings that it is not considered desirable or expedient to express distinctly by themselves. The opposite substitution of a proper name for some generic term is also sometimes called antonomasia; as, a "Cicero" for an orator. In both cases the figure is akin to metonymy.

ANTRIM, a maritime county in the north-east corner of Ireland, in the province of Ulster, situated between 54° 26′ and 55° 12′ 16″ N. lat., and 5° 47′ and 6° 52′ W long. It comprises, without including the 50,803 acres under water, an area of 711,275 statute acres, of which 16,702 belong to the incorporated county of the town of Carrickfergus. There were, in 1871, 257,211 acres under tillage, 373,839 in pasture, 6717 in plantation, and 72,065 waste. The county presents a considerable line of coast to the Atlantic Ocean on the north, and to the Irish Channel on the east; while Belfast Lough and the river Lagan divide it from the county of Down on the south; and Lough Neagh and Lough Beg, together with the river Bann, form its boundaries on the west, except towards the mouth of the river, where a small portion of the county of Londonderry lies on the eastern bank.

In area Antrim is exceeded by eight other counties in Ireland, but in population by Cork and Dublin alone. A large proportion of the surface, especially towards the east, consists of mountains and bogs; and it is computed that about 120,000 acres are irreclaimable. The mountains, occupying about one-third of the county, stretch from south to north, and terminate on the northern shore in abrupt and almost perpendicular declivities. Among the principal heights may be mentioned Trostan, 1810 feet; Knocklayd, 1685; Divis, 1567; Agnew's Hill, 1558; and Slemish, 1457. They attain their greatest elevation near the coast, and have a gradual descent inland, so that many of the streams, with their sources near the sea, flow south and west into Lough Neagh. The mountainous region has a gentler inclination as it approaches the Bann, and is occupied by turf-bogs susceptible of improvement. Some of the valleys, especially that of the Lagan, extend to a considerable width, and are of great fertility. The most extensive level tracts of rich and well-cultivated land lie along the shores of Lough Neagh, and from Belfast to Carrickfergus, and thence to Larne, between the mountain range and the sea. The most remarkable cliffs are those of perpendicular basaltic columns, which extend for many miles along the northern shore, and are most strikingly displayed in Fair Head and the Giant's Causeway.

Lough Neagh, the largest lake in Europe, with the exception of Lake Ladoga, Lake Wener, and the Lake of Geneva, is principally in Antrim. It is about 20 miles in length, 12 in breadth, and 80 in circumference, with an area of 98,255½ statute acres, of which 50,025 belong to Antrim; its greatest depth is from 45 to 48 feet, and its surface is 48 feet above the level of the sea. The lower Bann, obstructed by weirs and rocks, being the only outlet for the waters of the lake, which is fed by the Maine, the Six-mile Water, and a number of smaller streams, the surrounding country is in winter liable to be damaged by floods. The waters of the Lough, or at least of the Crumlin, one of the streams flowing into it, have petrifying powers; and some of the petrifactions are very beautiful, take a good polish, and rival those of Antigua. North of Lough Neagh, and connected with it by the river Bann, is Lough Beg, or the "small lake," containing 3145 acres, partly in Antrim. It is generally 15 feet lower than the larger lake, which it excels in the diversified and pleasing scenery of its banks. The Bann and Lagan, both of which rise in the county of Down, are the only rivers of importance. Of those strictly belonging to Antrim, none are navigable. They are generally rapid streams, of great value for turning machinery. The chief indentations of the coast are Red Bay, Carnlough, Glenarm, and Lough Larne. About 7 miles from the north coast, opposite Ballycastle, surrounded by a wild and troubled sea, lies the island of Rathlin, 6½ miles in length and 1½ in breadth, of similar basaltic and limestone formation with the neighbouring mainland. About a fourth of its 3399 acres are arable, and it supports a population of 453. There is a lighthouse on it with a fixed light.

The climate of Antrim is very temperate. The average annual rain-fall at Belfast is about 33 inches.

The geology of Antrim is of considerable interest, both on account of its peculiar character, and because the arrangement and alternations of strata are laid bare with more than usual distinctness. In all its more important features it coincides with the adjoining county of Londonderry. The greater portion of the surface is covered with trap. Along the coast, from a little way to the north of Carrickfergus, and up the valley of the Lagan, there is a considerable line of New Red Sandstone. All along from the south of Lisburn to Red Bay there is a chalk formation coming to the surface in narrow lines. It is quarried in many places, and varies in thickness from a few feet to 170, as at Glenarm. The south side of Red Bay and a part of the north are formed of New Red Sandstone, which gives place to porphyry near Cushendall, and is succeeded by Devonian grit northwards. There is a considerable circle of porphyry about five or six miles north-east of the town of Antrim. The lias (except at Larne) is very insignificant, and the greensand still more so. The coal measures are remarkable for their association with the basaltic formation, and differ from all the other coal districts in Ireland in wanting the underlying limestone, and resting directly on mica slate. The workings at the Ballycastle collieries are probably the oldest in the kingdom. In 1770 the miners accidentally discovered a complete gallery, which had been driven many hundred yards into the bed of coal, branching into thirty-six chambers dressed quite square, and in a workman-like manner. No tradition of the mine having been formerly worked remained in the neighbourhood. The coal of some of the beds is bituminous, and of others anthracite. The quantity available was calculated by the commissioners in 1871 to be 16,000,000 tons, at depths not exceeding 4000 feet. Lignite occurs in great abundance round about Lough Neagh, as at Ballintoy, Limineogh, Killymorris. In most places it is covered with columns of basalt; and in spite of the compressed state in which it is found, the bark and knots are often quite distinct, and the rings of growth may be counted. Basaltic pillars are found in many places besides the famous Giant's Causeway, as round about Coleraine, near Dunluce, at Ballintoy, Ballycastle, Ballygally Head (near Larne), in the neighbourhood of Carrickfergus, at Shane's Castle, and the mouth of the Glenavy. Iron ore is obtained at Ardshins, Belfast, Ballycastle, Glenrava, Kilwaughter, and Shane's Castle—the produce in 1871 being 157,874 tons, of the value of £61,110. Among the other minerals to be met with in Antrim, chalcedony (at Lough Neagh, and known as Lough Neagh pebbles), chrysolite, dolomite, jasper, onyx, opal, and talc may be mentioned. Very fine rock-salt is got at Duncrue, two miles north-west of Carrickfergus, and at one or two places in the same district. The Belfast Salt Mining Company raised during 1871 18,260 tons, and in 1870, 19,450. The mineral (chalybeate) waters of the county are in the neighbourhood of Antrim, Ballycastle, Belfast, Carrickfergus, and Larne.

The chief bathing-places are Ballycastle, Cushendall, Cushendun, Glenarm, Port Ballintrae, and Portrush. They are exposed to the easterly winds prevalent in spring, but are desirable summer residences. There is much variety of scenery in the county, from the low and somewhat monotonous shores of Lough Neagh, and the dreary bog and mountain land of the interior, to the wild romantic scenery of the northern coast, and the fantastically beautiful shores about Glenarm.

The soil varies greatly according to the district, being in some cases a rich loam, in others a chalky marl, and elsewhere a coating of peat. The chief feature in the tillage of a considerable portion of the county is the potato-fallow. The quantity of potato-land is commonly regulated by the amount of manure that can be collected; and since the use of lime was introduced it has been greatly increased. After potatoes, wheat or oats are sown; if the latter, two or three crops are successively taken. When the ground is exhausted potatoes are again planted, or the land is suffered to rest for a year or two until it is covered with natural grass. The sowing of wheat is chiefly confined to the baronies of Massareene, Belfast, Toome, and Antrim. Flax is also sown after potatoes, except in the lower or northern part of the county. The total area under tillage extended in 1871 to 257,211 acres. The crops are wheat, oats, barley, beans and pease, potatoes, turnips, vetches, rape, &c. Considerable quantities of flax are also grown, as well as grasses and clover. The cattle of Antrim do not belong to any particular stock, but they have been greatly improved by crossing with Dutch, Ayrshire, and other breeds. Pigs are reared in considerable numbers, the small farmers and cottars depending chiefly upon them for making up their rent. Comparing recent with previous years, we find an increase in all kinds of domestic animals, especially in sheep and goats—the former having more than doubled, and the latter increased more than fourfold. The farms are usually small. Extensive woodlands have in great measure been cleared, and there is now but little natural wood in the county. Many thriving plantations of trees have, however, been planted near noblemen and gentlemen's seats; and orchards have been formed on the Hertford estate, near Lough Neagh.

Cod, ling, pollock, ray, and turbot are caught off the coast in considerable quantities by the fishermen of Ballycastle, Larne, Carrickfergus, Belfast, &c., most of the fish thus taken being sent to Glasgow and Liverpool. Mackerel also appear in periodical shoals off Larne. Oysters of good quality are taken all over Belfast Lough, of the value of £400 or £500 per annum. Besides the fish usually found in fresh-water lakes, the char, a species of trout called dollagher, and the pullan (or fresh-water herring) are found in Lough Neagh. There are extensive salmon fisheries at Carrick-a-Rede near Ballintoy, along the coast north of Glenarm, and in the rivers Bann and Bush; and salmon are found in all the rivers in the county, except the Lagan. All the rivers abound with eels, which are chiefly taken at weirs in the Bann.

Antrim has long been distinguished for its linen manufacture, which is still the most important in the county. It was formerly carried on by hand-loom weavers, but the introduction of machinery has completely changed the character of the occupation. In 1841 there were about 240,000 spindles in operation, and now there are upwards of 580,000. There were 64 flax factories in 1870, with 9140 power-looms, employing 32,487. Cotton-spinning by jennies was first introduced in 1777 by Robert Joy and Thomas M'Cabe of Belfast; and twenty-three years after upwards of 27,000 people were employed in the cotton manufacture directly or indirectly, within 10 miles of Belfast. For many years great part of the yarn was imported from Manchester or Scotland, but now cotton-yarn has long been an article of exportation. In 1870 there were six cotton factories, with 73,000 spinning-spindles, in Belfast, and employing 814 persons. There is one hemp, and one jute factory in the county. A great source of employment for females is the working of patterns on muslin with the needle. Belfast is the centre of this trade, but about 300,000 persons, chiefly women, are employed in various parts of Ireland, and the gross value of the manufactured goods amounts to about £1,400,000. There are also extensive paper-mills in the county, and various manufactures in connection with the trade of the district. The exports are linen, linen yarn, all kinds of grain, pork, bacon, hams, beef, butter, eggs, lard, potatoes, soap, and candles.

The communication by means of roads is good, and there are several important railway lines. About 20 miles of the Ulster Railway, which runs from Belfast to Clones in Monaghan, are in the county. Another line joins Belfast with Carrickfergus and Larne; and the Belfast and Northern Counties Railway—using a portion of the Carrickfergus line—unites Belfast with Antrim, Ballymena, Ballymoney, and Coleraine in Londonderry, &c. A junction, 18½ miles long, from Antrim to Knockmore, joins this line with the Ulster Railway. There are regular steam-ship lines between Belfast and Glasgow, and Belfast and London. A canal—the Lagan—connects Lough Neagh with Belfast Lough.

The earliest known inhabitants were of Celtic origin, and the names of the townlands or subdivisions, supposed to have been made in the 13th century, are pure Celtic. Antrim was exposed to the inroads of the Danes, and also of the northern Scots, who ultimately effected permanent settlements. The antiquities of the county consist of cairns, mounts or forts, remains of ecclesiastical and military structures, and round towers. The principal cairns are—one on Colin mountain, near Lisburn; one on Slieve True, near Carrickfergus; and two on Colinward. The cromlechs most worthy of notice are—one near Cairngrainey, to the north-east of the old road from Belfast to Templepatrick; the large cromlech at Mount Druid, near Ballintoy; and one at the northern extremity of Island Magee. The mounts, forts, and intrenchments are very numerous. There are four round towers: one at Antrim, one at Armoy, one on Ram island in Lough Neagh, and a fragment of one between Lisburn and Moira. Of the ecclesiastical establishments enumerated by Archdall, there are some remains of those of Bonamargy, where the earls of Antrim are buried, Kells, Glenarm, Glynn, Muckamore, and White Abbey. The noble castle of Carrickfergus is the only one in perfect preservation. There are, however, remains of other ancient castles, as Olderfleet, Carn's, Shane's, Glenarm, Garron Tower, Redbay, &c., but the most interesting of all is the castle of Dunluce, remarkable for its great extent and romantic situation.

In 1584 the county was divided by the lord-deputy, Sir John Perrot, into eight baronies; but, by the subdivision of six of these into upper and lower, the number has been increased to fourteen, viz., Antrim, Lower and Upper; Belfast, Lower and Upper; Cary; Dunluce, Lower and Upper; Glenarm, Lower and Upper; Kilconway; Massareene, Lower and Upper; Toome, Lower and Upper. The number of parishes and parts of parishes is seventy-five, all, except Aghalee, in the diocese of Connor. There are seven poor-law unions in the county,—Antrim, Ballycastle, Ballymena, Ballymoney (partly in Londonderry county), Lisburn (partly in Down county), and Larne. The constabulary force has its headquarters at Ballymena, the county being divided into six districts. Antrim is in the Belfast military district, which has its headquarters, as has also the county militia, at Belfast. The valuation of rateable property in 1872 was £1,039,898. The county sends six members to the imperial parliament: two for the shire, —constituency, in 1873, 10,563; two for Belfast, one for Carrickfergus, and one for Lisburn,—constituencies, 15,000, 1166, and 568. Among the nobility and gentry who have estates in this county we may mention the earl of Antrim, (Glenarm Castle); the marquis of Donegall (Ormeau Park and Carrickfergus); Viscount Templetown (Castle Upton); Lord O'Neill (Shane's Castle); Lord Waveney (Ballymena

Castle); Sir Richard Wallace (Antrim Castle); Macnaughten of Dundarave; Adair of Loughanmore, &c.

The assizes, formerly held at Carrickfergus, are now held at Belfast, the county town. Quarter-sessions are held at Antrim, Ballymena, Ballymoney, and Belfast.

The principal towns are—Belfast, population (1871), 174,394; Carrickfergus, 9452; Lisburn, 7794; Ballymena, 7628; and Larne, 3343. Antrim, Ballycastle, Ballymena, Ballymoney, Belfast, Bushmills, Carrickfergus, Crumlin, Larne, Lisburn, Portglenone, and Randalstown are market-towns, and fairs are held at forty-eight places in the county.

Antrim is one of the most decidedly Protestant counties in Ireland, and of the Protestants a very great proportion are Presbyterians. The greater part of these are in connection with the General Synod of Ulster, and the others are Remonstrants, who separated from the synod in 1829, or United Presbyterians. By the returns of 1871 there were 108,835 Roman Catholics, 88,934 Episcopalians, and 184,144 Presbyterians. The number of children attending school in 1871 was 142,297, of whom 34,637 were Roman Catholics.

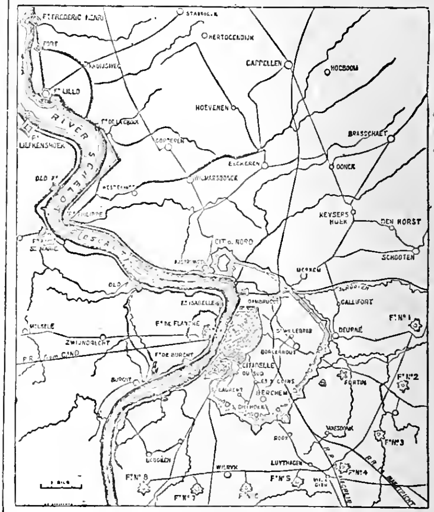
In 1813 there were in the county 42,258 dwelling-houses and 231,548 inhabitants. The returns since that year have shown a gradual increase, notwithstanding extensive emigration, and in 1871 the population was 404,015, inhabiting 71,327 houses.

See for geology, *Proceedings of Royal Irish Academy*, vol. x., article, with map, by John Kelly, C.E., and article by R. Tate, in the 21st vol. of the *Quarterly Journal of Geol. Soc. of London*, 1868; and for archæology, *The Ulster Journal of Archæology*, vols. iii. and iv., and Keane's *Towers and Temples of Ireland*.

ANTRIM, a town of Ireland, in the county noticed above, half a mile from Lough Neagh, on the banks of the Six-mile Water, in a fertile and beautiful valley, 13 miles north-west of Belfast, and 106 north of Dublin. It gives the title of earl to the family of MacDonnell, and prior to the Union returned two members to parliament by virtue of letters patent, granted to the inhabitants in 1666 by Charles II. There is nothing in the town particularly worthy of notice; but the environs, including Shane's Castle and the grounds of Massareene Castle, possess considerable interest. About a mile from the town is one of the most perfect of the round towers of Ireland, 95 feet high, and 49 in circumference at the base. Markets are held each Tuesday and Thursday, and fairs on January 1, May 12, and November 12. In 1871 the town contained 427 dwelling-houses, and 2020 inhabitants. The receipts by the town commissioners were £120 in 1872, and their expenditure £127. The manufacture of paper has been carried on here on a small scale for many years, and linen and woollen cloth is also produced in moderate quantity. The Belfast and Northern Counties Railway passes a short distance to the north of the town. A battle was fought near Antrim, between the English and Irish, in the reign of Edward III.; and on June 7, 1798, there was a smart action in the town between the king's troops and a large body of rebels, in which the latter were defeated, and Lord O'Neill mortally wounded.

ANTWERP (Dutch, *Antwerpen;* French, *Anvers;* Spanish, *Amberes;* Old German, *Antorff;* from "aent werf," "on the wharf"), a province of Belgium, bounded by the Dutch province of North Brabant on the N., and by the Belgian provinces of Limbourg on the E., South Brabant on the S., and East Flanders on the W. The greater part of the province, which consists of an extensive plain of 1096 square miles, scarcely diversified by a single elevation, is sandy but fertile, producing grain, flax, hemp, fruit, and tobacco, as well as cattle, sheep, and horses; on the north and north-east, however, there are considerable tracts of morass and heath. The principal rivers, the Scheldt and its tributaries, the Rupel, the Nèthe, and the Dyle, are navigable to a large extent, while railways intersect the country in various directions and there are also several canals. The chief towns are Antwerp, Mechlin (Malines), Turnhout, Lierre, and Boom. Population in 1870, 492,482.

ANTWERP, the capital of the province of the same name, is situated about 50 miles from the open sea and



Plan of Antwerp and Environs.

25 north of Brussels, in a level tract on the right bank of the Scheldt, which is there about 2200 feet broad, and has a depth at ebb-tide of from 30 to 40 feet, with a rise at spring-tides of 12 or 14. Antwerp seems to have been founded by people of Saxon race some time before the 8th century, when the Antwerpians or Ganerbians, as they began to be called, were converted to Christianity by St Willebrod and some Irish monks. A certain Rohingus of that period styles himself prince of Antwerp; and mention is made of a market-toll in force in 726. In 837 the town fell into the hands of the Northmen, who kept possession of it for about sixty years. It was erected into a marquisate of the Holy Roman empire by Henry II. in 1008, and, as such, was bestowed by Henry IV., in 1076, on Godfrey of Bouillon. About the beginning of the 12th century it had considerable commercial prosperity; and in the 13th, its municipal institutions took definite shape. It is worthy of notice that the law of 1290 contained provisions identical with those of the Habeas Corpus Act in England, maintaining the inviolability of the citizen's dwelling, and acknowledging the right of every man to be judged by his peers, and to have a voice in the imposition of taxes. As the result of such security and freedom, the commerce of the city rapidly increased. The English wools for the great manufactories at Louvain, Brussels, Tirlemont, Diest, and Lean, were imported through Antwerp; and the English merchants, who formed a "factory" there in 1296, received special protection by charters (1305, 1341, 1346, 1349) from the

Dukes of Brabant, at that time in possession of the marquisate. In 1338, while Edward III. of England was spending the winter in the city with his queen Philippa, she gave birth to Lionel, afterwards Duke of Clarence, and the event was celebrated by a magnificent tournament. To the king, then in great need of money, the merchants of Antwerp advanced 400,000 florins. The marquisate passed successively into the hands of the counts of Flanders and the house of Burgundy, and returned to Brabant about 1406. In 1474 the town made over a large house in Billinck Street to the English, in 1550 an "English Bourse" was established, and in 1558 the beautiful Hop van Lyere—now a military hospital—was ceded for the accommodation of our merchants. Between 1488 and 1570 was the time of the greatest prosperity which Antwerp was destined to attain for several centuries. The discovery of America in 1492, and of the passage to India in 1497, produced a great change in all European navigation, and permanently altered the old courses of commerce. While, in consequence of this, the cities of the Hanseatic League had withered, and Venice, and Nuremberg, and Bruges were sinking into decay, Antwerp was growing daily more worthy of the name which she soon acquired, "*Dives Antwerpia*," "the wealthy Antwerp." By contemporaneous writers, such as Guicciardini and Scribanius, the most glowing accounts have been left of her greatness. The annual fairs of Pentecost and St Badon's—which have now no commercial importance—attracted merchants from all parts of Europe. No fewer than 500 ships would enter the port in a day, and as many as 2500 were to be seen lying in the river at one time. On an average 500 waggons laden with goods daily entered the gates; above 500,000,000 guilders were annually put in circulation; and the population is said to have numbered upwards of 100,000. But from this height of prosperity the city was suddenly cast down by the wars of the 16th century. In 1576 it was taken by the Spaniards, and given up to a three days' pillage; it was besieged, though in vain, by the duke of Alençon in 1583; and, after a very obstinate defence, it fell before the assaults of the duke of Parma, whose triumphal entry took place on the 17th of August 1585. Its glory departed; its commerce was ruined; its inhabitants were scattered. As the people of Bruges had flocked to Antwerp, so now the people of Antwerp flocked to Hamburg. The Dutch, in their jealousy, endeavoured to complete its ruin by building forts on the river to intercept the passage of ships; and finally, by the peace of Westphalia, in 1648, the Scheldt was definitively closed. In 1794 the city fell into the hands of the French, who opened the river and made Antwerp the capital of the department of Deux Nèthes. Napoleon, who visited the place in 1803, attempted to make it a great military and commercial centre, and spent no less than £2,000,000 sterling in the construction of docks. He was wont to speak of it as *un pistolet chargé que je tiens sur la gorge de l'Angleterre.* It continued in French possession till 1814, when it was surrendered after the treaty of Paris by Carnot, who up to that time had defended it with great bravery against the allied army under Graham. From 1815 to 1830, Antwerp with the rest of Belgium united with Holland in forming the kingdom of the Netherlands. In 1830, during the Belgian revolution, the citadel was held by the old Dutch general Chassé, who resolutely refused to surrender. At length, however, in 1832 he was forced to capitulate by the French, under Marshal Gérard, and the city was handed over to the Belgians. All matters of dispute between Belgium and Holland being finally settled by the treaty of 1839, Antwerp has continued peacefully to advance in prosperity ever since. In 1860 the ancient fortifications were destroyed, and new fortifications erected at a considerable distance from the city; while a line of detached forts were built towards the south-east, in an arc of a circle, which it has been proposed to complete on both sides of the river. The famous "citadel of the south," which was originally built by the duke of Alva in 1567, has been bought from the Belgian Government by the *Société Immobilière* and the town of Antwerp, and the site is to be appropriated for new docks and a new quarter of the city—the docks to be for the accommodation of river-boats and lighters. A loan of 60,000,000 francs (£250,000) is to be contracted for the carrying out of the improvements. Since the destruction of the old fortifications, fine boulevards, avenues, and streets have been laid out, and the town is rapidly and constantly increasing in size. There are now seventeen quays or wharves, and a series of 6 or 8 docks communicating with each other. The two oldest, which were constructed under Napoleon, and preserved when his other establishments were destroyed, are respectively about 574 feet by 492, and 1312 by 574. Since Napoleon's time the city has added the *Bassin de Jonction*, the large *Kattendyk Dock* (opened in 1856), the *Bassin Sas*, the *Bassin aux Bois*, or timber-dock, the *Bassin de la Campine*, and the *Bassin du Canal*. The whole system has an area of nearly 100 acres, affording over 21,000 feet of quay-room. In spite of all this extension of accommodation, the commercial traffic is so great that ships are often delayed through lack of sufficient room for lading or unlading. In 1826, 909 vessels entered with a tonnage of 122,221, of which 126 were British, with a tonnage of 16,178; in 1862 the number of vessels was 2292, with a total tonnage of 579,899, of which 777 were British, with a tonnage of 199,000; and by 1872 the vessels amounted to 4206, and had a tonnage of 1,656,984, 2172 of them being British, and having a tonnage of 1,007,165. Of the British traffic, a very large proportion is carried on by means of steam-ships. The chief imports are steel, copper, iron, and other metals, machinery, coals (chiefly from Britain), salt, soda, grain, cotton (chiefly from New Orleans and Bombay), cotton yarn and goods, wool (mostly undressed), hides (raw and tanned), sugar (chiefly raw), tea, coffee, tobacco, rice, and oil-seeds. The chief exports are flax, woollen goods, refined sugar, metals, glass, and tallow. There is regular steam communication with London, Hull, Liverpool, and other English ports, and, indeed, with all the most important ports in Europe. There are also regular lines to the United States, Brazil, La Plata, and Chili. By the river and several canals there is communication with most of the other Belgian cities. The "*Canal de la Campine*" is the most important, and joins the Scheldt with the Meuse, through the Willem Canal, which was made by the Dutch Government. The railway system with which Antwerp is connected is extensive, but is far from sufficient to satisfy the demands of trade. The manufactures of Antwerp are various and considerable, the principal being lace, silk, linen, jute, cotton, tapestry, galloon, twine, sugar, white-lead, litmus, starch, printer's ink, and malt liquors. There are about 20 sugar refineries, 7 rice-mills, 3 sulphur refineries, several cigar manufactories, distilleries, petroleum refineries, stearine candle manufactories, and wool-mills. The lapidaries of Antwerp are celebrated for their skill in cutting diamonds.

The National Bank of Belgium has a branch in the city, and several other banks transact extensive business. The Exchange, built in 1531, was one of the finest buildings of the kind in Europe, and is said to have been chosen by Sir Thomas Gresham as a model for the old Royal Exchange in London. Burnt down in 1858, it was rebuilt in the same Gothic style as before, and opened again for business in 1872. The old magazine of the Hanseatic League (1564), known as the *Maison Hanseatique*, still stands a "massive and venerable" building. The cathedral of Notre Dame, probably founded about the middle of the

14th century, but not completed till 1518, is one of the most beautiful specimens of Gothic architecture in Belgium. It is about 500 feet long and 250 broad, and is the only church in Europe with six aisles. Of its two projected towers, the one rises to a height of 403 feet, the other remains unfinished. It contains, besides other remarkable pictures, Rubens's "Descent from the Cross," his "Elevation of the Cross," and his "Assumption." The cathedral, however, is greatly surpassed in the splendour of its decorations and the profusion of its monuments by the church of St James (15th century), which contains, in addition to other mortuary chapels and shrines, the family-chapel and tomb of Rubens, with a beautiful altar-piece, the workmanship of the great painter. The high altar of the church was also designed by Rubens. Of the remaining churches, the most important are St Paul's, St Andrew's, and the church of the Augustines. The church that formerly belonged to the Corporation of Tanners is now the Anglican place of worship. The *Hôtel de Ville* is a fine building in the Italian style, with a facade that exhibits four orders of architecture, one above the other; but within, there is not much to attract attention. Antwerp possesses an Athenæum, in which most of the usual branches of literature and science are taught; an academy of the fine arts, where the students receive instruction in painting, sculpture, architecture, and engraving; a "*Museum*" or Gallery of over 560 pictures, including some very fine specimens of Rubens, Vandyck, Titian, Teniers, Jordaens, Quintin Matsys, and other masters; a medical and surgical college; a school of navigation; zoological and botanical gardens; a theatre; and various scientific and literary societies. The town library contains 30,000 volumes. The library of the famous printer, Plantin, his workshop, presses, and printing materials, as left by the Moretus family who succeeded him, and a fine collection of paintings, drawings, manuscripts, &c., were purchased by the town for about a million and a half of francs (£62,500), and form an interesting typographic museum.

Antwerp is the birth-place of a number of distinguished men in various departments, as the painters Vandyck (b. 1599), Teniers the elder (1582), Teniers the younger (1610), Jordaens (1594), Frans Floris (1520), Gonzales Cocques (1618); the philologist Gruter (1560), the geographer Ortelius (1527), the engraver Edelinck (1649), and, among more modern celebrities, Van Meteren the historian, Ogier the dramatist, and Henri Conscience the novelist. Rubens was born at Cologne, but his family belonged to Antwerp, and he was educated, resided, and died in the latter city.

According to the general census of 1846, Antwerp contained 88,487 inhabitants, of whom 85,961 were Roman Catholics, and 1312 Protestants. In 1851 the population was 95,501, and in 1873, 126,663, or, including the suburbs now situated within the fortifications, above 180,000. The majority of the inhabitants speak Dutch or Flemish, and the rest, for the most part, French or Walloon.

See Guicciardini's *Descrittione di tutti i Paesi Bassi;* C. Scribanii *Origines Antwerpiensium;* Gens, *Histoire de la Ville d'Anvers;* Mertens and Torfs, *Geschiedenis van Antwerp;* Bruyssel, *Histoire du Commerce, etc., de Belgique; Consular Reports on British Trade Abroad*, 1873, pp. 517–555; Motley's *Rise of the Dutch Republic.*

ANUBIS, an Egyptian deity, called in hieroglyphs *Anepu* or *Anup*, and in Coptic, *Anob* or *Anoub*. It appears from the hieroglyphic legends that he was the son of Osiris and Isis, not Nephthys, as stated by Plutarch. His name has no particular meaning in hieroglyphs, although it resembles the Coptic *anebe*, the appellation of a particular kind of dog. His worship was of the oldest period, and is found in tombs at Memphis, of the age of the 4th dynasty, at which period all dedications run in his name instead of that of Osiris, which did not appear till the 6th. At this time he is always styled resident in the sacred abode, and attached to the land of Ut, and lord of the Taser or Hades. At the earliest period he presided over the funeral rites and embalming of the dead, on account of having rendered these offices to his father Osiris. In this character he is seen raising the mummy on its feet to receive the sepulchral sacrifices and libations, or else laying it out on the bier, to which the soul flies down to visit or be reunited to the body. In the great judgment Anubis, with Thoth, attends to the balance placed in the Hall of the Two Truths, where the soul is tried by Osiris as judge of Hades, and the heart of the dead is weighed against the feather of Truth. Besides his sepulchral character, Anubis was also called *Ap-heru*, "opener of the roads" or "paths," which were supposed to lead to heaven. Of these there were two, the "northern and the southern." As lord of the northern road he was lord of Sais, while as ruling the southern, he was lord of Taser or Hades. In this character he was often represented as a jackal seated on a pylon or gateway, the jackal being his sacred animal or living emblem. This may be considered the type of the celestial Anubis, and as such he was styled lord of the heaven, and opener of the solar disk. Anubis is represented with the head of a jackal, seldom with that of a man, and rarely with any head attire, although at the Roman period his head is surmounted by the pschent, or crown of Upper and Lower Egypt. In other respects his type is that of other Egyptian deities. In the tablets and other monuments of the 18th and later dynasties, Anubis is introduced as following, or as part of, the cortege of Osiris; sometimes he is worshipped alone; but he was a subordinate god of the third order, supposed to have reigned over Egypt as one of the kings of the 2d dynasty of gods. The principal site of his local worship was Lycopolis, or El Siut, the capital of the 13th and 14th (or Lycopolite) nomes, and at the 17th or Cynopolite nome; but he appears also as one of the gods of the 18th or Oxyrhynchite nome, and as such is styled lord of *Sep*. In this character he is said to have defeated the opposers of his father Osiris, which accords with the story of Diodorus, that Anubis was the general of Osiris in his Eastern expedition. The introduction of Anubis into the Isiac worship about the 1st century B.C., gave rise to various esoterical explanations not found in the hieroglyphs. He is stated to have been the son of Nephthys and Osiris, and discovered by dogs, and hence had a dog's or jackal's head; also that he represented the horizontal circle which divides the invisible world, called by the Egyptians Nephthys, in contradistinction to Isis, or the visible, or to have been like Hecate. He was also supposed to mean time and universal reason. But these explanations are not found in the hieroglyphs, and the change of his head to that of a dog instead of a jackal, was not Egyptian. On Roman monuments of the 1st and 2d century A.D., his form is combined with that of Hermes, and passed by the name of Hermanubis, in his character of the infernal Mercury. In the days of Tiberius, the seduction of a noble Roman lady in his temple at Rome, with the connivance of the priests, led to the suppression of his worship, but at a later period the Emperor Commodus, infatuated with the Isiac worship, shaved his head like an Egyptian priest, and carried in procession the figure of the god. The idea that his name meant gold, as suggested by the learned, is confuted by the hieroglyphs; nor are the statues found of him either gold or gilded, while in the Egyptian paintings he is always coloured *black*, and never yellow or golden, as the goddesses often are. The jackal was his sacred living animal, and was embalmed after death, and this animal represented, according to Clement of Alexandria, either the two hemispheres which environed the terrestrial globe, or the tropics. Figures of Anubis in porcelain are not uncommon in Egyptian collections, having been attached to the outer network of bugles which covered the mummies, but in other materials they are much rarer. The jackal, his animal and emblem, is, however, often placed on chests, or other sepulchral monuments. His worship commenced at the earliest period of Egyptian history, and continued, in one form or another, till Egyptian paganism was superseded by Christianity. He was, in fact, one of the oldest, if not the oldest deity of the paganism of the world. (Wilkinson, *Mann. and Cust.* vol. iii. p. 440, *ff.*; Birch, *Gallery of Antiquities*, p. 43; Bunsen, *Egypt's Place*, vol. i. 2d ed. p. 240; Plutarch, *De Iside*, c. 14; Josephus, *Ant.* xviii. c. 6; Brugsch, *Die Geographie des alten Ægyptens*, i. taf. 23, 25; Jablonsky, *Panth. Ægypt.* iii. p. 3, *ff.*) (S. B.)

ANVIL, an iron block, with a smooth flat steel face, on which the malleable metals are hammered and shaped. They are of all sizes, from the tiny anvils used by the watchmaker to the ponderous masses employed in the arsenal of Woolwich. The common blacksmith's anvil is built up of six pieces welded to a central core, viz., four corner pieces, a projecting end, with a square hole for the reception of a chisel with its edge uppermost, and a conical end for hammering curved pieces of metal. These six pieces are first roughly welded to the core, and the whole is then thoroughly hammered and suitably shaped. A thin facing of steel is next welded on and carefully tempered; the surface of this is then ground perfectly flat, and, if need be, polished.

ANWARI, one of the earlier Persian poets, was born in Khorassan, in the 12th century. He enjoyed the especial favour of the Sultan Sandjar, whom he attended in all his warlike expeditions. On one occasion, when the sultan was besieging the fortress of Hazarasp, a fierce poetical conflict was maintained between Anwari and his rival Rasheedi, who was within the beleaguered castle, by means of verses fastened to arrows. Anwari died at Balkh about 1200. *The Diwan*, or collection of his poems, consists of a series of long poems, and a number of simpler lyrics. His longest piece, *The Tears of Khorassan*, translated into English verse by Captain Kirkpatrick, appeared in the *Asiatic Miscellany*.

ANWEILER, or ANNWEILER, a town of Bavaria, in the Rhine Palatinate, situated on the Queich, 8 miles W. of Landau, containing 2734 inhabitants, who are chiefly employed in cloth weaving, brushmaking, tanning, and dyeing. Near it is the castle of Trifels, in which Richard Cœur de Lion was imprisoned in 1193.

ANXENOR, a Greek sculptor, a native of Naxus, known only from the inscription on a sepulchral relief in Orchomenus, of which he was the author. From the style of the sculpture, and the form of the letters, it is inferred that he had lived in the early part of the 5th century B.C.

ANZIN, a town of France, in the department of Nord, situated on the Escaut (Scheldt), not far from Valenciennes, in the centre of the most valuable coal-mining district in France, a large part of which takes its name from the town, and gives employment to about 6000 persons. Anzin also possesses iron foundries, glass-works, breweries, and distilleries of considerable value. Population, 7283.

AOSTA, a town of the kingdom of Italy, the capital of a circle of the same name in the province of Turin, situated on the Dora Baltea, at the point where the roads over Great and Little St Bernard meet, 49 miles N. of Turin. It is a tolerably well-built place, containing a cathedral, and a fine town hall, as well as a triumphal arch, an amphitheatre, and other Roman remains. The inhabitants, who number 7669, carry on a considerable trade in wine, cheese, leather, and hemp. Aosta, the ancient *Augusta Prætoria*, celebrated as the birth-place of Anselm, archbishop of Canterbury, was formerly the capital of a duchy of the same name in Piedmont, which eventually became a province of Sardinia, and was merged in the Italian province of Turin in 1861. The Val d'Aosta, which formed the greater part of Aosta province, produces large quantities of grain, fruit, and cattle, while the mountains abound in iron and other minerals. Cretinism prevails extensively among the inhabitants.

APAMEA, in *Ancient Geography*, the name of several Asiatic cities:—1. A large city of Syria, in the valley of the Orontes, so named by Seleucus Nicator, after Apama, his wife. It continued to be a place of importance down to the time of the Crusades, when it was known as *Fâmieh*, and is supposed to be represented by the extensive ruins at Kulat-el-Mudyk. 2. A large commercial city in Phrygia, which owed its existence to Antiochus Soter, and its name to his mother, Apama. It is identified with the modern *Denair*, where there are still a number of ancient ruins. 3. A city mentioned by Stephanus and Pliny as situated near the Tigris, the identification of which is still uncertain. 4. Now *Rum-Kala*, on the left of the Euphrates, opposite Zeugma. 5. The name given to Myrlea of Bithynia, by Prusias I., who rebuilt it. The ruins lie near Medania. 6. A Greek city in Parthia, near Rhagæ.

APANAGE (*apanagium*, probably from *panis*, bread), the provision in the form of lands or feudal superiorities made for younger sons by the kings of France. The custom of bestowing apanages was first established under the dynasty of the Capets; the rule at an earlier period being that the kingdom should be divided as equally as possible among all the members of the family on the death of the sovereign. Hallam (*Middle Ages*, c. i. part 2) points out how the possession of apanages made the princes of the blood royal "a distinct and formidable class of men." They were generally opposed to the sovereign, and the sovereign on his part endeavoured to check their power as much as possible. From the time of Louis VIII. apanages were held subject to the condition that they should revert to the crown on the extinction of heirs-male. (See Pasquier's *Recherches*, ii. 18; Henault's *Histoire de France*, anno 1283.) In England, where apanage is not a legal term, the word is used popularly in a variety of cognate senses.

APATIN, a town of Hungary, situated on the left bank of the Danube, 125 miles S. of Pesth. It has manufactures of woollen cloth and silk, dye-works, and a considerable trade in raw silk, hemp, madder, and woad. Population, 11,047.

APATURIA (Ἀπατούρια), a Greek festival held annually by all the Ionian towns except Ephesus and Colophon, the reason assigned for their exception being some suspicion of a murder (*Herod.*, i. 147). But, unless at Athens, little is known of the manner in which it was conducted. There it fell in the month of *Pyanepsion*, corresponding nearly to our November, and lasted three days, the occasion being one on which the various *phratriæ*, or clans of Attica, met to arrange matters proper to each, and hence the name has been traced to a form, ἀπατόρια, in the sense of ἁμαπατόρια, or ὁμοπατόρια, meaning "a ceremony for the assertion of relationship." According to the popular derivation, however, the festival originated 1100 B.C., to commemorate an encounter between the Athenians and Bœotians, in which the king of Attica, Thymœtes, having been challenged to single combat by the Bœotian king, Xanthius or Xanthus, and, being afraid to meet him, accepted as a substitute Melanthus, an exile, with the condition of his succeeding if victorious, to the throne of Attica. When the combatants met, Melanthus, to throw his adversary off his guard, declared that he was being unfairly assisted by a man wearing a black goat's skin. Xanthus turned to look, and while in the act was struck down. This deceit, ἀπάτη, was the origin of the festival! The man in the black goat's skin was believed to have been Dionysus (Bacchus) Melanaigis. On the first day of the festival, called *Dorpia* or *Dorpeia*, banquets were held towards evening. On the second, *Anarrhysis*, a sacrifice of oxen was offered at the public cost. On the third day, κουρεῶτις, children born since the last festival were presented by their fathers or guardians to the assembled *phratores*, and, after an oath had been taken as to their legitimacy, and the sacrifice of a goat or a sheep offered, their names were inscribed in the registers. On this day also it was the custom for boys still at school to declaim pieces of poetry, and to receive prizes. (A. S. M.)

APE

APE (*aap;* Dutch; *Affe*, German; *Affo*, Old German; *apa*, Swedish and Irish; *epa*, Welsh), a word of uncertain, and not improbably African origin, and by some supposed to have originated in an imitation of the animal's "chatter."

The zoological group denoted by the term "ape," when used in its widest sense, includes animals known by the familiar terms of "monkeys" and "baboons," as well as others bearing the less known names of "sapajous," "sakis," and "marmosets." In a more restricted sense the term "ape" is sometimes emphatically applied to those of the whole group which are most man-like in structure, namely, to the orang, the chimpanzee, the gorilla, and the gibbons.

Certain other animals, of very different structure, are generally associated in the same ordinal group with the apes. These other animals are the lemurs, or lemuroids; called also "half-apes," after their German designation of *Halbaffen*.

By Linnæus these creatures, together with bats and man, were placed in his highest and first order, to which he gave the name "*Primates*," dividing its contents into the four genera, *Homo*, *Simia*, *Lemur*, and *Vespertilio*. The bats are now by universal consent removed from the order; and some eminent naturalists, notably Professor Alphonse Milne-Edwards, are disposed to remove from it the lemurs also; but in every case there can be no question but that the latter animals must at least rank as a *sub-order*, for which the term "*Lemuroidea*" has been proposed.[1]

The question whether man should or should not be placed in the same zoological order with the apes, must be decided according to the principles of classification adopted. If that classification be purely morphological, *i.e.*, be determined by form and structure only, he cannot well be separated from them, at least by any naturalist who would also include the lemurs in such order. The Linnean name "*Primates*" has been retained for the ape order, not only by naturalists who (like Professor Huxley) retain man within its limits; but also by others (*e.g.*, the Professors Isidore Geoffroy St Hilaire and Gervais), who consider that he should be excluded from it. Cuvier, on the other hand, proposed for the ordinal group of apes and lemurs only the term *Quadrumanes* (or four-handed), giving to that order, within which he placed man alone, the antithetical term *Bimanes*. In this he has been followed by very many naturalists, and in England, amongst others, by Professor Owen; and, perhaps, the majority of writers since Cuvier have bestowed on two distinct *orders* the names *Quadrumana* and *Bimana* respectively.

Priority of use determines our preference for the Linnean name "*Primates*," but this preference is reinforced by considerations derived from anatomy and physiology.

The whole of the apes, as indeed the whole of the half-apes also, differ from man in having the great toe, or (as it is called in anatomy) the *hallux*, so constructed as to be able to oppose the other toes (much as our thumb can oppose the fingers), instead of being parallel with the other toes, and exclusively adapted for supporting the body on the ground. The prehensile character of the hallux is fully maintained even in those forms which, like the baboons, are terrestrial rather than arboreal in their habits, and are quite quadrupedal in their mode of progression. It was this circumstance that led Cuvier to bestow the name *Quadrumanes* upon the apes and lemurs. Now, if we accept, with Professor Owen, as the definition of the word "foot," "*an extremity in which the hallux forms the fulcrum in standing or walking*," then man alone has a pair of feet. But, anatomically, the foot of apes (as well as that of half-apes) agrees far more with the foot of man than with his hand, and similarly the ape's hand resembles man's hand and differs from his foot. Even estimated physiologically, or according to use and employment, the hand throughout the whole order remains the *special* prehensile organ; while the predominant function of the foot, however prehensile it be, is constantly locomotive. Therefore the term *Quadrumana* is apt to be misleading, since, anatomically as well as physiologically, both apes and men have two hands and a pair of feet.[2]

Apart then from man, the apes constitute the first sub-order of that which is the most man-like order of the class *Mammalia* (beasts), and which bears the name "*Primates*."

Such being the position of apes as a whole, they are zootomically divisible into a number of more and more subordinate groups, termed respectively *families*, *sub-families*, and *genera*.

The following table exhibits what is believed to be, on the whole, the most natural and convenient arrangement of these groups of apes :—

Family I. SIMIADÆ. Sub-Families.	1. *Simiinæ*,	Simia. Troglodytes. Hylobates.
	2. *Semnopithecinæ*,	Semnopithecus. Colobus.
	3. *Cynopithecinæ*,	Cercopithecus. Macacus. Cynocephalus.
Family II. CEBIDÆ. Sub-Families.	1. *Cebinæ*,	Ateles. Eriodes. Lagothrix. Cebus.
	2. *Mycetinæ*,	Mycetes.
	3. *Pitheciinæ*,	Pithecia. Brachyurus.
	4. *Nyctipithecinæ*,	Nyctipithecus. Chrysothrix. Callithrix.
	5. *Hapalinæ*,	Hapale. Midas.

The limits of the present article exclude altogether from consideration the half-apes or *Lemurs*.

The whole of the apes may be characterised by the following zoological definition, the meaning of the terms of which will be explained later :—

[1] See *Proceedings of the Zoological Society* for 1864, p. 635.

[2] See further on this subject, *Philosophical Transactions* for 1867, p. 362.

Unguiculate, claviculate mammals, with a deciduate, discoidal placenta and small allantois; with orbits encircled by and separated off from the temporal fossæ by plates of bone; lachrymal foramen not opening on the cheek; posterior cornua of os hyoides longer than the anterior cornua; dental formula as in man, save that a true molar may be wanting, or that there may be a premolar in excess, or both; brain with well-developed posterior cornua and with the cerebellum quite covered by the cerebrum, or only very slightly uncovered; hallux opposable, with a flat nail or none; a well-developed cæcum; penis pendulous; testes scrotal; only two mammæ, which two are pectoral; uterus not two horned; thumb sometimes rudimentary or absent.

The great group of apes thus characterised is divisible, as the foregoing table indicates, into two great families, which are sharply distinguished by geographical distribution as well as by structural differences. The first of these families, SIMIADÆ, is strictly confined to the warmer latitudes of the Old World. The second family, CEBIDÆ, is as strictly confined to those of the New World.

Of the three sub-families into which the Simiadæ are divided, the first, SIMIINÆ, contains only the orang, the chimpanzee, the gorilla, and the gibbons. These are the creatures which, anatomically, are the most like man of all the apes, on which account they are often called the "anthropoid" apes. They are also termed, on account of the relative breadth of their breast-bone or sternum, the "latisternal" or "broad breast-boned" apes.

The orang (*S. satyrus*) constitutes the genus *Simia*, which gives its name to the whole family (*Simiadæ*), as well as to the sub-family (*Simiinæ*) to which it belongs. Of this genus there is but one certain species, which is, however, subject to considerable variation. The orang is exclusively confined to the islands of Borneo and Sumatra, where it frequents the swampy forests near the coast. It attains a

FIG. 1.—The Orang-outan (*Simia satyrus*). From Mr Wolf's sketch at Zoological Gardens.

height of about 4 feet 4 inches; but its bulk is considerable, its legs, however, being exceedingly short. Its arms, on the contrary, are exceedingly long, reaching down to the ankle when the animal is placed in an erect posture. In harmony with this structure the animal rarely assumes, naturally, a truly erect posture, but walks resting on the knuckles of its hands and the outer sides of its feet, the soles of the latter being turned mainly inwards. Its motions are ordinarily very slow and deliberate, and its demeanour in captivity is languid and melancholy. It is, in a wild state, exclusively a vegetable feeder, and arboreal in its habits, forming in the trees a sort of nest or shelter of interwoven branches. The animal is covered with long, reddish-brown hair, and there are no naked spaces on the hinder part of the trunk. The forehead is rounded and rather high. Adult males are furnished with a longish beard on the chin, and they may also develop a large warty prominence, consisting of fibro-cellular tissue, on each side of the face. There is no vestige of a tail. The hands are very long; but the thumb is short, not reaching to the end of the metacarpal bone of the adjacent (*index*) digit. The feet have exceedingly long toes, except the great toe (*hallux*), which only reaches to the middle of the proximal phalanx of the index digit of the foot. The hallux is often destitute not only of a nail, but of the second or distal phalanx also; it nevertheless possesses an *opponens* muscle. The orang has twelve pairs of ribs, and has, compared with man, an extra wrist bone, or an *os intermedium* in its carpus. The brain of the orang has the cerebrum greatly convoluted, and is altogether more like the brain of man than is that of any other ape. A prolongation is developed from each ventricle of the larynx, and these processes in the adult become enormous, uniting together in front over the windpipe, and forming one great sac which extends down between the muscles to the axilla. There are, however, no cheek pouches. The canine teeth, especially of the adult males, are very large.

The chimpanzee and gorilla together form the genus *Troglodytes*. Both of these species agree with the orang in being destitute of any rudiment of a tail, in having no cheek pouches, and no naked spaces at the hinder part of the trunk, as also in possessing tusk-like canines, and in the habit of resting on the knuckles of the hand in walking

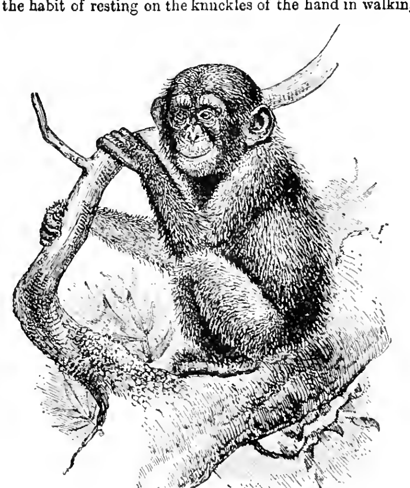


FIG. 2.—The Chimpanzee (*Troglodytes niger*). From Mr Wolf's *Sketches*, vol. i. pl. i.

on the ground and of mainly dwelling in trees. The chimpanzee (*T. niger*) is found in Western Africa, from the Gambia to the Benguela, and extending inland to 28° E.

long. It is the most man-like of the latisternal apes in the proportions of its arms, as these only reach a little below the knees when the body is placed upright. It is of moderate stature, never appearing to exceed 5 feet in height. In disposition it is lively and intelligent, and its playfulness in captivity contrasts greatly with the lethargy

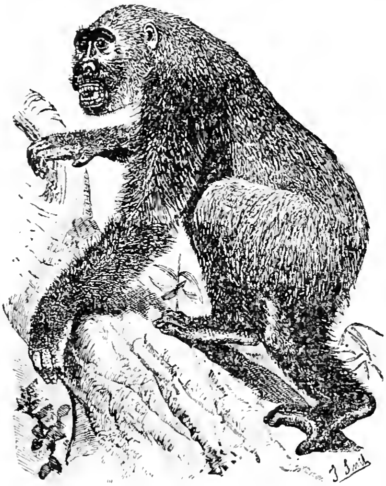


FIG. 3.—The Gorilla (*Troglodytes gorilla*). From *Trans. Zool. Society* vol. iv. pl. 43

of the orang. The forehead is not rounded, but a bony, supra-orbital ridge extends transversely above the eyes. Its ears are very large, and it has distinct eyebrows, eyelashes, and whiskers. The pollex reaches nearly or quite to the base of the first phalanx of the index of the hand, and the hallux to the proximal end of the second phalanx of the index of the foot. There is no *os intermedium* in the carpus. The laryngeal sacculus may, as in the orang, extend downwards to the axilla. There are thirteen pairs of ribs.

The gorilla (*T. gorilla*) is also West African, but has a less extended range than the chimpanzee, namely, between the Cameroon and Congo rivers only. It is the largest ape known, attaining a bulk of body considerably exceeding that of man, though, on account of the shortness of its legs, it never seems to exceed the height of 5 feet 6 inches. It was first made known to moderns by Dr Thomas Savage, but it appears to have been seen by Hanno of Carthage,[1] in his voyage south of the pillars of Hercules. The gorilla has not such dark hair as has the chimpanzee, being blackish-dun in colour, and becoming grey when old. Its skin, however, is black. Its arms are longer than those of its congener, reaching half-way down the shin. Its pollex reaches but very little beyond the proximal end of the first phalanx of the index of the hand (slightly further than in the chimpanzee), and its hallux to about the distal end of the proximal phalanx of the index of its foot. The fingers and toes, however, are curiously syndactyle, being bound together by the integument to the ends of the proximal phalanges. The forehead is not rounded, the supra-orbital crest being more prominent than even in the chimpanzee; the ears too are smaller relatively. The larynx is provided with enormous air-sacs, communicating with the ventricles and meeting over the trachea, and extending to the axilla with age. There is no os intermedium in the carpus, and there are thirteen pairs of ribs.

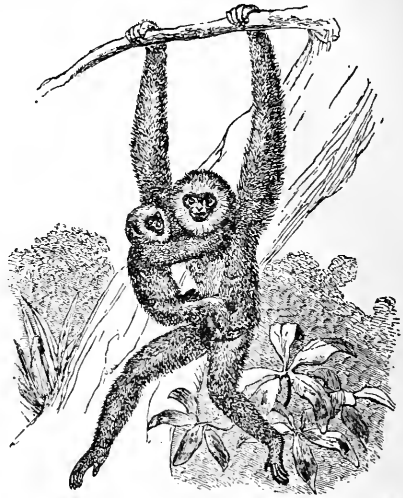


FIG. 4.—The Entellos-like Gibbon (*Hylobates entelloides*). From *Archives du Muséum*, vol. ii. pl. 29.

The gibbons, or long-armed apes, form the genus *Hylobates*, confined in the present day to the south-eastern continent of Asia and the Indian Archipelago. There are several species, but individual variation and sexual difference in colour are so great that their limits are not yet well defined. One well-marked species, the largest of the genus, is the siamang (*H. syndactylus*) of Sumatra, which is remarkable as being the ape with the best developed chin and widest breast-bone. It has also the second and third toes united by skin down to the last joint of each. Another well-marked form is the hoolock of Assam (*H. hoolock*). In the gibbons we first find that part upon which the body rests in sitting provided with naked callous spaces, termed (from that part of the haunch bone to which they are applied, the *ischium*) "ischial callosities;" they are, however, still small. Though vegetable feeders, the gibbons are probably less exclusively so than are the yet higher apes before noticed. In captivity their manners are gentle, although their activity is surprising; especially remarkable are the enormous distances they can swing themselves by their long arms. In spite of this length of arm, which seems to render their bodily proportions so unlike those of man, the length of leg, when compared with the length of the trunk of the body, is more human than in either of the two preceding genera. Another point in which they approach nearest to man, is the quality of voice which at least some of the species (*e.g. H. hoolock*) possess.

None of the gibbons have any rudiment of a tail, and they have no cheek pouches, but the canines are elongated and tusk-like. When the body is erect, the arms are so long that they reach the ground. The hallux is well developed, reaching to the middle or end of the proximal phalanx of the index of the foot, while the pollex only attains to, or reaches a little beyond, the proximal end of the

[1] See Pliny, *Nat. Hist.*, ii. 169, v. 8, vi. 200, ed. Sillig.

proximal phalanx of the index of the hand. There is an os intermedium in the carpus. The laryngeal sacs are no longer prolongations of the laryngeal ventricles, but open into the larynx above the false vocal chords. The number of species is, as has been said, doubtful, but the following kinds are often reckoned as distinct,—*Syndactylus, Lar, Leuciscus, Agilis, Mulleri, Rafflesii, Hoolock, Entelloides, Pileatus,* and *Funereus.*

On leaving the gibbons, which close the series of Anthropoid apes, we come at once upon animals of very different aspect, and from creatures devoid of any vestige of a tail, we pass at once to monkeys, which have that organ at its maximum of development. These are the two genera *Semnopithecus* and *Colobus*, which so closely resemble each other as to be hardly separable, but for their different geographical distributions. Together they form the sub-family *Semnopithecinæ*, and agree in having, as well as the long tail, arms shorter than the legs, and a slender body. They have small ischiatic callosities, but no cheek pouches. Their nails are compressed and pointed. Their stomach is very elongated and exceedingly sacculated, and their hindermost lower grinding tooth has five tubercles. The laryngeal sac opens medianly into the front of the larynx, and is an extension of the thyro-hyoid membrane. The thumb is small or absent.

The genus *Semnopithecus*, in which there is a small thumb, is confined to South-Eastern Asia from the Himalaya southwards, the Indian Archipelago being its head-quarters. One species, *S. entellus* (the hounaman), is an object of religious veneration to the Hindoos. Another very remarkable kind is found in Borneo. It is *S. asalis* (the kahau, or proboscis monkey), and, as its name im-

FIG. 5.—The Proboscis Monkey of Thibet (*Semnopithecus roxellanæ*). From Milne-Edwards's *Recherches des Mammifères*, pl. 36.

plies, it has an exceedingly long nose. In the young state, the nose is much smaller relatively, and is bent upwards. No similar structure was known to exist in any other ape whatever till quite recently. Now, however, the Rev. Father David (a Lazarist missionary, who has made many other important discoveries in zoology), has found high up in the cold forests at Moupin in Thibet, a large well-clothed species, with a small but distinct nose excessively turned up, on which account the name *S. roxellanæ* has been bestowed upon it. It is remarkable that a form, reminding us of the young condition of *S. nasalis*, should have been discovered in a region so remote from the island of Borneo as is Thibet. It is also very remarkable that a monkey of a genus the home of which is the warm Archipelago of India, should be found in forests where frost and snow last several months in the year, when their only food is tree buds, and tender shoots and twigs. The species of the genus to be mentioned, besides *Entellus, Nasalis,* and *Roxellanæ*, are,—*Nemœus, Leucoprymnus, Latibarbatus, Obscurus, Nestor, Cucullatus, Johnii, Priamus, Cristatus, Maurus, Femoralis, Auratus, Frontatus, Siamensis, Mitratus, Flavimanus, Rubicundus, Albipes, Nigripes,* and *Schistaceus.*

The genus *Colobus* is exclusively African, but the species composing it only differ from the *Semnopitheci*, in that the thumb is generally absent or reduced to a small tubercle, which may or may not support a nail. The species are —*Guereza, Verus, Temminckii, Vellerosus, Fuliginosus, Satanas, Angolensis, Ursinus, Ferrugineus, Kirkii,* and *Palliatus.*

We now come to the concluding genera of the apes of the Old World, together forming the third sub-family *Cynopithecinæ*. This is a very natural group, but one exceedingly difficult to subdivide in a satisfactory manner, because the different characters gradually alter as we pass from round-headed, long-tailed, and comparatively slender monkeys to dog-faced, short-tailed, and massive baboons. All the *Cynopithecinæ* agree in having pretty well-developed thumbs and a single stomach, as also in having the sides of the face distensible, serving as pockets wherein food may be temporarily stored, and technically called "cheek pouches." The hair is often annulated. The ischiatic callosities are larger than in the forms hitherto noticed, and in some kinds these parts become greatly swollen at the period of sexual excitement, the enlargement extending sometimes (as in *Macacus cyclopis*) even to the tail. The male external generative organs tend to assume a bright and varied coloration, which is often accompanied with vivid hues on and about the face. By common consent, the *Cynopithecinæ* are divided into at least three genera, and by some naturalists (*e.g.* M. Isidore Geoffroy St Hilaire) they have been divided into as many as seven.

The first genus, *Cercopithecus*, includes those species of the sub-family, which by their length of tail and comparative slenderness, most nearly approach the members of the preceding sub-family. Many of the species (*e.g.* the Diana and white-nosed monkeys) are very attractive animals. Commonly the *Cercopitheci* have four tubercles to the last lower molar. The talapoin monkey (*C. talapoin*) has been made the type of a separate genus (*Miopithecus*), because it has but three such tubercles, while the mangabeys and white-eyelid monkeys (*C. æthiops, collaris,* and *fuliginosus*) have been separated off into a genus *Cercocebus*, because in them the last lower molar has five tubercles. All the *Cercopitheci* (including *Miopithecus* and *Cercocebus*) are African forms. Besides those already mentioned, the following species have been described by authors :—*Nictitans, Petaurista, Cephus, Mona, Monoides, Diana, Labiatus, Leucampyx, Pygerythrus, Lalandii, Sabæus, Cynosurus, Ruber, Pyrrhonotus, Callitrichus, Rufoviridis, Albigena, Erythrogaster, Werneri, Melanogenys, Ludio, Erythrarchus, Ochraceus, Flavidus, Lunulatus,* and *Erxlebenii.*

The next genus, *Macacus*, is Asiatic, with the exception of the Barbary ape, or magot (*M. inuus*), which is found in Northern Africa and on the Rock of Gibraltar. Already, in some of the *Cercopitheci*, notably in the mangabeys, the muzzle has acquired a greater prolongation. This becomes still more marked in the *Macaci*. It is this greater production of muzzle, the greater size in the ischiatic callosities, the frequent shortness of the tail, and the different geographical distribution, which can alone be given as differentiating these animals from the *Cercopitheci*. In some kinds the tail is long. Occasionally (as in the wanderoo, *M. silenus*) it is tufted at the end and short. Sometimes, as in *M. nemestrinus*, it is very short, and occasionally, as in *M. inuus*, it is absent. On account of this absence of tail, this species has sometimes been made the type of a distinct genus, *Inuus*.

Another species, *M. niger* (from Celebes and Batchian), has, on account of the much greater production of its muzzle, been made the type of another genus, termed *Cynopithecus*.

The *Macaci* present us with the most northern forms of apes, namely, that of Gibraltar, and *M. speciosus* of Japan. Father David has lately brought from Moupin, in Thibet, a new species (*M. thibetanus*) which inhabits snowy mountains, and is clothed suitably for such a habitat, in thick and dense fur. In addition to the *Macaci* already mentioned, we may name the species *Sinicus*, *Pileatus*, *Aureus*, *Cynomolgus*, *Silenus*, *Rhesus*, *Nemestrinus*, *Thibetanus*, *Ochreatus*, *Palpebrosus*, *Brunneus*, *Rufescens*, *Rheso-similis*, *Erythræus*, *Cristatus*, *Tcheliensis*, *Cyclopis*, *Inornatus*, *Sancti-johannis*, *Lasiotus*, *Assamensis*, *Maurus*, *Philippinensis*, and *Nigrescens*.

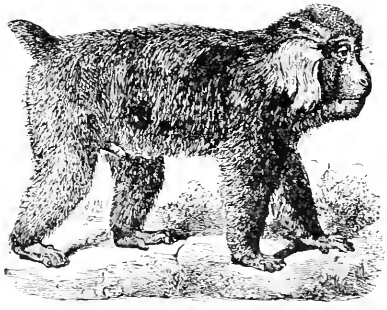


FIG. 6.—The Thibet Macaque (*Macacus thibetanus*). From Milne-Edwards's *Recherches des Mammifères*, pl. 34.

The remaining apes of the Old World are the baboons, which are entirely confined to Africa, and to that part of Asia which is zoologically African, namely, Arabia. These animals, which constitute the genus *Cynocephalus*, have the characters of the *Macaci* still further developed in having still larger callosities, and a muzzle so extremely produced as to give the head the appearance of that of a dog, whence their generic name. The general form has also here become very massive, and the limbs being sub-equal in length, the appearance, like the locomotion, is quadrupedal. But the baboons have not only the muzzle so greatly produced, they have also the nostrils terminal in position like those of a hound and unlike what we have yet met with. The species *C. gelada* of Abyssinia and *C. obscurus* form exceptions to this condition, as they have the nostrils placed as in the *Macaci*, on which account they have been made the type of a distinct genus, *Theropithecus*.

In the other *Cynocephali*, the tail may be moderately long, as in *C. hamadryas*, or very short, as in the mandrill, *C. mormon*. In the last-named species we again meet with much bulk of body, as it exceeds the chimpanzee in this respect. It is also remarkable for its bright coloration, the cheeks being brilliant blue, the

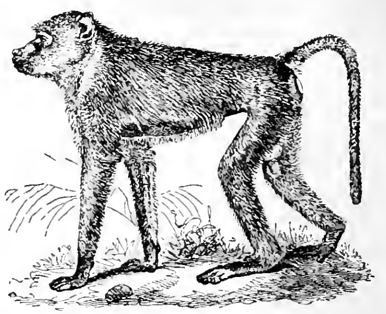


FIG. 7.—The Babuin Baboon (*Cynocephalus babuin*). From *Archives du Museum*, vol. ii. pl. 34.

nose vermilion, and the beard golden-yellow. Other species described are *Sphinx*, *Olivaceus*, *Babuin*, *Anubis*, *Obscurus*, *Doguera*, *Porcarius*, and *Leucophæus*.

The baboons are the least arboreal and the least frugivorous of the Old World apes, some species, *e.g.*, the chacma of Southern Africa (*C. porcarius*), living habitually amidst rocks, and feeding on eggs, large insects, and scorpions, as well as on vegetable food.

In the whole series of Old World apes we find the same number of different kinds of teeth as in man, the dental formula being—

$$\text{I. } \frac{2-2}{2-2} \text{ C. } \frac{1-1}{1-1} \text{ P.M. } \frac{2-2}{2-2} \text{ M. } \frac{3-3}{3-3} = \frac{16}{16};$$

or thirty-two teeth in all. Again, in the whole series the two nostrils are divided the one from the other by a narrow septum; and if the skull be examined, a long bony tube (the *meatus auditorius externus*) is seen to lead inwards on each side to the internal ear. Moreover, the thumbs, when present, are always more or less opposable to the other fingers.

In passing to the second family of apes—the *Cebidæ*, or apes of the New World—we find them to form a very distinct and easily-defined group, and a little experience readily enables an observer to pronounce at a glance that a given ape belongs either to the Old or the New World, as the case may be.

The *Cebidæ* are more thoroughly arboreal in their habits than are the *Simiadæ*. Ranging over tropical America, they have their headquarters in the forests of Brazil, a region where most animal forms put on a more decidedly arboreal character. Accordingly, it is amongst the *Cebidæ* that we meet with, for the first time, a special arboreal organ—namely, a prehensile tail. Such a tail has its free end curled, and capable of grasping with greater or less tenacity the objects about which it coils. Again, in the *Cebidæ*, the septum between the nostrils is broad, instead of narrow, imparting to the physiognomy a markedly different character. In passing to these American apes we entirely lose cheek pouches and ischial callosities; while the thumb, even where best developed, is capable of but a very partial opposition to the other fingers, bending almost in the same plane with the latter, so as to be more like a fifth finger than a thumb. We also constantly find an additional premolar tooth on each side of each jaw, and that bony tube, the *meatus auditorius externus*, is wanting

None of the *Cebidæ* attain the bulk of the larger baboons, nor have any such prominent muzzles as have the latter.

The *Cebidæ* are subdivisible into five sub-families: *Cebinæ*; 2. *Mycetinæ*; 3. *Pitheciinæ*; 4. *Nyctipithec* and, 5. *Hapalinæ*.

The first sub-family consists of the four genera, *Ateles*, *Eriodes*, *Lagothrix*, and *Cebus*.

The genus *Ateles* is composed of the spider monkeys, which, as their name implies, have long and slender limbs. They have also a very long tail, which is in the highest degree prehensile, being naked beneath towards the tip, for more secure prehension. So powerful is the grasp of this organ that the whole body can be sustained by it alone. It even serves as a fifth hand, as detached objects, otherwise out of reach, can be grasped by it, and brought towards the hand or mouth. Their prehension is in other respects exceptionally defective, as the spider monkeys alone amongst the *Cebidæ* (like the *Colobi* amongst the *Simiadæ*) have the thumb reduced to a mere tubercle. Their laryngeal sac opens medianly, but from the back part of the trachea, just below the cricoid cartilage.

The spider monkeys are very gentle in disposition, and, by this and by their long limbs and special fitness for tree-life, seem to represent in an analogous manner in the New World the gibbons of the Old. Nevertheless, in spite of their admirable adaptation for arboreal life, their comparatively slow progression offers a marked contrast to the vigorous agility of the gibbons. Their hair is long, but not woolly. Species described are—*Ater*, *Pentadactylus*, *Paniscus*, *Marginatus*, *Belzebuth*, *Melanochir*, *Hybridus*, *Vellerosus*, *Albifrons*, *Rufiventris*, *Variegatus*, *Griescens*, *Cucullatus*, and *Fuscipes*.

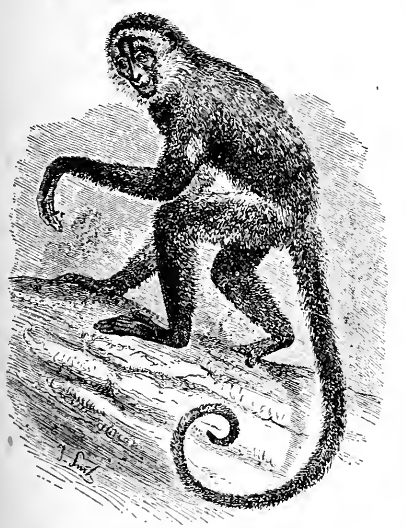


FIG. 8.—The Black-handed Spider Monkey (*Ateles melanochir*). From *Pro. Zool. Soc.* 1871, pl. 15

Three species of ape having much general resemblance to spider monkeys have been erected into the genus *Eriodes* (*E. arachnoides*, *hemidactylus*, and *hypoxanthus*). These animals, which are from South-Eastern Brazil, have the fur woolly, the thumb more or less rudimentary, the nails very laterally compressed, and the nostrils more approximated than in the other *Cebidæ*.

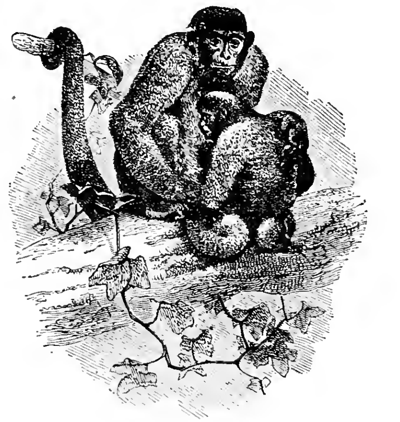


FIG. 9.—Humboldt's Lagothrix (*Lagothrix Humboldtii*). From *Pro. Zool. Soc.* 1863, pl. 31.

The woolly monkeys, *Lagothrix*, differ from the two preceding genera in having the thumbs well developed. Their nails are compressed laterally, as in *Eriodes*, but their nostrils are not approximated. As their name implies, their fur is woolly. Like *Eriodes* and *Ateles*, they have the tail strongly prehensile, and naked beneath towards the tip. The species which have been described as distinct are—*Canus*, *Humboldtii*, *Castelnaui*, *Tschudi*, and *Geoffroyi*.

The genus *Cebus*, the typical genus of American apes, is composed of the sapajous, so commonly seen in captivity, and so much used for the exhibition of tricks of various kinds. Smaller in size, they are more robust in form than are the spider monkeys. They have well-developed thumbs, and their tail is curled at the end, but, not being naked beneath, is less strongly prehensile than in the three preceding genera. The sapajous have a pleasing voice, a flute-like whistling tone. The different species are very ill-defined, the individual differences being so numerous and so considerable. The species described are the following:—*Capucinus*, *Hypoleucus*, *Elegans*, *Robustus*, *Apella*, *Cirrifer*, *Flavus*, *Castaneus*, *Barbatus*, *Frontatus*, *Chrysopus*, *Variegatus*, *Versicolor*, *Leucocephalus*, *Flavescens*, *Annellatus*, *Subcristatus*, *Capillatus*, *Fatuellus*, and *Vellerosus*.

The next sub-family of American apes is very distinct, consisting, as it does, of a single genus, *Mycetes*, composed of the howling monkeys. These creatures are the most bulky of the American apes, and are those the muzzles of which are the most projecting. If the spider monkeys may be considered the analogical representatives of the gibbons, the howlers may similarly be esteemed those of the baboons. They are sluggish, and apparently stupid animals, but have a wonderful power of voice, facilitated by an enormous distension of the body of the hyoid bone into a large, deep, bony cup, sheltered between the jaws, which are specially deep for that purpose. Into this cup is received one of the three or five sacs with which the larynx is provided. The thyroid cartilage is very large. The howlers have long, very prehensile tails, naked beneath towards the tips. Their thumbs are well developed. Some of the species show much brilliance of colour, with bright red or golden hair on the flanks. There is, however, so much individual variation, or so many local varieties, that the species are as yet very little determined. The sexual difference in colour is great in one species—the male being deep black, and the female pale straw colour. Amongst the species described may be named—*Seniculus*, *Ursinus*, *Caraya*, *Rufimanus*, *Niger*, *Villosus*, and *Palliatus*.

The third sub-family of American apes is composed of very peculiar forms, termed Sakis, which are subdivided into two genera, *Pithecia* and *Brachyurus*, according as the tail is long or short. They are together distinguished from all the *Cebidæ* yet noticed, by not having the tail prehensile, even when long; also by having the lower incisor teeth inclined forwards, instead of standing up vertically. Great differences as to the hair exist in this group, some having long hair over the whole body, others on the head, and others on the chin and cheeks, while a species of Brachyurus (*B. calvus*) has the head naturally bald. Of the genus *Pithecia*, the following species have been described:—*Leucocephala*, *Rufiventer*, *Monachus*, *Satanas*, *Chiropotes*, *Albinasa*, and *Chrysocephala*. Of *Brachyurus*, besides *Calvus*, only *Rubicundus* has as yet been described.

The *Brachyuri* are the only American apes with short tails, and they are the least arboreal, frequenting bushes rather than trees. They are very timid creatures, and gentle, and rather slow in their movements. It is but very rarely that any of the *Pitheciinæ* have been brought to Europe alive.

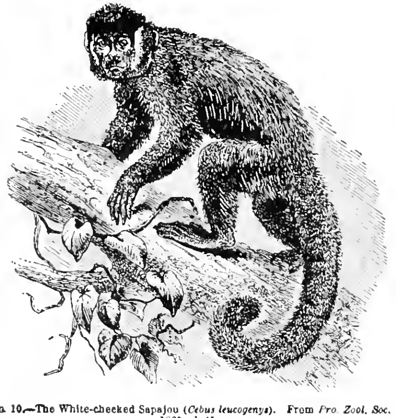


FIG. 10.—The White-cheeked Sapajou (*Cebus leucogenys*). From *Pro. Zool. Soc.* 1865, pl. 45

The next sub-family, *Nyctipithecinæ*, contains three genera, which have a long but not prehensile tail, fairly-developed thumbs, and vertical lower incisor teeth. These animals are, in part at least, insectivorous.

The typical genus, *Nyctipithecus*, contains only the night-apes, or douroucoulis (*N. felinus*, *lemurinus*, *oseryi*, *rufipes*, and *Spixii*), which have, in harmony with their noctural habits, enormous eyes. The orbits, though closely approximated, are nevertheless separated by a complete bony system. The head is rounded, but greatly drawn out posteriorly. The nostrils are rather approximated.

The beautiful little squirrel monkey, or Saimiri, and three allied species (*Ch. ustus*, *entomophagus*, and *Œrstedii*), form the genus *Chrysothrix*. They are distinguished from all other apes by the great backward prolongation of the bony cranium, the orbits of which, though smaller than those of *Nyctipithecus*, are, nevertheless, separated, but by an imperfect bony septum.

A few other kinds of American apes, together forming the genus *Callithrix*, somewhat resemble the night apes, but

FIG. 11.—The Lemurine Night Ape (*Nyctipithecus lemurinus*). From *Archives du Museum*, vol. iv. pl. 2.

that the eyes are much smaller, and the nostrils wider apart. They differ from *Chrysothrix* in having small canine teeth, and the tail furnished with long hairs. The species of this genus are—*Moloch*, *Personatus*, *Amictus*, *Gigo*, *Melanochir*, *Discolor*, *Donacophilus*, *Ornatus*, and *Castaneoventris*.

There remains now to notice but one more group of apes, those which have been classed as the last sub-family—the *Hapalinæ*, marmosets, or oustitis. These animals are so different from all that have gone before that there is probably almost as much to be said for ranking them as a family by themselves as for considering them, as is here done, but a sub-family. Much, however, as they differ from all the other apes, they manifest their affinity to the rest of the *Cebidæ* by the absence of the *meatus auditorius externus*, and by the presence of the extra premolar tooth on each side of each jaw. They have, however, the same total number of teeth as have man and the *Simiadæ*. This is occasioned by their not possessing any third true molar, either above or below; so that their dentition thus differs from that of the Old World apes in two points, instead of only one. In all the apes we have yet noticed, except the orang, the hallux is well developed, while in the marmosets it is exceedingly small. The hand, however, is yet more exceptional, as the thumb is not at all opposable, while, in common with all the other fingers, it is furnished with a long, curved, and pointed claw. The tail is not prehensile, but long, and furnished with more or less elongated hairs. In several, and especially the more commonly seen species, a tuft of long hairs projects outwards and backwards on each side of the head. These animals are very small, the largest being about the size of squirrels. They are, like squirrels, active in their motions, and arboreal in their habits, living in small troops, and eating insects as well as fruit. They are very difficult to keep in captivity in northern climates; but, nevertheless, they have occasionally bred in England, bringing forth as many as three at a birth, while all the other apes habitually bring forth but one. There are many different species of marmosets, and they have been divided into two genera, according as the lower canine (eye) teeth are or are not

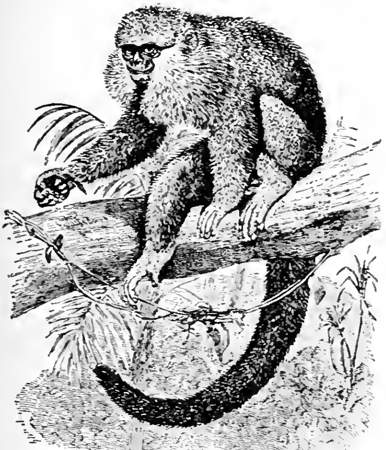


FIG. 12.—The Moloch Callithrix (*Callithrix moloch*). From *Archives du Muséum*, vol. iv. pl. 3.

decidedly larger than the incisors (cutting-teeth) between them; those kinds in which the inferior and incisor canines are almost of equal length being retained in the genus *Hapale*, while those in which the lower incisors are much shorter

FIG. 13.—The Golden Marmoset (*Midas chrysoleucus*). From *Pro. Zool. Soc.* 1868, pl. 24.

than the adjacent canines are taken to form the genus *Midas*. It seems doubtful, however, whether this generic distinction can ultimately be maintained, an intermediate condition existing in some forms. The species of the genus *Hapale* are—*Jacchus*, *Albicollis*, *Aurita*, *Humeralifer*, *Penicillata*, *Leucocephala*, *Melanura*, and *Pygmæa*.

The species of the genus *Midas* are—*Rosalia*, *Chrysomelas*, *Œdipus*, *Geoffroyi*, *Bicolor*, *Ursulus*, *Rufimanus*, *Labiatus*, *Mystax*, *Rufoniger*, *Devilli*, *Nigrifrons*, *Flavifrons*, *Illigeri*, *Weddellii*, *Leucogenys*, *Melanurus*, *Argentatus*, *Chrysoleucus*, *Lagonotus*, *Graellsi*, *Pileatus*, *Elegantulus*, and *Rufiventer*.

The characters of the subdivisions of the ape group may be synoptically expressed as follows:—

Family I. SIMIADÆ.

P.M. $\frac{2}{2}$ M. $\frac{3}{3}$; a bony *meatus auditorius externus;* pollex opposable, if present; tail never prehensile; internasal septum narrow; often cheek pouches; often callosities; pectoral limbs sometimes greatly exceeding the pelvic limbs in length; pelvic limbs never much longer than the pectoral limbs; Old World habitat.

Sub-Family I. *Simiinæ.*

Pectoral limbs much longer than pelvic limbs; no tail; no cheek pouches; cæcum with a vermiform appendix; sternum broad; sometimes no os intermedium in the carpus; stomach simple.

1. *Simia.*—Head vertically produced; arms reaching to ankle; ribs, twelve pairs; an os intermedium; hallux very small; no ischiatic callosities; hair red; habitat Asiatic.

2. *Troglodytes.*—Head not vertically produced; arms not reaching more than half down the shin; ribs, thirteen pairs; no os intermedium; hallux well developed; no ischiatic callosities; hair black, dun, or grey; habitat African.

3. *Hylobates.*—Head not vertically produced; arms reaching to the ground; an os intermedium; hallux well developed; small ischiatic callosities; habitat Asiatic.

Sub-Family II. *Semnopithecinæ.*

Pelvic limbs longer than pectoral limbs; tail very long; no cheek pouches; no vermiform appendix; sternum narrow; an os intermedium; ischiatic callosities; stomach complicated by sacculations; third lower molar always with five tubercles.

4. *Semnopithecus.*—Thumb small; habitat Asiatic.

5. *Colobus.*—Thumb generally absent; habitat African.

Sub-Family III. *Cynopithecinæ.*

Pelvic and pectoral limbs sub-equal in length; tail long, or short, or absent; cheek pouches; no vermiform appendix; sternum narrow; an os intermedium; ischiatic callosities present, often very large; stomach simple; third lower molar sometimes with four tubercles.

6. *Cercopithecus.*—Muzzle more or less short; callosities moderate; last lower molar generally with four tubercles; tail long; habitat African.

7. *Macacus.*—Muzzle more or less elongated; callosities rather large; last lower molar with five tubercles; tail long, short, or absent; nostrils not terminal; habitat Asiatic, North African, or European.

8. *Cynocephalus.*—Muzzle very long; callosities very large; last lower molar with five tubercles; tail more or less short; muzzle swollen by enlargement of maxillary bone; nostrils almost always terminal; habitat African.

Family II. CEBIDÆ.

P.M. $\frac{3}{3}$; no bony *meatus auditorius externus;* pollex never opposable; tail often prehensile; internasal septum broad; no cheek pouches; no ischiatic callosities; no vermiform appendix; always an os intermedium; pectoral limbs never more than slightly exceeding[1] in length the pelvic limbs; pelvic limbs sometimes much longer than the pectoral limbs; New World habitat.

Sub-Family I. *Cebinæ.*

M. $\frac{3}{3}$; incisors vertical; tail long and prehensile; hyoid bone moderate; thumb present or absent.

9. *Ateles.*—Form slender; limbs very long; fur not woolly; internasal septum as broad as usual in Cebidæ; thumb absent; tail distally naked beneath; nails not much laterally compressed and pointed.

10. *Eriodes.*—Form slender; limbs very long; fur woolly; internasal septum narrower than usual in Cebidæ; thumb rudimentary; tail distally naked beneath; nails exceedingly compressed laterally, and pointed.

[1] Only at all so in *Ateles*.

11. *Lagothrix.*—Form rather robust; limbs moderate; fur woolly; internasal septum as broad as usual; thumb well developed; tail distally naked beneath.

12. *Cebus.*—Form rather robust; limbs moderate; fur not woolly; internasal septum as broad as usual; thumb well developed; tail not naked beneath distally.

Sub-Family II. *Mycetinæ.*

M. $\frac{3}{3}$; incisors vertical; tail long and prehensile, naked beneath distally; hyoid bone enormous; form of body massive; thumb well developed; internasal septum as broad as usual.

13. *Mycetes.*

Sub-Family III. *Pitheciinæ.*

M. $\frac{3}{3}$; incisors inclined outwards distally; tail long or short, never prehensile; hyoid bone moderate; thumb well developed; internasal septum as broad as usual.

14. *Pithecia.*—Tail long.

15. *Brachyurus.*—Tail short.

Sub-Family IV. *Nyctipithecinæ.*

M. $\frac{3}{3}$; incisors vertical; tail long, not prehensile; hyoid bone moderate; thumb well developed.

16. *Nyctipithecus.*—Head rounded; eyes enormous; nostrils rather approximated.

17. *Chrysothrix.*—Head exceedingly elongated; eyes large, closely approximated; canines well developed; hair of tail rather short.

18. *Callithrix.* — Head small, depressed, and not elongated; nostrils widely separate; canines small; hair of tail elongated.

Sub-Family V. *Hapalinæ.*

M. $\frac{2}{2}$; incisors vertical; tail long, not prehensile; hyoid bone moderate; thumb elongated, not at all opposable; hallux very small; a long curved and pointed claw to all the digits, except the hallux.

19. *Hapale.*—Lower incisors and canines of equal length.

20. *Midas.*—Lower canines much longer than the lower incisors.

THE ANATOMY OF APES.

To describe generally the anatomy of apes would be, in fact, to describe in an elementary manner the general anatomy of man. It is necessary, therefore, here to assume that the reader has already an elementary knowledge of human anatomy, and to refer such readers as have not such knowledge to the article ANATOMY.

THE EXTERNAL FORM AND CLOTHING.

The difference in bulk between the different members of the group (*e.g. Troglodytes* and *Hapale*) is extreme, being greater than that between a man and a common squirrel.

The proportions of the body as regards the relative lengths of the two pairs of limbs one with the other, and both with that of the trunk, vary considerably. Both pairs may be much elongated, as in *Ateles* and *Hylobates*, and either sub-equally, as in the first of these genera, or with the arms very greatly in excess, as in the second. The legs may be excessively short, and the arms, at the same time, excessively long, as in the orang. Both pairs may be short and sub-equal, as often in the *Cynopithecinæ*. Only in the *Nyctipithecinæ* and *Hapalinæ* does the excess in length of the lower limbs over the upper exceed or equal that which is found in man. The length of the tail presents some noteworthy points. At its first appearance it is found at once at its greatest absolute length, and also greatly developed relatively, being about twice the length of the trunk. Its greatest relative length is, however, attained in *Ateles*, where it reaches three times the length of the trunk. The constancy of the degree of its development varies much in different groups. In the greater number of genera it is long in all the species, and in some (*Simia*, *Troglodytes*, and *Hylobates*) it is absent in all. In others it may be long or short, or completely absent, *e.g.*, in *Macacus*. The form of the head presents great differences—it may be rounded, as, *e.g.*, in *Ateles;* produced vertically, as in *Simia;* drawn out posteriorly to an extreme degree, as in *Chrysothrix;* or anteriorly, as in *Cynocephalus*. A production of the muzzle, necessitated by the presence of large teeth, exists already in *Troglodytes;* but in the baboons, not only is this prolongation carried much further, but the terminal position of the nostrils gives an emphatically dog-like aspect to the face.

The eyes may be small compared with the size of the head, as in the baboons; they may, on the contrary, attain a relatively enormous size, as in *Nyctipithecus*. They are always forwardly directed, and never much more separated one from another than in man. They may, however, be much more closely approximated, as notably in *Chrysothrix*.

The external ears are always well developed, and have very generally their postero-superior angle pointed. They may be large and small in the same genus, as in *Troglodytes*. Only in the gorilla do we find present, even in a rudimentary condition, that soft depending portion of the human ear which is termed the "lobule."

The nose has scarcely ever more than a very slight prominence, and yet an enormous development is to be met with in *Semnopithecus nasalis;* while in *S. roxellanæ* we find a sharply prominent, though smaller and extremely upturned, nose. The hoolock gibbon also possesses a prominent but slightly aquiline nose. The terminal position of the nostrils in *Cynocephalus* has been just mentioned. These apertures may be closely approximated, as in all the *Simiadæ*, or they may be separated one from the other by a broad septum, as in the *Cebidæ*, its breadth, however, varying somewhat in different genera, as, *e.g.*, in *Ateles* and *Eriodes*, and in *Callithrix* and *Nyctipithecus*.

The lips are generally thin, but may be very extensive, as in *Simia*.

The hands are generally provided with thumbs, though these organs (as in *Colobus* and *Ateles*) may be represented only by small nailless tubercles. The thumb (*pollex*) is more human in its proportions in the chimpanzee than in any other of the highest apes. As compared with the length of the hand, it is most man-like in the lowest *Cebidæ*, *e.g.*, *Chrysothrix* and *Hapale*. In spite of greater relative length, however, it may but little merit the name of thumb, as it is but slightly opposable to the other digits in any of the *Cebidæ*, and is not at all so in the *Hapalinæ*.

The *hallux* (great toe) is never rudimentary like the pollex. It is never, as it often is in man, the longest digit of the foot, but is constantly the shortest one. As compared with the entire length of the foot, it is most human in the chimpanzee and some gibbons, and smallest of all in the orang, and next smallest in *Hapale*. More detailed proportions will be more appropriately given in speaking of the skeleton.

Every digit is provided with a nail, except the hallux of the orang and those rudimentary tubercles already spoken of as representing thumbs in *Ateles* and *Colobus*. The nail of the hallux is flat in every species, but the other nails are never so flat as are the nails of man. The lateral compression of the nails becomes more strongly marked in some *Cebidæ*, *e.g.*, in *Eriodes*, but attains its extreme in the *Hapalinæ*, where every nail, except that of the hallux, assumes the form of a long, curved, and sharply-pointed claw.

All the apes, without exception, differ from man in having the body almost entirely clothed with copious hair, and especially in never having the back naked. In the gibbons, the *Semnopithecinæ*, and the *Cynopithecinæ*, naked spaces (*ischiatic callosities*) are present on that part of the body which is the main support in the sitting posture. These naked spaces increase in size as we descend through the series of *Cynopithecinæ*, and are subject to a tumefaction (sometimes excessive and extending to parts adjacent) at the season of sexual excitement. Such naked spaces are never found in any of the *Cebidæ*. No ape has so exclusive and preponderating a development of hair on the head and face as exists in most men. As to the head, long hair is found thereon in *Hapale œdipus* and in some of the *Semnopitheci*, whilst certain of the *Macaci* (as, *e.g.*, the Chinese bonnet monkey, *M. sinicus*) have the hair of the head long, and radiating in all directions from a central point on the sinciput. A beard is developed in the male orang, and *Cercopithecus Diana* has long hair on the cheeks and chin. The wanderoo (*Macacus silenus*) has the face encircled by a kind of mane of very long hairs, and many of the marmosets have a long tuft of hairs on each side of the head. The American apes exhibit some extremes respecting hair development. Thus in some of the howlers (as in some of the *Colobi* of the Old World) the hair of the flanks is greatly elongated. Some also have an elongated beard, but the latter structure attains its maximum of development in the couxio (*Pithecia satanas*). Some of *Pitheciinæ* have the hair of the whole body and tail very long, others have the head of the female furnished with elongated hair, while another species (*Brachyurus calvus*) has the head bald. Long hair may be developed from the shoulders, as in *Cynocephalus hamadryas* and *Hapale humeralifer;* or may form a tuft at the end of the tail, as in *Macacus silenus*, *Cynocephalus hamadryas*, and *Cynocephalus gelada*.

The direction of the hair may sometimes vary in nearly allied forms. Thus the hairs on the arm and forearm respectively may be so directed that the apices converge towards the elbow. Such is the case in most of the latisternal apes, yet in *Hylobates agilis* all the hair of both these limb segments is directed towards the wrist.

The hair presents generally no remarkable character as to its structure. It may, however, assume a very silky nature, as in *Hapale rosalia*, or assume the character of wool, as in *Eriodes*, and as in that remarkable form recently discovered by Father David, *Macacus thibetanus*. The last named species inhabits the snowy ranges of the Thibet mountains, and is provided for this habitat by a modification in its hairy clothing similar to that which suited the extinct mammoth for the severity of its Siberian home. This fact as to *M. thibetanus* has an interesting bearing on fossil forms, which we shall have to consider later.

Great brilliance of colour is sometimes found in the naked parts of the body, particularly in the *Simiadæ*, and especially in the regions of the face and sexual organs. In some of *Cercopitheci* and *Cynocephali*, rose colour, turquoise blue, green, golden yellow, and vermilion appear, in various combinations, in one or other or both of these regions, and become especially brilliant at the epochs of sexual excitement.

The Skeleton.

The skeleton of apes generally, if we except the tail, consists of but few more bones than that of man. The proportions of its parts, except as regards the relative length of the limb bones, are also much as in man; nor are their shapes, except those of the jaws and haunch bones, greatly different. The same general resemblance may be predicated of their minute structure, though the osseous tissue is generally rather dense, and the medullary cavity in the long bones small.

The Axial Skeleton.—The Skull.

The axial skeleton consists of the skull and the vertebral column, and the general shape of its more anterior portion, the skull, has already been indicated when speaking of the head as part of the external form. It is scarcely ever so evenly balanced on the occipital condyles as in man.

The artificial division of the skull into a *cranial* and a *facial* portion may be here conveniently adopted from human anatomy. The proportion of the latter portion to the former varies greatly from age and sex, owing mainly to the differences produced through the development of large and powerful canine teeth in the adult males of most species. This proportion also varies in an irregular manner as we descend (through the series of apes) from those which are most like man. Thus the facial part is already very large in the orang and chimpanzee, much more so than in *Semnopithecus*, where most of the ape cranial characters are moderately developed, or even than in many *Cercopitheci;* but it attains its maximum of relative size in the *Cynocephali*, above all in *C. porcarius*. In the *Cebidæ* the facial part is relatively smaller than in the *Simiadæ*, with the exception of *Mycetes*, while in *Chrysothrix* the facial portion of the skull is relatively smaller than even in man himself. The relation of the face to the cranium (or brain case) is best shown by the craniofacial angle, which is estimated by means of two lines, one drawn parallel to the base of the skull (from the front margin of the occipital foramen to the anterior end of the cerebral surface of the presphenoid), the other drawn from the front end of that base to the middle of the lower margin of the upper jaw.

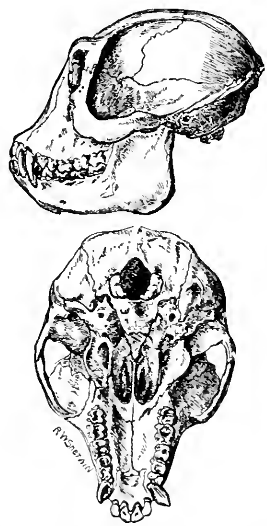


Fig. 14.—Side view and base of the skull of the Douc (*Semnopithecus nemæus*). From De Blainville.

No ape, especially no ape of the Old World, presents so elevated and rounded a contour in the frontal region as does man. It is in American forms, especially in the genus *Pithecia*, that we find the greatest resemblance to man in this respect: but the skull is lofty in the orang.

The convexity of the occiput is well marked in *Simia*, *Troglodytes niger*, and *Hylobates*, while in the inferior *Simiadæ* it is flat. Its maximum of production, however, is met with in the genus *Chrysothrix*.

Ridges for muscular attachment, or other bony prominences, more or less disguising the rotundity of the cranium, are very generally developed, except in the smallest species. Such ridges are met with at once at their very maximum of extent in *Troglodytes gorilla*. In that animal an

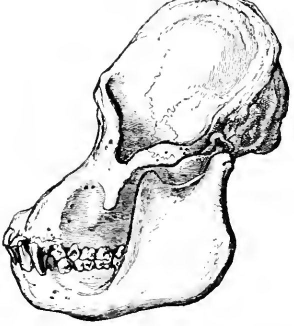


FIG. 15.—Side view of the skull of adult Orang (*Simia satyrus*). From *Trans. Zool. Soc.* vol. i. pl. 53.

enormous sagittal ridge traverses the middle of the sinciput antero-posteriorly, joining at its hinder end a prodigious lambdoidal crest for the insertion of the muscles of the neck. A very largely developed supra-orbital ridge runs transversely above the orbits, which it obliquely overhangs. The orang has no supra-orbital ridge, but in the other large *Simiadæ* all these ridges are more or less developed, and moderate sagittal and lambdoidal ridges are found in *Mycetes*, *Cebus*, *Pithecia*, and some other of the *Cebidæ*.

The mastoid process never attains in apes the large relative size it has in man; but it is prominent in the baboons and larger *Macaci*, as well as in *Troglodytes*, its development bearing relation to the size and weight of the head. As the mastoid diminishes we find that the under surface of the petrous bone assumes a swollen or "bullate" condition.

The orbits are in *T. gorilla* much as in man, but in the orang they are more rounded. They become very large in *Hylobates*, but attain an *enormous* size in *Nyctipithecus*. The extent to which each orbit opens into the adjacent temporal fossa, *i.e.*, the size and shape of the spheno-maxillary fissure, varies considerably. It is narrow and much elongated in the gorilla and in *Cynocephalus*; it is short in the *Semnopithecinæ* and in *Ateles*, but opens widely so as to expose the vidian foramen. It is most completely closed of all in *Mycetes*, where it sometimes all but disappears entirely. The olfactory chamber is narrow and deep in the lower *Simiadæ*. The cribriform plate of the ethmoid is generally separated from the presphenoid by the junction of the orbital plates of the frontal. Such, however, is not the case in the orang and chimpanzee, though it is so in the gorilla and in *Hylobates*.

The plane of the foramen magnum, as compared with the basi-cranial axis, varies with the projection of the occiput. It generally forms a less open angle with that axis than in man, but in *Chrysothrix* the angle is yet more open than in the human skull.

The zygomata are arched both outwards and upwards in the gorilla and some baboons, but decrease in relative as well as absolute size in the smaller forms,—notably in *Chrysothrix*. No long slender styloid process is normally attached to the skull, though such may be the case in *Cynocephalus*. The vaginal process never attains the size it does in man, though it is considerable in the gorilla, and sometimes noticeable in *Simia*. A bony *meatus auditorius externus* exists in all the *Simiadæ*, and is absent in the whole of the *Cebidæ*. In *Nyctipithecus* the ali-sphenoid is almost shut out from the parietal by the close approximation of the squamosal to the malar. In *Cebus* there is often a large malar foramen.

The premaxillary bones have throughout the apes a distinctness of development and a relative size not found in man, the sutures separating them from the maxillaries remaining visible, with the exception of the chimpanzee, after the adult dentition has been attained. The maxillaries themselves develop great swollen tuberosities in the *Cynocephali*, and a similar structure is developed even in *Macacus niger*.

The nasal bones are small, and generally flatter than in man. In the orang they are quite flat. They are convex in some of the *Semnopitheci* and in the *Cynocephali*, but the proboscis monkey has its nasal bones no more developed than have other species of its genus. The nasals seem to attain their maximum of relative size in *Mycetes*.

The lower jaw, or mandible, is always in one piece in adults. It is most man-like in the siamang, since we there alone find a slight chin. On the other hand, in *Hylobates* the angle is produced downwards and backwards, and we find the same in *Hapale*. Its maximum of relative size is attained in *Mycetes*, where the very broad ascending ramus serves to protect and shelter the enormously developed body of the hyoid.

Air cells may be developed, as in the gorilla, in the parts adjacent to the mastoid. Frontal sinuses are generally absent in the *Simiadæ*, being replaced by a coarse diploe. We find them, however, in the *Cebidæ*, and in *Cebus*

FIG. 16.—Side views of skull and hyoid bone of Howling Monkey (*Mycetes seniculus*). From De Blainville.

they are often larger than they are in man. The total length of the cerebral cavity is never so much as $2\frac{1}{4}$ times the length of the basi-cranial axis.

The sutures of the skull become entirely obliterated with age. In the gorilla the sutures assume a more dentated structure than is found in any other ape or in man. The internasal suture becomes early obliterated in most of the *Simiadæ*. The tentorium is sometimes ossified, as in the *Cebinæ* and *Mycetes*. From *Hylobates* downwards there is a small cerebellar fossa on the inner surface of the petrosal.

The Vertebral Column.

The vertebral or spinal column in all apes consists of the same regions as it does in man, and, with the exception of the coccygeal or caudal portion, these regions bear more or less the same proportions one to another as they do in him. That beautiful sigmoid curvature which exists in the human spine is not found in any ape; but the nearest approximation to it is found, not in the *Simiinæ*, but in the *Cynocephali*. In the latisternal apes the spinous processes are directed as in man, but in the rest their apices converge towards a single point in the back.

The *cervical region* is relatively more elongated than in man in *Hylobates*, *Cynocephalus*, and *Ateles*. The atlas is very man-like in *Troglodytes* and *Simia*, except that its transverse process is rather smaller and shorter relatively, and more curved dorsally. Except in *Ateles* and the *Simiinæ*, it is almost always perforated by the vertebral artery, instead of being merely grooved by it. In *Cynocephalus* the atlas is exceedingly massive, and may, by very rare exception, develop a spinous process. The spines of the cervical vertebræ do not bifurcate beyond the second, and generally the spine of the seventh vertebra is the longest, at least with the exception of that of the axis. In the gorilla and orang, however, the spines of the third, fourth, fifth, and sixth vertebræ are exceedingly elongated and longer than that of the seventh. The cervical neural laminæ are wider antero-posteriorly, the vertebral column being supposed horizontal, in *Hylobates* and *Ateles* than in other forms. Beneath the anterior articular process (prezygopophysis) a marked prominence—the metapophysis—may be developed, and is particularly conspicuous in *Ateles*. The costal plate of the sixth cervical is almost always larger than the homologous part in the other cervicals; but it predominates least in the chimpanzee and *Nyctipithecus*. The length of each centrum, compared with its breadth, is already greater in *Troglodytes* and *Simia* than in man. In others the dimensions are about equal, except that in *Cynocephalus*, *Ateles*, and *Mycetes* the length slightly exceeds the breadth.

The *dorsal vertebræ* vary in number from eleven, as sometimes in *Cercopithecus* and *Macacus*, to fourteen, as sometimes in *Hylobates*, or even to fifteen, as in *Nyctipithecus*. In the *Cebidæ*, above the *Hapalinæ*, the number rarely falls below thirteen In the orang the number is, as in man, twelve; in *Troglodytes* it is thirteen. The proportion of this region does not increase regularly with the number of its vertebræ. It attains its greatest relative length in *Ateles*, where it is over nine-twentieths of the total length of the spine without the tail; while in *Nyctipithecus* it is relatively shorter than in *Troglodytes* or *Simia*. The increase in transverse diameter of the bodies of the vertebræ, as we proceed from before backwards, is exceptionally great in *Hylobates* and *Cynocephalus* The *lumbar* region contains from four to seven vertebræ In the *Simiinæ* and *Cebinæ* there are four or five, though in *Cebus* the number is often six Its relative length is greatest in *Nyctipithecus*, *Chrysothrix*, the *Semnopithecinæ*, and *Cynocephalus*. It is least in the *Simiinæ* and *Ateles*. The number of dorsal and lumbar vertebræ, taken together, is seventeen in *Troglodytes* and *Simia*, eighteen (mostly) in *Ateles* and *Hylobates*, and nineteen in the rest. In most forms the dorsal and lumbar regions are about equal in length, but the lumbar region is the shorter in the *Simiinæ*, and less than half the length of the dorsal in the gorilla. The lumbar spinous processes are vertical, or project backwards in the *Simiinæ* and in *Ateles*; in the other forms they project strongly forwards, especially in the lower *Cebidæ*. The lumbar transverse processes always project outwards, more or less at right angles to the axis of the spine, or else forwards. In the *Simiinæ* and *Ateles* they are never inclined ventrally, but in some of the lower *Simiadæ* they begin to be so; in the lower *Cebidæ* they are so very decidedly. Only in *Troglodytes* and *Simia* are they inclined somewhat dorsally. In the last two genera the lumbar vertebræ are broader than their length; in most other forms length is in excess. The length of the individual lumbar vertebræ, compared with the dorsal (*e.g.*, the longest lumbar with the ninth dorsal), is greatest in the lower *Cebidæ*, rather less in the lower *Simiadæ*, and least in the *Simiinæ*.

The *sacrum* attains its greatest absolute length in the gorilla, but it is relatively longer than in man in all the *Simiinæ*. Of all the inferior apes, *Hylobates* has the relatively longest sacrum. The number of vertebræ in-included in the sacrum varies more or less with age. In the apes below the *Simiinæ* there are generally only two or three sacral vertebræ. In *Ateles*, *Hylobates*, and *Brachyurus*, there may be four; while in the *Simiinæ* there are always five, and sometimes six sacral vertebræ. In most apes the sacrum and lumbar vertebræ appear to lie in one slightly curved line. *Troglodytes* presents in this respect a great contrast to the human structure. In *Simia* the sacro-vertebral angle is rather more marked; but sometimes in *Cynocephalus* it is so much so as almost to rival that of man. The same may be said of the concavity of the anterior surface of the sacrum. It is most marked in the *Cynocephali*, and is more so in *Simia* than in *Troglodytes*. The sacrum gradually tapers posteriorly in *Troglodytes* and *Simia*, and more or less so in *Hylobates*. In the other *Simiadæ*, however, the sacrum is very wide at its anterior end, and it then very rapidly contracts backwards, so that the transverse diameter of the third sacral vertebra is very much narrower than that of the first. In the *Cebidæ* generally, and especially in *Ateles*, the contraction is not so marked.

The *caudal vertebræ* are always more than four in number, except in the *Simiinæ* and in *Macacus inuus*. In *Cynocephalus mormon* (the mandrill), however, there are some times only five vertebræ The short-tailed *Macaci* and *Brachyuri* have from about fifteen to seventeen caudal vertebræ, the shortness of the tail being occasioned rather by a diminution in the size of the component vertebræ than by a decrease in their number. In the other forms the number varies between twenty and thirty-three, the latter being the number attained in the genus *Ateles*. The

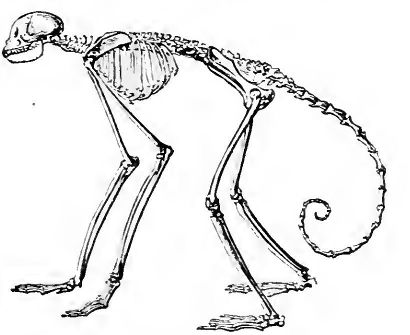


FIG. 17.—Skeleton of *Ateles Belzebuth*. From De Blainville

proportion borne by this region of the spine to all the more anterior parts is greatest in *Ateles*, almost three to one; in the other longest-tailed genera it is rarely so large as two to one. The absolute length of the tail is greatest in the *Semnopithecinæ*, where also the individual caudal vertebræ attain their greatest length, namely, two inches. The caudal vertebræ generally increase in length as we proceed backwards from the sacrum, till about the seventh, eighth, or ninth, which, with the tenth and eleventh, are the longest caudal vertebræ in most long-tailed forms. In *Ateles*, however, it is the eleventh, twelfth, thirteenth, and fourteenth vertebræ that are the longest. In the *Simiinæ* and in *Inuus* the caudal vertebræ decrease in length as we proceed backwards. Except in the forms just named, all the first four caudal vertebræ possess a complete neural arch, sometimes six are so provided, but only in *Ateles* does the number attain eight. With the same exceptions, again, the first four caudal vertebræ unite by articular processes, while transverse processes (single or antero-posteriorly

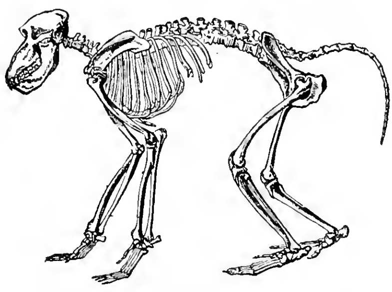


FIG. 18.—Skeleton of Chacma Baboon (*Cynocephalus porcarius*). From De Blainville.

double) exist in a great part of the tail. In *Ateles* the caudal vertebræ are (as might be expected from the very prehensile character of the tail) exceptionally provided with bony processes serving as points of muscular attachment. *Chevron bones* and processes for their attachment are altogether wanting only in the *Simiinæ* and in *Macacus inuus*. They attain their maximum in *Ateles*, where they present almost every variety of development in one or other part of the caudal region.

Certain vertebral processes, which in man are generally inconspicuous, and which are but little developed in the *Simiinæ*, attain in lower forms a marked development. These are the *metapophyses* and *anapophyses*. The first of these generally appear about the eighth or ninth dorsal vertebra, and may thence be traced backwards into the anterior caudal vertebræ, where they end by coalescing with the prezygopophyses. In *Ateles* these processes may sometimes be traced as far forward as the third cervical vertebra. The anapophyses become, below the *Simiinæ*, very conspicuous, projecting outwards and backwards from one vertebra, and embracing the prezygopophysis of the vertebra next behind. Generally they may be traced from the eighth or ninth dorsal vertebra to the penultimate lumbar vertebra. They attain their maximum of relative size in the lower *Cebidæ*. They may (as sometimes in *Ateles* and *Cynocephalus*) be traced on to the posterior cervical vertebræ, while they appear to coalesce with the transverse processes in the tail, and thus they may be developed almost throughout the vertebral column. The *Cebidæ* often develop *hyperapophyses* in the last dorsal and in the lumbar vertebræ. These processes are somewhat similar to *anapophyses*, but are placed much higher, and each pair embraces the spinous process of the vertebra next behind.

In most apes *the sternum* is quite narrow, and consists of a more or less enlarged manubrium, followed by a chain of sub-equal and antero-posteriorly elongated bones from three to six in number. In the *Simiinæ* alone do we find a broad sternum, or one consisting of a manubrium, followed by one bone only, as in *Hylobates*. The orang presents a singular peculiarity, in that the breast-bone long remains made up of ossifications arranged in pairs, side by side, successively. The total number of *ribs* has already been indicated in speaking of the dorsal vertebræ. The *true ribs* are seven in number on each side in the highest forms, but in *Hylobates* there are sometimes eight. In *Ateles* there are sometimes nine pairs. In *Hapale* the number varies from six to eight, and it is seven or eight in the other genera. The "angles" of the ribs are never so marked as in man. They are most marked in *Hylobates*. *Pithecia* is distinguished by the greater relative breadth of the ribs. In no ape is the thorax half as broad again as it is deep from back to breast. Nevertheless, in the *Simiinæ*, its transverse diameter exceeds its depth by from about one-fourth to a little under one-third of the latter. In *Ateles* (and sometimes also in *Mycetes*) the thorax is wider than it is deep, but in all the rest it is narrow, being deeper than it is wide.

The Appendicular Skeleton.

The development of this part of the skeleton has been indicated in a general manner in speaking of the external form. The length of the pelvic limb compared with the pectoral one—the foot and hand being removed—attains in no ape the proportion that it does in man, *i.e.*, 145 to 100; the nearest approximation being made by *Nyctipithecus* and *Callithrix*, namely, about 137 to 100. The length of the foot, compared with that of the hand, is exceptionally small in the *Simiinæ*, namely, from 84 up to 115 to 100. Its greatest relative length is in *Chrysothrix*, viz., about 177 to 100. In man it is about 134 to 100. The entire pectoral limb (measured from the summit of the head of the humerus to the distal end of the longest digit) is absolutely longest in the gorilla and orang. Its proportion to the spine is greatest in *Hylobates*, where it may attain the proportion of 222 to 100. Next come *Ateles* 174, *Simia* 170, the gorilla 150, and the chimpanzee 152. The rest vary from 121 to a little shorter than the spine, except certain of the lower *Cebidæ*, thus in *Chrysothrix* and *Hapale* it is less than 84 to 100. Only in the *Simiinæ* and in *Ateles* is the pectoral limb, without the hand, shorter than the spine.

The *scapula* of the gorilla presents a remarkable likeness to that of man, but that of its congener, the chimpanzee (the posterior vertebral angle being so acute), is less like man's than is that of the orang. The size of the supra-spinous fossa, as compared with the infra-spinous one, attains its maximum in the gorilla and *Mycetes*. In *Simia* and the *Pitheciinæ* the supra-spinous fossa is exceptionally small. The margin, corresponding with the superior margin of man's scapula, is generally convex in the forms below the *Simiinæ* (except *Ateles* and *Pithecia*), and attains its maximum of convexity in aged *Cynocephali*. A suprascapular notch is not well defined in the great majority of the *Simiadæ*, but in some of the *Cebidæ* (*Ateles* and *Mycetes*) it is constantly, and in others often, so enclosed as to become a foramen. In *Mycetes* a remarkable flat process springs from the bridge of bone encircling this foramen. This process exists in no other genus. The surface for the *teres major* muscle projects out very strongly in the *Cynopithecinæ* and in *Cebus* and *Chrysothrix*. The *acromion* and *coracoid processes* are short in the lower *Simiadæ;* both are long in the *Simiinæ* and in *Ateles*.

The *clavicle* is well developed in every species of the order, and that of the orang is absolutely the largest; and it is longest, compared with the spine, in that animal and in *Hylobates*, being as 28 or 32 to 100, while in the lower *Cebidæ* it may be less than 12 to 100. This bone is exceptionally slender in *Mycetes*, and is broadest in *Troglodytes* and the *Cynopithecinæ*. In the lower *Simiadæ* a fossa is excavated beneath the acromial end of the bone. Rarely, as in *Simia*, there is a very prominent deltoidal ridge.

The *humerus* presents in all apes the same fossæ and prominences as in man. Its length, as compared with the spine, is in *Hylobates* 70 or 80 to 100; but in most apes its length, thus compared, is between 45 and 30 to 100. The articular surface of the head is directed backwards and inwards, instead of almost exclusively inwards, as in man. In this respect man is most resembled by the *Simiinæ*. The tuberosities may project upwards slightly above the articular head, as in *Cynocephalus*. Generally they are about on a level with its top, but may be decidedly below it, as in *Ateles*, *Hylobates*, and *Simia*. The radial border of the bicipital groove may be very prominent, as in *Cynocephalus*. The groove may be spanned by a bridge of bone, as sometimes in the chimpanzee. The position of the nutrient foramen varies even in different individuals. The supinator ridge is especially developed in *Cynocephalus*, *Cebus*, and *Hapale*. In the *Simiinæ* it is only slightly developed. The external condyle is distinct in the *Simiinæ;* in the other genera it is closely applied to the capitellum. A supra-condyloid foramen is never present normally in the *Simiadæ*, but is present more or less constantly in the *Cebidæ*, from *Cebus* downwards, being perhaps most frequently absent in *Hapale*. Through this canal the brachial artery and median nerve pass. The projection of the radial margin of the trochlea is most prominent in the *Simiinæ* and *Hapale*. It almost disappears in the *Cynopithecinæ*. The *radius* and *ulna* are never ankylosed together in apes. They diverge most, medianly, one from another in the gorilla. The radius is four-fifths the length of the spine in *Hylobates*, and three-fifths in *Simia* and *Ateles*. Mostly it is between three-tenths and two-fifths of the length of the spine, but may, as in *Hapale*, be only a quarter. The total length of the radius rather more frequently falls short of, than exceeds, that of the humerus. It exceeds it in *Simia*, *Hylobates*, *Ateles*, *Cynocephalus*, and sometimes in the *Semnopithecinæ*. In all the others it falls short—in none, however, so much so as in man, *Brachyurus* approximating most to the human proportion. The radius is stoutest in *Cynocephalus*, slenderest in *Ateles*, and, above all, in *Hylobates*. The ulna varies, like the radius, in length and breadth. The olecranon is broad in the *Simiinæ*, but in the lower apes it is relatively larger, especially in *Cynocephalus* and *Mycetes*. The styloid process is very long in *Hylobates*, where it develops a prominence, on its hinder side, for the internal lateral ligament of the wrist. In *Ateles* this process is extremely long, having, as it were, a rounded articular head placed at the end of a peduncle. The ulna articulates with the carpus in all the apes except *Troglodytes* and *Simia*.

The skeleton of the *hand* attains its greatest bulk in the gorilla, but its greatest length in the orang. It may be more than half the length of the spine in *Hylobates*, and hardly less in *Simia* and *Ateles*. It may be but a fifth, as in *Chrysothrix*.

The *carpus* consists, in *Troglodytes*, of the same eight bones as in man. In all the other genera there is a ninth bone, the *intermedium*. Only in *Hylobates* does the length of the carpus considerably exceed its breadth—as 100 to 82. The nearest approach to this is made by *Ateles*, where the length is to the breadth as 100 to 107. The *scaphoides* may, as in the gorilla and lower *Simiadæ*, develop a large tuberosity. The *intermedium* has a flattened proximal surface, which joins the ulnar part of the concave distal articular surface of the scaphoides. Its distal surface is in general deeply concave antero-posteriorly, and embraces the radial side of the head of the magnum. The bone appears to answer to part of the scaphoid of man. The *cuneiforme*, except in *Troglodytes* and *Simia*, articulates directly with the ulna. The *pisiforme* is small (as in man) in *Simia* and *Ateles;* it is very large in the gorilla and *Cynocephalus*, and long but slender in *Hylobates*. Commonly it contributes to form, with the cuneiforme, a cup for the reception of the end of the styloid process of the ulna. The *trapezium* has sometimes, as, *e.g.*, in the gorilla and *Hylobates*, a very large radial tuberosity. The surface for the reception of the first metacarpal is convex from the dorsal to the palmar surface of the bone, and sometimes it is more or less concave in the reverse direction, but this concavity is never so strongly marked as in man. In the highest apes there appears to be much irregularity as to its development. In *Hylobates* there is no trace of any concavity, but a strongly convex and rounded tubercle receives the articular cup of the base of the first metacarpal. In the lower *Simiadæ* the concavity is sometimes present, and sometimes in the *Cebidæ* (as, *e.g.*, occasionally in *Cebus* and *Brachyurus*) a small saddle-shaped surface may be found. In *Ateles* the trapezium is large in spite of the rudimentary condition of the pollex, but there is no saddle. The trapezium is always so placed that the axis of the convexity of the saddle forms a marked angle with a line drawn across the articulations of the four outer metacarpal bones with the proximal row of carpals. In the gorilla this angle is, as in man, very open; but in the chimpanzee and lower *Simiadæ* it is smaller, the trapezium being, as it were, somewhat more pressed inwards, at its radial end, towards the middle of the palm. In the American apes the trapezium is well set out; and this, no doubt, contributes to produce that very feeble opposition and palmad flexion of the pollex which have been noticed as existing in them. The *magnum* is not generally the largest carpal bone, but rather the unciforme, which latter has its palmar process sometimes very much produced, as is the case in *Hylobates*. The *metacarpus* attains its greatest absolute length in the third metacarpal of *Simia*. This segment may, as in *Hylobates*, attain the proportion of one-fifth the length of the spine. The metacarpals are longer and narrower proportionally in apes than in man.

The *phalanges* are the same in number in apes as they are in man, except that in *Ateles* and *Colobus* the pollex may have but one small nodular phalanx or none. The phalanges are generally more curved than in man, and, except in the *Hapalinæ*, the ultimate phalanges are always flattened from dorsum to palm. In the *Hapalinæ* they are laterally compressed, curved, and pointed to support the peculiar claws of that sub-family. The length of the pollex with its metacarpal bears a much greater proportion to that of the spine in *Hylobates* and *Simia* than in man. With the exception of *Ateles* and *Colobus*, the shortest thumb, thus estimated, is found in *Nyctipithecus* and *Chrysothrix*, namely, 11 to 100.

The pollex without its metacarpal, compared in length with the manus, is shortest (viz., as 17 to 100) in *Hylobates*, and longest (viz., as 32 to 100) in *Hapale*. The pollex, when brought beside the index digit, rarely extends so far as in man, and does so only in the *Cebidæ*, where, in the *Hapalinæ*, it may reach nearly to the distal end of the proximal phalanx of the index. In *Cynocephalus* it may reach the middle of that phalanx, while in

Troglodytes it reaches but very little beyond its proximal end.

The entire *pelvic limb*, measured from the summit of the femur to the distal end of the longest digit, is absolutely greatest in the gorilla, and then in the orang and the chimpanzee. If the pes be removed, then the leg of the chimpanzee is longer than that of the orang.

Compared with the length of the spine, the entire pelvic limbs of *Hylobates* and *Ateles* are longest, namely, as 162 or 169 to 100. That of *Hapale* is the shortest, being but as 110 to 100. Without the pes, the leg of *Hapale* is also shortest relatively compared with the spine, namely, as 77 to 100; while that of *Hylobates* is longest, namely, as 125 to 100. The *os innominatum* is in every species strikingly different in form from that of man. In absolute size this bone attains its maximum in the gorilla, where it is much larger than in man, and where the ilium is very broad. The external surface of the ilium is generally more or less concave, and concave only. In *Troglodytes* and *Simia*, however, it is more or less convex, but not as in man, and therefore there is no sigmoid curvature of the crest of the ilium, and there are no distinct gluteal lines. The internal surface of the ilium is generally narrow and flat, or only slightly concave, except in the gorilla. The tuberosity of the ischium is always a marked and more or less rugose enlargement of the bone; but in the *Simiadæ* below *Troglodytes* it is flattened and very much developed, and so much everted that sometimes (in *Cynocephalus*) its transverse exceeds its antero-posterior diameter. In the *Cebidæ* it again becomes small, and more or less rounded.

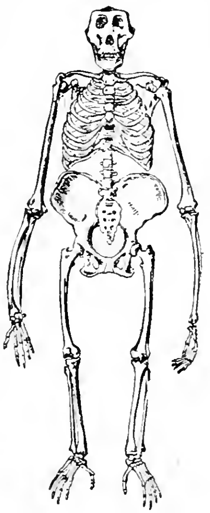


FIG. 19.—Skeleton of the Gorilla (*Troglodytes gorilla*). From De Blainville.

The spine of the ischium is generally very small, yet distinct. Only in *Simia* does it attain a considerable sharpness and prominence. The great sciatic notch is never very deep and concave, as in man. It is most concave in the gorilla, the orang, and in *Cynocephalus*. The lesser sciatic notch is generally represented by a margin which is so slightly concave as to be almost or quite straight save through the eversion of the tuberosity. The projection of the spine of the ischium produces in man a deep notch such as exists in no ape. The cotyloid notch, and the excavation continuous with it, are constantly present, even in *Simia*, where, however, it is very small and narrow, in harmony with the absence of the *ligamentum teres*.

The *femur's* length, compared with that of the spine, is as 67 to 100 in *Hylobates*, 61 in *Ateles*, 54 in the gorilla, 47 in *Simia*. It is shortest in *Chrysothrix*, 40, and *Hapale*, 37. In the *Simiinæ* it is shorter than is the humerus, its proportion to which in *Simia* is as 73 to 100. Only in some of the *Semnopithecinæ* does its length exceed that of the humerus more than it does in man. The shaft of the femur is sometimes nearly straight, as in *Hylobates* and in most *Cebidæ*. The femur is stoutest, relatively as well as absolutely, in the gorilla. It is slenderest in *Hylobates*. The neck of the femur is longest in *Simia* and *Hylobates;* shortest in *Hapale*. Except in the *Simiinæ* and in *Mycetes*, the great trochanter is pointed at its upper end. The trochanteric fossa is shallow in the gorilla, but is in most forms deep. The lesser trochanter is at its minimum of relative size in the *Simiinæ*, and is largest relatively in *Hapale*, and the posterior surface of the femur is in that genus wide and flat between the trochanters. The pit for the insertion of the *ligamentum teres* is always present, except in the orang and gorilla, where it is absent almost constantly in the first ape, occasionally in the second. In the *Simiinæ*, *Ateles*, and *Lagothrix* the internal condyle projects considerably further backwards than does the external one. The angle formed by the neck of the femur with the shaft varies from about 155° (*Simia*) to 128° (the gorilla).

The *tibia* and *fibula* never become ankylosed together. The tibia is absolutely longest in the gorilla. Its length, compared with that of the spine, is never so great as in man, except in *Hylobates*, in which it is slightly longer relatively. It is shortest in *Mycetes*, about as 37 to 100. Its length is generally less than that of the femur, but sometimes, in *Hapale*, it slightly exceeds it. It is never, however, so short compared with the femur as in man. The crest of the tibia is not so sharp as in man. The shaft is sometimes straight, as in *Lagothrix* and *Pithecia*, sometimes considerably curved, as in the gorilla and lower *Cebidæ*. The malleolus is generally well-developed, but sometimes, as in the orang, very short. Its articular surface is sometimes nearly at right angles with the inferior surface of the shaft of the tibia, as in the chimpanzee; sometimes it forms an obtuse angle with that surface, as in the gorilla, and still more in the orang. The distal articular surface of the shaft of the tibia is rarely horizontal, as in *Ateles* and *Lagothrix*. In the *Simiadæ* and lower *Cebidæ* the outer portion rises so that the articular surface slopes upwards and peronead. The fibula has its malleolus much produced outwards, projecting only about as much as, or rather less than, the tibial malleolus, whereas in man the fibular malleolus is much deeper than the tibial one.

The length of the *pes* (or foot) is absolutely greatest in the orang and gorilla. Estimating the spine as 100, the length of the pes is as much as 53 in the orang; it approximates to man (35 to 100) most in the lowest *Simiadæ*, and in *Chrysothrix*—36 to 100. The proportional length of the pes to the rest of the pelvic limb is greatest in *Simia* (58 to 100), then in *Nyctipithecus* and *Hapale* (50 to 100), but never falling quite so low as in man, where it is 30 to 100. Its length, as compared with that of the tibia, is greatest in *Simia* (122 to 100). In all the rest it is more than four-fifths, except sometimes in *Hylobates*, which however is never so small as in man, *i.e.*, as 67 to 100. The length of the pes, compared with that of the manus, is greatest in *Chrysothrix* (177 to 100). In *Ateles* it sinks to 113 to 100, and in *Hylobates* to 85 or 84 to 100.

The absolute length of the *tarsus* is never so great as in man, though that of the gorilla is nearly as long. The rest of the foot is so much longer relatively in apes than in man, that, whereas in him the proportion of the tarsus to the whole pes is as about 46 to 100, it is only 39 to 100 in the gorilla, which in this respect approaches nearest to man. The proportion sinks to 26 to 100 in *Simia* and *Ateles*, and 27 or 28 to 100 in *Hylobates*. Only in *Simia* and *Hylobates* is the tarsus ever less, or only a very little more, than twice the length of the carpus. The tarsus consists constantly of the same seven bones as in man, and these bones are so arranged, or bound together by ligaments, as to form a transverse and an antero-posterior arch. In no ape, however, do the distal ends of the inner metatarsals form the anterior point of support of the antero-posterior arch, as in man. The *os calcis* is always, except in the gorilla, shorter compared with the spine than in man. The *tuberosity* may be produced upwards or downwards, or both, and is concave or grooved behind, except in the gorilla. In no ape are the long axis of the heel or the peroneal and tibial surfaces of the os calcis so vertical as they are in man; but the bone is always more or less twisted, so that the *sustentaculum tali* forms a more or less acute angle with the long axis of the tuberosity instead of a right angle, as in man. The twisting of the os calcis is very slight in *Simia* and *Pithecia*, and not great in *Ateles* and *Hylobates*. It is more marked in the lower *Simiadæ*, and more so still in *Troglodytes*. A narrowing of that part, which answers to the plantar surface of man, accompanies this in-twisting. In the gorilla that part of the os calcis which is behind the articular surface for the astragalus exceeds in length all the bone anterior to the hinder border of that surface; and in this respect the gorilla may be said to have the longest heel of any ape, and a longer heel than man. The head of the *astragalus* is generally united to its body by a tolerably long neck. This neck is, however, in the gorilla shorter than even in man. The upper surface of this bone is less convex than in man, in *Simia*, *Ateles*, and the gorilla; generally it is more convex than in man. The surface for the external malleolus forms, with the upper surface of the astragalus, almost a right angle in *Hylobates* (as in man), and an obtuse one in *Ateles* and *Lagothrix*. In most other apes (including *Troglodytes*) it forms an acute angle. The angle formed by the upper surface of the astragalus with that for the tibial malleolus, instead of being a right angle, as in man, is generally more or less obtuse, especially in the gorilla. The *naviculare* has sometimes its tuberosity greatly developed; this is especially the case in *Hylobates*. The surfaces for the three cuneiform bones are generally more convex and concave respectively than in man. The *ento-cuneiforme* generally has its plantar and distal surfaces considerably longer than its dorsal and proximal surfaces respectively. These are exceptionally equal (as in man) in the orang and gorilla. The surface for the hallux is always strongly convex. The long axis of this articular surface always forms a more or less acute angle with a line drawn across the articular surfaces for the four outer metatarsals. In the lower *Simiadæ* this angle is as acute as in man. In *Troglodytes* it is a little more open, but not nearly so open as is the homotypal angle in the hand even of the same species. The surface is never saddle-shaped in apes. In all apes, even in the chimpanzee, the distal tarsal segment is capable, as a whole, of a considerable degree of motion upon the proximal part,—*i.e.*, upon the astragalus and os calcis,—and this mobility is extreme in the orang. The absolutely longest *metatarsal* bone is the second of *Simia*. The metatarsus often exceeds the tarsus in length, but it may, as in the gorilla, fall much short of it, thus resembling man. The four outer metatarsals and the innermost one diverge instead of being parallel, as in man. The former, except in the *Simiinæ* and in *Ateles*, are more rounded than in man, and their distal articular surfaces are less bent downwards, and are limited posteriorly by a deeper transverse groove. The first metatarsal, compared in length with the spine, is longest in *Hylobates* (10 or 12 to 100), and shortest in *Hapale* (about 6 to 100). It is always longer than the first metacarpal, except in *Simia*. Its proximal surface is generally more concave than in man, and its long axis is different. It is as if the metatarsal of man had been removed, softened, and then, after being turned, so that the dorsum looks inwards as well as upwards, reapplied to the convex ento-cuneiforme, and thus stamped with an oblique depression. The angle formed by this surface, with a line traversing the articular heads of the four outer metatarsals, approximates to a rectangle instead of to a straight line, as in man.

The *phalanges* are always the same in number as in man, except that the hallux of *Simia* has often but one. They are very like their homotypes in the manus, and are convex above, concave and flattened below. Only in the *Hapalinæ* are the last phalanges laterally compressed instead of flattened. The pedal digits are never nearly so short relatively in apes as they are in man; yet the proportion borne by the hallux, with its metatarsal, to the spine closely approximates in the gorilla to the proportion existing in man, and the proportion is exceeded in *Hylobates* and *Ateles*. It is much in defect in *Hapalinæ*, where it is little more than one-tenth. Its proportion to the whole pes in *Hylobates* (as in man) is nearly half, while in *Simia* it is but a quarter, and but little more in the *Hapalinæ* and the *Semnopithecinæ*. The hallux, when brought beside the second digit, never reaches so far as in man, but at most (as in the chimpanzee) to the proximal end of the second phalanx, or to the middle of the proximal phalanx (as in most *Cebidæ*), or a little beyond its base (as in *Hapale* and the *Semnopithecinæ*), or not nearly even to the distal end of the metatarsal (as in *Simia*). Except in *Simia* and some *Cebidæ*, notably *Hapale*, the hallux projects further than does the pollex of the same individual when applied to the second digit of the manus. The hallux also always exceeds the pollex in absolute length, except in *Hapale* and *Simia*. The length of the hallux, without its metatarsal, compared with that of the spine, is as 25 to 100 in the chimpanzee (as in man), 19 in the gorilla, and but 8 in *Simia*. The second digit of the pes is always longer than that of the manus except in the *Simiinæ*, which so far resemble man. The index digit, with its metatarsal, compared with the spine, is as 38 to 100 in *Simia*, and it varies thence down to 21 in *Cercopithecus*. The longest digit of the pes always exceeds that of the manus, except in the *Simiinæ* and *Ateles*.

The Muscles.

The muscles of apes are very similar in number, distribution, and form to those of man, except that in the long-tailed forms (*e.g.*, *Semnopithecus*) the muscular bundles answering to the coccygeal muscles of man are so greatly developed as to form eight sets of caudal muscles. The *latissimus dorsi* commonly sends on a slip, called the *dorso-epitrochlear*, as far as the olecranon. Often there is a *rhomboideus capitis*, and a muscle, called *levator claviculæ*, almost always descends from the cervical transverse processes to the outer part of the clavicle. The *flexor longus pollicis* and the *flexor digitorum profundus* are always more or less united. The *extensor indicis* commonly sends a tendon to the third digit as well as to the index, and at the same time the *extensor minimi digiti* sends a tendon to the fourth digit as well as to the fifth. An *extensor primi internodii pollicis* is never developed, but the *extensor ossis metacarpi pollicis* is often doubled, even in the chimpanzee. In the orang the *flexor longus pollicis* sends a tendon only to the index. In *Hylobates* the *supinator longus* is inserted into the middle of the radius, and there is an *abductor tertii internodii indicis* going from the metacarpal of the index to its ungual phalanx. Often the *extensor brevis pollicis* and the *abductor longus* become more or less united. In spite of the rudimentary condition of the thumb in *Ateles*, its muscles exist, though in a rudimentary condition, but in *Hapale* the *opponens pollicis* is wanting.

The lower limb in the orang generally wants the *ligamentum teres*, which seems to be sometimes absent in the gorilla also. The *glutæi* muscles of apes are feeble and small, and are inserted low down on the femur. Only in the gorilla are they large enough to cause a small buttock to protrude over the ischiatic tuberosities, but even in this ape the buttocks do not meet so as to conceal the anus. Apes have an extra muscle, called the *scansorius*, which passes down from the edge of the ilium to the great trochanter of the femur, and must act as a powerful rotator of the thigh inwards The *gracilis* is much broader than in man, and is inserted lower down on the tibia than in him, as is also the case with the *semi-membranosus* and *semi-tendinosus*. The short head of the *biceps femoris* is generally wanting. The *gastrocnemei* and *soleus* are flatter than in man, and the latter has only a fibular origin. In the lower *Simiadæ* the *plantaris* passes over the pulley-like end of the os calcis, and goes to the plantar fascia. No ape seems to have any *peroneus tertius*, but we may find even in *Semnopithecus* a slender *peroneus quinti digiti* passing behind the outer malleolus, and going to the metatarsal of the fifth digit, while in the *Cebidæ* we may also have a *peroneus quarti digiti* going similarly to the fourth digit. The *tibialis anticus* may be divided, as even in the chimpanzee, like its homotype the *extensor ossis metacarpi pollicis*. The muscles of the foot, with the exception of the *interossei*, resemble the muscles of the foot of man, and not those of his hand. As regards the *interossei* even, the difference is very slight. It consists in the insertion of the tendon of that dorsal interosseous mass which is interposed between the second and third metatarsals, into the proximal phalanx of the third digit (as in the human hand), instead of into that of the second digit (as in the human foot). The hallux in the orang is, in spite of its imperfect development, provided with an *opponens* muscle. The *flexor brevis digitorum pedis* does not, in apes, arise exclusively from the os calcis, and the *flexor accessorius* arises from the surface of the deep flexor tendons. The last named muscle may be wanting, as sometimes at least in *Hylobates*. A muscle, called the *abductor ossis metacarpi quinti*, exists even in the chimpanzee. In the lower *Cebidæ*, and especially in the *Hapalinæ*, the interossei become true *flexores breves*, and altogether cease to be visible on the dorsum of the foot.

The Brain.

The absolute size of the brain never in any ape approaches that of man. Thus the cranial capacity is never less than 55 cubic inches in any normal human subject, while in the orang and chimpanzee it is but 26 and 27½ cubic inches respectively. The relative size of the brain varies inversely with the size of the whole body, but this is the case in warm-blooded vertebrates generally. The extreme length of the cerebrum never exceeds, as it does in man, two and a quarter times the length of the basi-cranial axis. The proportion borne by the brain to its nerves is less in the apes than in man, as also is that borne by the cerebrum to the cerebellum. In general structure and form the brain of apes greatly resembles that of man. Each half of the cerebrum contains a triradiate lateral ventricle, and though in some *Simiadæ* the posterior cornu is relatively shorter than in man, it again becomes elongated in the *Cebidæ*, and in many of the latter it is actually longer relatively than it is in man. The posterior lobes of the cerebrum are almost always so much developed as to cover over the cerebellum, the only exceptions are the strangely different forms, *Mycetes* and *Hylobates syndactylus*. In the latter the cerebellum is slightly uncovered, but it is so considerably in the former. In *Chrysothrix* the posterior lobes are much more largely developed relatively than they are in man. The cerebrum has almost always a convoluted external surface. In this group, however, as in mammals generally, a much-convoluted cerebrum is correlated with a considerable absolute bulk of body. Thus in *Hapale* (and there only) we find the cerebrum quite smooth, the only groove being that which represents the Sylvian fissure. In *Simia* and *Troglodytes*, on the contrary, it is very richly convoluted. A *hippocampus minor* is present in all apes, and in some of the *Cebidæ* it is much larger relatively than it is in man, and is absolutely larger than the *hippocampus major*. Of all apes, the orang has the brain which is most like that of man; indeed, it may be said to be like man's in all respects, save that it is much inferior in size and weight, and that the cerebrum is more symmetrically convoluted and less complicated with secondary and tertiary convolutions. If the brain of *Simia* be compared with that of *Troglodytes*, we find the height of the cerebrum in front greater in proportion in the former than in the latter; also the "bridging convolutions," though small, are still distinguishable, while they are absent in the chimpanzee. Nevertheless, this character cannot be of much importance, since it reappears in *Ateles*, while two kinds of the genus *Cebus* (so closely allied as to have been sometimes treated as one species) differ strangely from each other in this respect. The *corpus callosum*, in apes generally, does not extend so far back as in man, and it is very short in *Pithecia*. In the orang and chimpanzee there are, as in man, two *corpora albicantia*, while in the lower monkeys there is but one. The *vermis* of the cerebellum is larger in the *Cebidæ* than in the *Simiadæ*. In all apes below the *Simiinæ*, each lateral lobe of the cerebellum gives off a small lobule, which is received into a special fossa of the petrous bone. Certain prominences of the *medulla oblongata*, termed *corpora trapezoidea*, which are found in lower mammals, begin to make their appearance in the *Cebidæ*.

The Teeth.

The teeth, of apes consist, as in man, of incisors, canines, premolars, and molars; but the series of teeth nowhere forms so perfect an arch as in man, the opposite series of grinding teeth tending to become more parallel. No ape has the teeth placed in one uninterrupted series in each jaw, as is the case in the human species, but there is always a small interval (*diastema*) between each upper canine and the adjacent incisor, and between each lower canine and the adjacent premolar. This condition is due to the excessive size of the canines, the interspaces giving passage to the apices of these teeth. This prolongation of the canines into tusk-like weapons of offence and defence (especially developed in the males), makes a great difference between the aspect of the dentition in apes and man. The number of the teeth is the same as in man in the *Simiadæ*. The *Cebidæ* have an additional premolar on each side of each jaw, and the *Hapalinæ*, besides this, have a true molar the less. The incisors are always nearly vertical, save in the *Pithecinæ*, when their apices project strongly forward. The canines are always considerably longer than the incisors, except in the genus *Hapale*, where the lower incisors equal the canines in length. The premolars differ structurally from the molars much as in man, save that the first lower premolar may be modified in shape to give passage to the upper canine, as is specially to be seen in *Cynocephalus*. The grinding surface of the molars consists generally of two transverse ridges, each end of each ridge projecting more than the intermediate part, and so giving rise to four tubercles. In *Simia* and *Troglodytes*, however, we find in the upper molars an additional structure, which also exists in man. This is a ridge which runs obliquely from the front inner tubercle (or cusp), outwards and backwards to the hind outer tubercle. In the rest of the *Simiadæ* this ridge is wanting, but it reappears in *Ateles* and *Mycetes* amongst the *Cebidæ*. In the *Hapalinæ* the tubercles of the molars are more produced and sharp-pointed, in harmony with their decidedly insectivorous habits. The last lower molar may be reduced or much enlarged as compared with the others. Thus in *Cercopithecus talapoin* it has but three tubercles, while in the *Macaci* and *Cynocephali* it is very large, and has five well-developed cusps. The number of milk teeth is as in man, save that the *Cebidæ* have an additional milk molar. In general the canines are the last teeth to be cut of the permanent dentition. Their cutting sometimes causes such constitutional disturbance as to produce convulsions and death. In the gibbons, however, the canines accompany, if they do not precede, the appearance of the hindmost molar, while in the orang they at least sometimes make their appearance before that grinder.

Organs of Nutrition and Excretion.

The alimentary, circulating, and excretory organs of apes closely resemble those of man. The mouth is always guarded by *lips*, which, though generally thin, are often very mobile and extensible, the lower lip having no frænum in the orang, and this is also absent in *Cebus*, though it may be present in other forms, as, *e.g.*, in *Troglodytes* and *Cynocephalus*.

The *tongue* is much longer relatively in most apes than in man; but it may closely resemble his, as does that of the orang, in which the circumvallate papillæ are collected in a V-shaped aggregation, while there may be only two such papillæ, as in *Cynocephalus* and *Ateles*. In *Hylobates* the tongue is in this respect man-like; yet in that genus we first meet with a *sub-lingual process* (which becomes much larger in the lower apes), in the form of a little conical bifid membrane. This structure is formed by the union of the processes upon which open the sub-maxillary ducts—processes much elongated in the chimpanzee, though man-like in the orang.

The *uvula* is generally present, but becomes rudimentary in the *Cebidæ* generally, though it exists as a relatively thick, short structure in *Hapale*. It is long and pointed in *Semnopithecus*, and plainly visible in *Hylobates* and *Troglodytes*. On the other hand, in *Simia* it is disguised by the extensive development of the membranous edge of the *velum palati* on each side of it.

The *stomach* is simple in all the apes except the *Semnopithecinæ*. It is especially human in shape in *Hylobates*, except that the pylorus is somewhat more elongated and distinct. It is of a rounded form in *Pithecia*, and in *Hapale* the cardiac orifice is exceptionally near to the pylorus. In the *Semnopithecinæ* the stomach is extremely sacculated, especially at the cardiac end, being, in fact, very like a colon spirally coiled. It is in the stomach of these apes that the oriental Bezoar stones are found.

The *intestine* in apes is devoid of *valvulæ conniventes*, but is always provided with a well-developed *cæcum*, though it is short and conical in *Cynocephalus*. Only in the *Simiinæ* do we find a *vermiform appendix*.

The *colon* may be much longer relatively than in man, as in *Simia* and *Troglodytes*. It may be greatly sacculated, as in *Hylobates*; or devoid of sacculations, as in *Cebus*. As in fœtal man, so in the lower apes, only the right extremity of the mesocolon is involved in the formation of the great omentum, the middle and left parts of the mesocolon lying behind, and independent of the omentum. This is not, however, the case in the *Simiinæ*, which are more like adult man in this respect.

The *liver* may be very like man's, especially in *Hylobates*, the orang, and the chimpanzee; but in the gorilla both the right and left lobes are cleft by a fissure almost as much as in *Cynocephalus*. In the *Semnopithecinæ* the liver is much divided, and it is placed obliquely to accommodate the sacculated stomach. The lateral lobes of the liver are in *Hapale* very much larger than the central lobe. The *caudate lobe* is very large in the *Cebidæ*, especially in *Ateles*, and above all in *Pithecia*. There is always a gall-bladder.

The *larynx* is in many apes furnished with sac-like appendages. These are different in different species as regards number, size, and situation. They may be dilatations of the laryngeal ventricle (opening into the larynx below the false vocal chords), as in *Simia* and *Troglodytes*. They may open above the false vocal chords so as to be, in fact, extensions of the thyro-hyoid membrane, as in *Hylobates*. There may be but a single median opening in the front part of that membrane at the base of the epiglottis, as in the *Simiadæ* below the *Simiinæ*. There may be a single median opening at the back of the trachea, just below the cricoid cartilage, as in *Ateles*. There may be but a single sac, or there may be five, as sometimes in *Mycetes*. These may be enormous, meeting in the middle line in front, and extending down to the axillæ, as in the gorilla and orang. A sac may occupy the cavity of the expanded body of the hyoid bone, as in *Mycetes*.

The *os hyoides* has its basilar part generally somewhat more convex and enlarged than in man; but in *Mycetes* it becomes greatly enlarged and deeply excavated, so as to form a great bony bladder-like structure.

The cornua of the hyoid are never entirely absent, but the anterior or lesser cornua may be so, as in *Mycetes*. The anterior cornua never exceed the posterior cornua in length; but they may be (*e.g.*, in *Cercopithecus*) more largely developed relatively than in man, and they may even be jointed structures, as in *Lagothrix*.

The *lungs* have generally the form of those of man; but the right lung may have four lobes, as, *e.g.*, in *Hylobates*.

The great *arterial trunks* in *Simia* and *Troglodytes* are arranged as in man. In *Hylobates* and the lower apes, however, the left carotid may take its origin from the innominate artery.

The Generative Organs.

The generative organs are, in common with the other parts of the body, formed on the same model as in the human species. The *penis* is pendulous, *i.e.*, hangs freely, instead of being (as in the dog) bound to the ventral surface of the abdomen. The prepuce, however, is without a frænum. The *testes* are relatively large, and descend into a scrotum. In some species, however, they do not descend so much as they do in man, but remain just outside the inguinal ring, and are thus placed rather beside than beneath the penis. These parts, as has been said, are brightly coloured in some of the lower *Simiadæ*. The penis is furnished with a *bone* in all the apes below the Anthropoid ones, and probably in the latter also, since the chimpanzee has one about one-third of an inch long and gristly at each end. In all apes the *uterus* is single, and not two-horned; but it is more elongated relatively in monkeys than in the human species. The *clitoris* is well-developed, but boneless in the *Simiadæ*, and is large even in *Troglodytes niger*. In the *Cebidæ* it contains a bone; and in some genera, especially in the *Cebinæ*, it is enormously developed, so as to be very easily mistaken for a penis. In *Ateles*, however, its length is mainly due to its extremely elongated prepuce.

The *placenta* of apes is discoidal and deciduate, and is generally bilobed. Sometimes, however, as in *Mycetes*, it is single. It is especially thick in proportion in the *Hapalinæ*. In the *Simiadæ* there is but one umbilical vein, but in the *Cebidæ* there are two.

Gestation in the lower *Simiadæ* lasts about seven months, but in the *Hapalinæ* only three months.

Menstruation occurs periodically, but the excretion is less sanguineous than in the human species. In the lower *Simiadæ* it is chiefly manifested by a turgescence of the external organs, which may extend widely in the parts adjacent, and even beneath the tail.

Lactation lasts, in the better known forms, for an average of six months, and the young are carried at the breast in a very human attitude.

DISTRIBUTION IN TIME.

There appears as yet to be no evidence of the existence of apes earlier than during the Miocene period. This absence of evidence must by no means be taken as a conclusive proof of their non-existence, since, as Dr Falconer has pointed out, we ought not to expect to find ape fossils often. We ought not to expect this, because the agility and arboreal life of these animals enable them to escape local inundations, and other causes of destruction and speedy burial, to which more sluggish and terrestrial animals are exposed. When they fall dead they are almost immediately devoured by carnivorous animals and feeders on carrion, and it is owing to this that their remains are so rarely found in India, on which account the Hindoos believe that they bury their dead.

Two teeth found in Suffolk were at first described by Professor Owen as those of apes, under the title *Macacus eocænus*. This opinion, however, he has since withdrawn.[1]

A fragment of a right maxilla, from Soleure in Switzerland, was described by Rutimeyer in 1862, under the name *Cœnopithecus lemuroides*. But the recent discovery of fossil lemurs in France renders the ape character of this fragment (which was always doubtful) still more uncertain.

When we enter upon Miocene deposits we find plentiful and unquestionable remains of apes now extinct. In India, in the Sewalik hills, the astragalus of a *Semnopithecus* (resembling *S. entellus*) has been found. Also jaws and teeth of other forms allied to *Semnopithecus* and *Macacus* have been discovered, one with an upper jaw nearly as large as that of the existing orang. These fossils, however, exhibit no remarkable difference in form from the bones of existing apes.

In Europe a very remarkable ape fossil, named *Dryopithecus fontani* (Lartet), has been found at Saint Gaudens in France. A lower jaw and humerus were there obtained, but isolated teeth have also been met with in the Suabian Alps. This creature was an ape belonging to the highest sub-family, *Simiinæ*, and was allied to *Hylobates*, but of greater bulk than any existing gibbon.

Two other species of ape have been found allied to *Hylobates*, but of smaller size than *Dryopithecus*, and showing some probable affinity to *Semnopithecus*. These are *Pliopithecus antiquus* (Lartet), and *P. platyodon* (Biedermann). Of the former, two imperfect lower jaws were found in fresh-water deposit at Sansan, near Auch, in France, while of the latter, an upper jaw has been found in Zurich at Elgg, in the upper fresh-water Molasse there. Another ape (probably of the *Simiinæ*), of which a lower jaw has been found in the lignite bed at Monte Bamboli in Tuscany, has been named by G. M. Gervais, *Oreopithecus bambolii*.

M. Gaudry has also found a rich deposit of ape relics at Pikermi in Greece. He has sent thence to Paris parts of as many as twenty-five individuals, while other remains are preserved in Munich, and no less than five crania at Milan. These remains have been placed by Wagner in a new genus, *Mesopithecus*. They are very interesting, as showing a somewhat intermediate structure compared with living apes. The cranium and dentition bear affinity to *Semnopithecus*, but the limbs are rather those of *Macacus*.

Certain fragments found at Eppelsheim (in strata of the same geological age as the Pikermi deposits) have also been attributed to the former genus; while five mandibula, found at Steinheim in Würtemberg, have received the name, from Fraas, of *Semnopithecus grandævus*.

Amongst the rich palæontological treasures which have recently been found in the North American Miocene deposits are certain teeth and fragments, which, it has been suggested, may be those of apes. At present, however, their nature is quite problematical, though the presence of apes at that period in America would be a fact of extreme interest, if sufficient remains could be found to determine whether such apes were *Simiadæ* or *Cebidæ*, or forms intermediate between the two.

The Pliocene deposits have not yet yielded much in the way of ape remains. Some teeth from Montpellier (found in fresh-water marl) have been named *Semnopithecus Monspessulanus* by M. Gervais, while part of a lower jaw from the same locality has been called *Macacus priscus*. Other fragments of jaws, and some teeth of *Macaci*, have been found in the Val d'Arno, and are preserved at Pisa, Turin, and Florence. A single tooth from Grays, Essex, has been described by Professor Owen as *Macacus pliocænus*.

In America, besides the Miocene fragments before referred to, numerous bones of *Mycetes* and other genera have been found in the caves of Brazil. These, however, appear to be, geologically speaking, quite recent, and they closely resemble the bones of apes now living in that region.

For further details as to fossil apes, an article may be referred to (a translation from the Italian) by Major Forsyth, in the *Annals and Magazine of Natural History*, for the month of September 1872.

GEOGRAPHICAL DISTRIBUTION

The apes are, as far as is yet certainly known, at present almost confined to tropical latitudes. Their most northern limits in the Old World are Gibraltar (*Macacus inuus*), Moupin, in Thibet (*Macacus thibetanus* and *Semnopithecus roxellanæ*), and Japan (*Macacus speciosus*). In the New World the highest northern latitude certainly known to be attained is 18° or 19° (*Ateles melanochir*) in Southern Mexico, but they possibly reach even latitude 23° Father David, however, sees no reason (considering the severity of the climate of Moupin) why apes should not also be found in the mountains of Northern China, and the natives have repeatedly assured him they are to be found there. Southwards, apes are found to near the Cape of Good Hope, and the island of Timor (*Macacus cynomolgus*), in the Indian Archipelago, in the Old World, and to about 30° in Brazil and Paraguay, in the New World. As to vertical extent, a *Semnopithecus* has been seen near Simlah, at a height of 11,000 feet; Dr Hooker saw monkeys in the Himalaya at an elevation above 8000 feet; and *Semnopithecus roxellanæ* and *Macacus thibetanus* were found by Father David inhabiting the Snowy Mountains of Moupin, in Thibet, at an elevation of about 3000 metres, where frost and snow last several months. In Miocene times the ape range was more extensive—namely, to Greece, Tuscany, the South of France, Zurich, Würtemberg, and even to Essex.

Some of the localities richest in monkeys are islands, such as Ceylon, Borneo, Sumatra, and Java; and apes are also found in Trinidad, and the island of Fernando Po.

[1] *Ann. and Mag. of Nat. Hist* 1862, p 240.

There are, however, certain islands which seem eminently well suited to support an ape population, where apes, nevertheless, are conspicuous by their absence. Such are the West Indian Islands, Madagascar,[1] and New Guinea, moreover, no ape inhabits tropical Australia These facts become the more remarkable, if, as Father David suspects, apes exist in Northern China to-day Evidently it is not climate which prevents their existing in Central Europe now The continents of Africa, south of the Sahara, of Asia, south of the Himalaya, and of America, from Panama to the southern part of Brazil, are, with the islands before mentioned, the special ape regions of the existing fauna.

There is a remarkable difference between the ape population of the New and the Old World, the latter being inhabited exclusively by *Simiadæ*, the former as exclusively by the *Cebidæ*. Europe has but a single ape species, and Asia, north of the Himalaya, has but the few found in Thibet, China, and Japan. Africa, north of the Sahara, is zoologically a part of Europe, and there also *Macacus inuus* is found, which is the only African species of the genus. African apes are the chimpanzee and gorilla of the west coast, the former extending eastwards to 28° E. long.; the *Colobi* (which are, in fact, but the African form of *Semnopithecus*), the long-tailed *Cercopitheci*, including mangabeys (or white-eyelid monkeys); and, lastly, the baboons, *Cynocephali*. The genus *Cynocephalus* extends into Arabia; but that, zoologically speaking, is a part of Africa. The Asiatic regions possess the orang (*Simia*) (in Borneo and Sumatra), the long-armed apes (*Hylobates*), the *Semnopitheci*, and *Macaci*.

One form of *Macacus*, and a very peculiar one (*M. niger*), is found in the islands Batchian and Celebes; and it is a noteworthy fact that this, the most baboon-like of all the *Macaci*, should only exist in a region so extremely remote from Africa. The genus *Macacus* is the most widely spread of any existing genus—namely, from Gibraltar North Africa, Thibet, and Japan (perhaps even from Northern China), down to the island of Timor, and from the north-west of Africa in the west, to Batchian, Japan, and the Philippine Islands in the east. In ancient times this genus seems to have extended to France, and even to Essex. It is interesting to note that, in the Miocene period, the geographical range of the apes of India was much greater. Gibbon-like monkeys existed in the south of France, while forms intermediate between *Semnopithecus* and *Macacus* abounded in Greece.

In America, north of Panama, the genera as yet known to be represented are *Chrysothrix*, *Nyctipithecus*, *Cebus*, *Ateles*, *Mycetes*, and *Hapale*, in Veragua, *Nyctipithecus*, *Cebus*, *Ateles*, and *Mycetes*, in Costa Rica and Nicaragua, *Ateles* and *Mycetes*, in Guatemala; and *Ateles*, in Southern Mexico. Brazil is, of course, the headquarters of the American apes; but different portions of that vast region have a somewhat different ape fauna. Thus the genus *Eriodes* appears in South-Eastern Brazil to represent the species of *Ateles* inhabiting the more northern and western parts of the empire. Southwards, the genera *Cebus*, *Mycetes*, *Chrysothrix*, and *Callithrix* extend furthest; but they do not probably all extend to the furthest limit yet known, namely, 30° S. The species found farthest south are *Mycetes caraya*, *Cebus fatuellus*, and *Callithrix personatus*.

ZOOLOGICAL POSITION AND AFFINITIES OF APES.

By universal consent apes are placed in the highest rank of all brutes, and, excepting man, are generally taken to be the most perfect animals of the mammalian class. It may be questioned, however, whether, if the animal man had never existed, this place would be assigned them by any observing intelligence The half-apes, or lemurs, commonly placed in the same order with them, are certainly inferior mammals, and it might be contended that the perfection of the mammalian type is rather to be found in the *Felidæ* (or cat family), by reasoning analogous to that by which it might also be contended that birds (with their differentiated limbs, perfect circulating and respiratory systems, acute sense organs, complex instincts, and teachableness) are really the highest of all vertebrate animals, and represent the vertebrate type of structure carried to the highest degree of perfection yet attained

The question as to which animals are most nearly allied to apes is one by no means easy to answer Leaving man aside (whose close anatomical resemblance to apes is so obvious), it is at present extremely difficult to say what are the apes' true zoological affinities. It is to be hoped that future palæontological researches may afford us materials for tracing these out, but at present a chasm separates the apes from every other group of animals The half-apes, or lemurs, were generally considered to lead down from the apes towards the insectivora, and thence to the implacental mammals, but the differences between the apes and lemurs are so many and great, that it cannot be considered otherwise than in the highest degree improbable that (on the Evolution hypothesis) they took origin from any common root-form that was not equally the progenitor of other mammalian orders

But if the apes cannot be considered to show evidence of genetic affinity with any other mammalian order, do they constitute so homogeneous a group as to suggest the former existence of one ancient root-form common to them all? To this question it may be answered that the differences between the *Simiadæ* and *Cebidæ* are such as to render it doubtful whether they may not have had respectively quite different origins, and whether their resemblances may not have been superinduced by similarity of needs and conditions. The differences referred to are as to—(1), dentition, (2), nasal septum, (3), tail—the *Cebidæ* showing a tendency to a curled tail-end, while the *Simiadæ* never manifest any such tendency, (4), cheek pouches, (5), ischiatic callosities, (6), general form and habit of body, (7), opposability of the thumb, (8), bony *meatus auditorius externus*. All these characters, taken together, seem to make it probable that the *Cebidæ* and *Simiadæ* are not diverging offshots from some common ape parent, but that they have arisen in an independence as complete as that between the origin of either of them and the origin of the lemuroids or carnivores Possibly further discoveries in the Miocene deposits of North America will reveal to us transitional forms between the Old and the New World apes, but the existence of such forms cannot certainly as yet be affirmed. It may be asked, however, Can the genera, which possess so many points in common as *Cebus* and *Cercopithecus*, have come to resemble each other independently? To this it may be replied, that the number of similarities of structure which must have had an independent origin is so great that it is difficult to see why those of the two genera named may not also have had such an origin. As examples of such similarities of independent origin, the following structures may be referred to:—The bony covering of the temporal fossa in *Chelonia*, *Pelobates*, and *Lophiomys*; the compound tooth structure of *Orycteropus* and *Myliobatis*; the coexistence of a certain form of dentition with a saltatory habit in *Macropus* and *Macroscelides*; the presence of but eight carpal bones in *Troglodytes* and *Indris*; the course of the vertebral artery in *Auchenia* and *Myrmecophaga*; the flying membrane in certain squirrels

[1] Madagascar is the special home of the half-apes or lemurs.

and phalangers; the canines and premolars of *Canis* and *Thylacinus;* the grinders of *Peromeles* and *Urotrichus;* the external form and habit of body of *Mus*, *Sorex*, and *Antechinus;* and the peculiar dorsal shields in tortoises and certain frogs. But if some naturalists are disposed to admit that the common origin of the *Cebidæ* and *Simiadæ* may be very doubtful, can the be even sure of that of *Cercopithecus* and *Hylobates?* It has been recently suggested, that the *Artiodactyla* and the *Perissodactyla* (the even and the odd-toed ungulates) may be genetically independent (their common characters being merely adaptive, functional ones), as also with the *Balænoidea* (whales), and *Delphinoidea* (dolphins). The response of organisation to need being such as it is (structure and function manifesting themselves so simultaneously), the discrimination between genetic and adaptive characters must always be a work of extreme delicacy. In the presence of the various genealogical trees of animal descent which have been so hastily put forward of late, a judicious scepticism seems the attitude best warranted by the evidence yet obtained. If so many similar forms have arisen in mutual independence, then the affinities of the animal kingdom, or even of the mammalian class, can never be represented by the symbol of a tree. Rather, we should conceive the existence of a grove of trees, closely approximated, greatly differing in age and size, with their branches interlaced in a most complex entanglement. The great group of apes is composed of two such branches; but their relations one to another, to the other branches which represent mammalian groups, and to the trunks from which such branches diverge, are problems still awaiting solution.

There can, however, be no doubt that the *Simiadæ* and *Cebidæ* together form a most natural group, and are closely allied with man in structure. Moreover, as man is the highest animal, and, zoologically considered, differs less from even the lowest ape than such ape differs from any other animal, man and apes must be placed together in one order, which may well bear its primitive Linnean name, "*Primates.*" Whether any other animals (and, if any, what) should also be included in this order, are questions for the consideration of which the reader is referred to the heading MAMMALIA.

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(ST G. M.)

APELDOORN, a flourishing town in the Netherlands, in the province of Guelderland, 17 miles N. of Arnheim, with large paper-mills, and a population of upwards of 12,000. A short distance off is the Castle of Loo, the favourite residence of King William I.

APELLAS, a Greek sculptor, mentioned by Pausanias (vi. 1. 6) as the author of a group at Olympia, representing a quadriga, with the statues of a charioteer and of Cynisca, the sister of Archelaus. This group having been executed to commemorate the chariot victory gained by Cynisca at the Olympic games, 420 B.C., the date of the artist is obtained. A bronze sculptor of the same name, and probably the same person, occurs in Pliny (*Nat. Hist.*, xxxiv. 86).

APELLES, the most celebrated of ancient Greek painters. The date assigned to him by Pliny (*Nat. Hist.*, xxxv. 79) is 332 B.C., and with this agrees the fact of his having been the court painter of Alexander the Great, who it was said would allow no one else to paint his portrait, though, in point of fact, portraits of him by other artists are known (Pliny, vii. 93 and 125; Horace, *Epist.*, ii. 1, 239; Cicero, *Ad Fam.*, v. 12, 13). Apelles had worked before then for Philip, the father of Alexander, and with a career of nearly half a century, was at work after in the time of the first successors to Alexander's empire. He was born at Colophon, where it appears his father Pytheas, also a painter, resided. His first instructor was a certain Ephorus, of Ephesus, which was then the centre of the Asia Minor school of painting; the rival school being that of Sicyon in Greece proper, whither Apelles next proceeded, apparently to undergo the stricter discipline in drawing for which that school was renowned, and perhaps also, as is said (Plutarch, *Arat.*, 13), to win a share of the good fortune and fame of its leaders. He was here in the neighbourhood of Corinth, and it was probably then that he was taken by the beauty of the young Lais, on seeing her drawing water at the fountain of Peirene. Another incident, that of his having seen the notorious Phryne bathing at Eleusis, and from this conceived the design of his picture of Aphrodite Anadyomene, would also fall about this time, for the two reasons that Phryne's celebrity occurred in the period before Alexander, and that Apelles is not known to have made a second stay in that district of Greece. From Sicyon he went to the Macedonian court, and was there employed until Alexander departed on his expedition into Asia, on which the painter accompanied him as far as Ephesus, where he settled. Of the intimacy between him and his royal patron there are a number of stories, which, however, from the variety in the telling, may be without foundation in fact. According to Pliny (xxxv. 85), Alexander having betrayed ignorance by some remark about painting, was told by Apelles to be silent, lest the boys who were rubbing down colours in the studio might laugh at him. But the version of the same story given by Plutarch (*De Adul.*, 15) has, in the place of Alexander, the Megabyzos, or priest of Diana at Ephesus; while in Ælian (*Var. Hist.*, ii. 2) the story is told of Zeuxis, not of Apelles. Again, Ælian (*Var. Hist.*, ii. 3) relates, that while Alexander was inspecting a painting of a horse by Apelles, a horse neighed towards the picture, upon which the painter remarked that the horse knew more of art than the king. But Pliny (xxx. 95) instances the neighing of a horse, only as having decided a competition between Apelles and some other painter. Still, so far as the painter's readiness of rebuke is concerned, these stories are confirmed by other incidents, as when he told an artist, who boasted of his speed in work, that the wonder was why he could not produce more of such stuff in the same time; or, when having once accepted correction from a shoemaker about a wrongly painted boot in one of his pictures, he declined further criticism from him, with the observation which has since become a proverb, *Ne supra crepidam sutor judicaret* (Pliny, xxxv. 84). Of an opposite kind were his relations with Protogenes, the Rhodian painter, whose abilities he readily recognised, and whom he brought into notice by spreading a report that he intended to purchase his friend's pictures, and sell them as his own. Finding Protogenes not at home on one of his visits, Apelles, instead of leaving his name, drew with a brush an exceedingly fine line on a prepared tablet. Protogenes knowing the hand, and accepting the challenge, drew within the line a still finer one in another colour. But Apelles returning, divided the line a third time, and was confessed the victor. Though Ephesus continued to be his home, Apelles worked also elsewhere, as in Smyrna, Samos, and Rhodes, but principally in Cos, where he received the rights of a burgess, and where probably he died. For an account of his works and style, see ARCHÆOLOGY (CLASSICAL). (A. S. M.)

APENNINES, an extensive range of mountains traversing the entire extent of the Italian peninsula, and forming, as it were, the backbone of that country. The name Apennines is probably of Celtic origin, and derived from *pen*, properly signifying a head, or mountain height. By the Greek and Latin writers the name is generally used in the singular, as *Apenninus Mons*, ὁ Ἀπέννινος, τὸ Ἀπέννινον ὄρος. The name may have been originally applied only to a particular mountain, and afterwards extended to include the whole chain.

The Apennines may be considered as a southern branch of the great Alpine system of Europe. Both the mountain systems have a general resemblance as regards the age and lithological character of the rocks and strata which compose them. Geographers have differed as to the point where the Apennines are to be distinguished from the Alps. Some have placed it at the pass of Bocchetta; others at the Col di Tenda; and others at the low pass which runs from Savona to Cairo. Strabo, who gives a very accurate account of the general features and direction of this chain, considers it as beginning in the vicinity of Genoa. From Col di Tenda the Apennines run in a semicircle round the Gulf of Genoa, in a general direction from west to east; they afterwards turn to the south, and traverse the whole of the Italian peninsula to the Strait of Messina. The entire length of the chain is about 600 miles measured in a direct line, and about 800 miles if measured along the windings. The chain lies between 38° and 44° 30′ N. lat., and 7° 40′ and 18° 20′ E. long. The mountains are divided into the Northern, Central, and Southern Apennines.

The *Northern Apennines* include what are usually designated the Ligurian and Tuscan Apennines. The Ligurian Apennines extend from the Maritime Alps past Monte Gisa to the borders of Tuscany. The principal passes here, between Piedmont and the duchy of Genoa, are through the valleys of the Tanaro, the Bormida, and the Lemma. The pass of Pontremo leads up the Magra Valley from Spezzia to Parma. The Tuscan Apennines extend from Monte Pellegrino to Monte Cornaro, in 12° 3′ E. The Alpi Appuani form an outlying mass of mountains between the valley of the Magra and the Secchio. The chief passes are those of Bratello, Fiumalbo, Monte Carelli or Pietra-Mala, and that proceeding from the valley of the Sieve, over Borgo di San Lorenzo, through the valley of the Lamone, and on towards Faenza.

The *Central* or *Roman Apennines* comprehend that part of the chain between Monte Cornaro, in which the Tiber rises, and Monte Velino, north of Lake Fucino. Its general direction is from N.N.W. to S.S.E. or nearly parallel to the Tiber. The descent towards the Adriatic is continuous and direct, but towards the Mediterranean it forms two distinct inclined planes. The principal passes from the north are at the village of Scheggia, where the Cantiano rises; at Serravalle, south-east of Monte Pennino, at the head of the valley of the Chienti; at Castellucio, between Norcia and Arquata; and the chief pass of all between Rieti and the valley of the Pescara.

The *Southern Apennines* include the remaining portion of this chain. From Monte Velino they proceed in a south-easterly direction to the valley of the Ofanto, which cuts through the range. South of that limit, one short branch extends eastward towards Altamura, another runs westward to the neighbourhood of Salerno, while the main chain is prolonged nearly due south to the heights of Aspromonte overlooking the Strait of Messina. In the upper part of the Southern Apennines a number of sharp pyramidical points raise themselves above the mountain chain. Among these are Monte Forcone at the source of the Sangro, Monte Sant' Angelo, above the sources of the Volturno and Trigno, and Monte Calvello north-east of Salerno. The principal pass over this part of the Apennines is that of Sulmona, near the sources of the Volturno, so called from the town of Sulmona, where the roads from Rome, Pescara, and Aquila unite. The passes above Castel Franco and Ariano are the highest points of the roads over the ridge, from Benevento to Troja, and from Avellino to Foggia.

The geology and palæontology of the Apennines have been fully investigated by Savi, Meneghini, Pareto, Lavini, Orsini, Bianconi, Mortillet, and others. As a general rule, the same formations occur here as in the Alps, and the system usually consists of a central ridge having secondary and lower ridges running parallel with the main range, the intervening country being formed of but slightly disturbed newer Tertiary deposits. Thus, in that portion of the Apennines which borders on and extends into Tuscany and Bologna, the system consists of two parts. The one which is most distant from the Mediterranean forms the Apennines proper; here the Eocene beds prevail, and are covered, especially on the north flank, by Miocene and Pliocene beds; the axes of elevation are numerous and parallel to each other, following strikes which run from W.N.W. to E.S.E., and from N.W. to S.E. The other part is nearer the Mediterranean, and is remarkable for its richness in metalliferous ores, the rocks prevalent in it belong to the Palæozoic and Oolitic periods, and have a N.N.W. to S.S.E. strike. Between Spezzia and Civita Vecchia it is represented by numerous outliers of verrucano (probably of Carboniferous age), and trias surrounded by Oolitic rocks. The district of Carrara abounds in marbles belonging to the Liassic and Oolitic periods. Nearly all the mountains between Carrara and Monte Sagra have beds of marble, which sometimes acquire considerable thickness, as for instance in the vertical escarpments of Monte Corchio. The mountains between the meridians of Genoa and Parma form but one chain, composed of parallel ridges striking W.N.W. to E.N.E. The strata consist of Eocene formations flanked by Miocene and Pliocene beds, pierced by numerous ophiolitic masses. Towards Genoa the mountains conform to the S.S.W. and N.N.E. directions of the Western Alps; the rocks are of Eocene age, but are much metamorphosed by the serpentines of Pegli, Voltri, and Varagine. In the Central Apennines there is a large development of secondary beds from the trias to the upper chalk, and of the Tertiary formation, which is represented by strata of the Eocene, Miocene, Pliocene, and Post-Pliocene periods. The main axis of the chain is chiefly formed of the Secondary rocks, while the minor ranges are formed of Tertiary beds. The mountains, as a whole, rise from N. to S., culminating in Monte Corno, 9593 feet high, beyond which their height again decreases. Mount Amaro is 8960 feet, and Mount Velino 7910 feet high. The oldest rock seen in this part is a dolomite; it is unfossiliferous, and acquires its greatest massiveness in the mountains of Cesi, Spoleto, and Ventosa. Above it follows a limestone, which is in places many hundred yards thick. Fossils are rare in it as a whole, though locally abundant in a few places. The strata which next succeed are ferruginous limestones and marls, abounding in Middle Liassic fossils; then red limestones, yielding ammonites and other shells of the Upper Lias; then a vast series of limestones, marls, and siliceous beds, which compose a large part of the flanks and summits of the Apennines, and which represent the Oolitic period. The hippuritic chalk is largely developed, and in places it forms the mass of the Apennines, as in the Rossa Chain, and the lofty ranges of the Abruzzi. Fossils are abundant in this limestone. The Upper Cretaceous beds are represented by massive limestones with comparatively few fossils. Above these follow a nummulitic limestone, marly schists, arenaceous macigno, &c. The Miocene beds are varied in their lithological nature and rich in fossils. The more recent strata seldom occur at any great height above the sea.

(See D'Achiardi, *Mineralogia della Toscana*, 2 vols. 1872; W. P. Jervis, in *The Mineral Resources of Central Italy*, 8vo, 1868; and papers by Lavini and Orsini, in *Bull. Soc. Geol. France*, 2d series, xii. 1202–1232; Pareto, in *Bull. Soc. Geol.*, xix. 239–320, Bianconi, *Ibid.*, xxiv. 482; and Ponzi, *Giornale Arcadico*, new series, vol. xxiii.)

APENRADE, a town of Prussia, in Schleswig, beautifully situated on the Apenrade fiord, an arm of the Little Belt, 38 miles N. of Schleswig. It is connected by a branch line with the main railway of Schleswig, and possesses a tolerably good harbour, by means of which it carries on a considerable transit trade, while there are also several manufactures, as well as some shipbuilding and sea-fishing. Population, 5932.

APHASIA (from α and φάσις; synonyms, *Aphemia, Alalia, Aphrasia, Aphthongia, Aphthenxia*), a term applied to indicate a condition in which the function of expressing ideas by articulate sounds is arrested, perverted, or destroyed, in consequence of lesion of the brain. Loss or perversion of the power of expressing ideas by written signs is often associated with this condition. The term Aphasia is generally held to comprise two great varieties: (1), Amnesic Aphasia, in which the memory of words is lost or perverted; and (2), Ataxic Aphasia, in which the function of articulation is lost or perverted. Although this broad distinction is very properly made, it very rarely happens that a case occurs in which the two conditions are not to a greater or less extent coexistent.

Amnesic (α, μνῆσις) aphasia is symptomatised very variously. The earliest and most common indication consists in—(α.) The loss of the memory of substantives and names, other parts of speech being properly applied; in such cases a periphrasis is employed to express the term. (β.) The memory of a language with which the patient had been thoroughly conversant may become lost. (γ.) Terms are persistently misapplied; for instance, in recorded cases "pamphlet" has been used for "camphor," "hogshead" for "sugar," "horse" for "man," &c., &c. This symptom has been named Heterophasia (ἕτερος, φάσις). In *ataxic* (α, τάξις) aphasia—(α.) the function of articulation is completely lost, the patient being only able to indicate by signs that he is conscious of the idea conveyable by the term; thus an ataxic aphasic, who had been an engine-driver, when asked what had been his trade, could only express himself by imitating the sound made by an engine when starting, "Hish, hish, hish." In many instances even this power of imitation is in complete abeyance—assent to the fitness of a spoken word to indicate the object exhibited being given by a nod or other gesture. (β.) The function of articulation is modified; thus a word may be only half articulated; for instance "watch" can only be pronounced as "wa," no prompting, or effort on his own part, enabling the patient to complete the word. (γ.) Only automatic phrases can be articulated, oaths, "yes," "no," "aye," &c. (δ.) The patient makes use of a set phrase, which may consist of actual words, but more frequently of confused sounds, such as "tan tan," "ta ta," "didoes doe the doe," &c.; but such phrases do not appear to satisfy him as expressive of ideas, although only one is persistently employed. In almost all cases of ataxic aphasia there is a well-marked desire and effort to enunciate words, the muscles of articulation often working strongly but convulsively. The great diagnostic point between amnesic and ataxic aphasia is, that in the former the patient can always articulate the forgotten word when it is suggested to him; in the latter, no prompting or assistance can enable him to enunciate the proper sound. Closely associated with both forms of aphasia is the loss of the power of expressing ideas by written signs. To this condition the term agraphia (α, γράφειν) has been applied. Most frequently this power is completely lost, the effort of putting pen to paper being only followed by a confused scribbling; occasionally a strong effort is made to write; for instance, the patient makes a feeble endeavour to make his signature, which results in the production of a badly-formed initial letter, the subsequent ones being either quite unformed, or represented by a confusion of wrong signs. In the most slightly-marked cases of agraphia, *i.e.*, those in which the patient is able to produce actual graphic signs, the general character of the handwriting is completely changed from that which had existed during health.

Aphasia, whether amnesic or ataxic, may, but seldom does exist disassociated from absolute insanity.

Great interest has centred around the question of the pathology of aphasia, as many observations have been adduced which appear to connect with this condition lesion of a specific portion of the brain, and from this it has been sought to deduce the absolute localisation of the function of speech in the hemispherical ganglia. The large proportion of cases of ataxic aphasia occur in association with right-sided hemiplegia, although others are on record in which it has appeared in connection with left-sided hemiplegia in left handed persons. Bouillard, Andral, and Dax placed on record a series of cases which bore upon the association of disease of the frontal lobes of the brain, with loss of the faculty of articulate speech. In 1861 Broca of Paris enunciated the theory, founded on the clinical and pathological observation of two carefully reported cases, that the portion of the cerebrum which is necessarily diseased in aphasia is the *posterior third of the third or inferior left frontal convolution*. A large number of cases have since been published which appear to support this theory; but an almost equally large number have been recorded in which disease of this portion of the above-named convolution has been found without material impairment of speech, in which it has been found intact in cases of aphasia, or in which disease of other convolutions has been accompanied by similar symptoms. Broca's positive localisation of the function of speech has been disproved by several well-authenticated cases; it is, nevertheless, held by many prominent pathologists, that, although his deduction is not absolutely correct, it is in the main true, as lesion of the portion of the brain indicated by Broca may affect neighbouring convolutions of the frontal lobes, in which their observations lead them to believe the function of speech is localised, although its seat cannot be exactly indicated. Another section of pathologists hold that the nutrition of the whole encephalon is effected by lesion of this particular convolution, the locality of which, by its anatomical relations to the middle cerebral artery, is peculiarly liable to embolus and apoplexy, and that as a consequence, the faculty of speech is affected in common with other cerebral functions; and they further argue, that, as destruction of other portions of the cerebrum has been known to be accompanied by similar symptoms affecting speech (the left inferior frontal convolution being intact), it is in no wise proved that localisation of function can be fairly deduced from the occasional association of lesion of this convolution with aphasia.

(See Dr Bateman, *On Aphasia*; papers by Drs Tuke and J. Fraser in the *Journal of Mental Science*, 1870; Dr Ferrier "On the Localisation of Brain Function," *West Riding Reports;* and for bibliography, *Dictionnaire Encyclopédique des Sciences Médicales*.) (J. B. T.)

APHORISM (ἀφορισμός, from ἀφορίζω, to define) is a terse and definite statement of a principle or important doctrine in science or philosophy. The word has been used as the title of some well-known works—as the *Aphorisms of Hippocrates*, the *Aphorisms of the School of Salerno*, and the *Aphorisms of Boerhaave*, which represent respectively the medical doctrines of the 5th century B.C., and the 12th and 17th centuries of the Christian era. One of the best specimens of a philosophical treatise wholly written in aphorisms is the *Novum Organum* of Lord Bacon.

APHRODITE [VENUS]. From the accepted meaning of the name Aphrodite, "born in the foam of the sea," (ἀφρός), together with Hesiod's (*Theog.*, 187–206) account of her appearing first in the waters round Cythera, and finally landing on Cyprus; and from the further explanation of her principal title *Urania*, to the effect that she derived her being from the maimed Uranos, this goddess might appear to have been of pure Greek origin, as indeed would also be gathered from the fact of Homer placing her among the Olympians, and calling her a daughter of Zeus and Dione. But her connection with Cyprus, which even Homer admits, calling her *Kypris* (*Iliad*, v. 330, 422, 760), and in the *Odyssey* (viii. 362), speaking of her visit to Cyprus, where were a temple and an altar for her, has provoked an inquiry as to how far her worship may have been based on that of Astarte, the patron goddess of the Phœnician settlers in that island, the more so since the worship of Aphrodite Urania flourished mainly in the track of the Phœnician factories in the islands and in Greece proper. The obvious facts are—first, that Aphrodite was not associated with any of the legendary families of the mainland of Greece, her mortal favourites—Adonis, Pygmalion, Anchises, Æneas, Paris—being all non-Hellenic, and more or less Asiatic in origin; secondly, that her worship in Cyprus, as Herodotus was told (i. 105), had been transplanted from Ascalon, where was the oldest temple of a goddess whom the Greeks translated into Aphrodite Urania, and identified with the Alitta of the Arabians, the Mylitta of the Assyrians, and the Astarte of the Phœnicians; thirdly, that this Astarte or Mylitta was a goddess of the heavens (Urania), or better, of the heavenly bodies, and, though the details are unknown, doubtless personified the harmony of their movements while controlling their supposed influence on human affairs, not least their influence on the sea, in which respect her worship would commend itself to a seafaring and trading people like the Phœnicians. As the universal goddess of love, her province embraced every phase of nature. While this, which was the basis of the character of Astarte, was the basis also of the character of Aphrodite; and while, through commercial ascendency, the alphabet of the Phœnicians, and their system of numbers, weights, and measures were adopted by the Greeks, there is nothing in the way of assuming that the idea of their goddess Aphrodite was borrowed under similar circumstances. If the 15th century B.C. be correctly assigned as the period of the Phœnician settlements in Greece, there would be interval enough before the time of Homer to admit of the new goddess becoming Hellenised and obtaining a place in Olympus; and this would be brought about with the greater facility if, as is supposed, the Oriental goddess really supplanted a cruder form of a goddess of love previously existing in the Greek system. How widely the scope of love was interpreted in the last days of Greece, may be seen, on the one hand, from the manner in which the unseemly account of the birth of Aphrodite in Hesiod was elevated into a scene at which all the higher deities were present, as rendered by Phidias on the base of the statue of Zeus at Olympia; and, on the other hand, from the fact that the philosophers, particularly the earlier thinkers in natural philosophy, conceived heaven, earth, and sea as bound into an harmonious whole by the power of love. A very different interpretation was put upon it in later times when sensual indulgence was the master feeling, and Aphrodite became the patroness of hetæræ. For these two different characters she bore the titles of *Urania* and *Pandemus*. Under the former title she was not only a goddess of the heavens, in respect of the fertility which they produce on earth, but was also a goddess of victory, either herself armed or occupied with the arms of Ares (Mars). Her power extended to the sea, but only to soothe it, and hence she was worshipped in seaports with the epithet of εὔπλοια. Where her influence, however, was mostly felt was in the gardens among the flowers in springtime. It was then that her principal festivals occurred, and in such places and at such a time the full charm of her character as goddess of love was appreciated. The Graces (*Charites*) and the Seasons (*Horæ*) worked her garments with flowers, from which a scent came as in nature. The sweetness of her smile, her persuasive voice, and her entire beauty were then irresistible. From being the goddess of beauty and love throughout nature, she became goddess of love in the hearts of gods and men; either inspiring a passion for herself, as in the case of Pygmalion and Anchises, or herself inflamed with love, as for Adonis and Cinyras, the reputed founder of her worship in Cyprus; or again inspiring a passion between two other persons, as between Paris and Helena, and between Phaon and the women of Lesbos. When the subjects were women, her power was frequently carried to a desperate issue, as in the cases of Medea, Pasiphae, Phædra, and many others. But she gave also the pleasures of love, and while this led to the degradation of her character finally, it was differently viewed in earlier times, in which she was in this matter simply the goddess of domestic life and of the relations between families, being in some places associated with Eileithyia, the goddess of childbirth, or elsewhere regarded, like Artemis, as a guardian of children and young maidens. It seems, indeed, as if it had been for the protection of family love that she was made to assume after Solon's time the protection of the institutions for hetæræ. Among the other deities her power and also—after the rivalry of Hera (Juno) and Athene (Minerva) had been set aside by the judgment of Paris—her surpassing beauty were acknowledged. Eros (Cupid), the male personification of love, who at one time is called her son, at another is present at her birth, is the chief of her companions, the others being Himeros, Pothos, Anteros, Peitho, the Graces, and the Seasons. She was the wife of Hephæstos (Vulcan), and if in that capacity she was unfaithful with Ares, as in the ludicrous incident when the two were caught in the cunning net made by her husband, there yet appears some ground for the invention of this myth, in the fact of her being associated in worship with Ares at Thebes. Her connection with Ares may have originated in the character of *Areia*, which she derived from the Oriental goddess, her prototype. As an armed goddess she appeared at Cythera and in other of the earliest seats of her worship. It was only as *Charis*, the personification of grace and refined skill, that she could have been the wife of Hephæstos, and this is the name which in that capacity she bears in the *Iliad*. In the Trojan war she was opposed to the Greeks, and protected Æneas, Hector, and Paris. The chief seats of her worship were Cyprus, Cythera, Cnidus, Corinth, Thebes, Sicily, and Athens. Her usual symbols were the tortoise, dove, swan, hare, dolphin, and goat. In Paphos, where was the oldest form of her religion, she was worshipped under the image of a ball or pyramid surrounded by burning torches. In the best days of art every charm of beauty was exhausted for her statues, culminating in the Aphrodite at Cnidus by Praxiteles. Of existing statues, the Venus of Milo and the Venus of Capua are the best examples. With regard to the native Roman goddess Venus, as distinguished from the Venus who through contact with the Greeks was afterwards identified with Aphrodite, it is known that her worship did not exist in the time of the kings, and that it was introduced into Rome from Lavinium, Ardea, and Gabii, where she was connected with Æneas and his advent into Italy. But for the rest, whether she was the goddess called Venilia, or a native goddess of gardens, is uncertain. Doubtless her functions were in important instances exchangeable with those of Aphrodite; and this being so, it was an obvious gain to incorporate with their own goddess another whose relations with Mars and Anchises, the founders of the Roman race, were express and distinct.

Aphrodite and Eros, from carnelian intaglio in Brit. Mus. (enlarged).

In her sway over the productivity of the fields Venus was associated with Priapus; in the spring time with its flowers she was sacrificed to by young maidens; in war she was Victrix; in peace, Concordia and Conciliatrix; on the sea she was Marina; as Libentina (Lubentina) she was goddess of desires; as Libitina, goddess of death; and as Genetrix, the founder of families, especially of the Julian family. The derivation of her name given by Cicero (*De Nat. Deor.*, ii. 27, iii. 24) is *Venus quod ad omnes veniat.* (A. S. M.)

APICIUS. There were three Romans of this name, all celebrated as epicures. The second, M. Gabius Apicius, who lived under Tiberius, is the most famous. He invented various cakes and sauces which bore his name, and rival schools of cookery claimed their descent from him. A treatise, *De Re Culinaria, sive de Obsoniis*, &c., bearing the assumed name of Cælius Apicius, was compiled at a later period.

APION, a Greek grammarian and commentator upon Homer, son of Posidonius, was born at Oasis in Libya, but called himself a native of Alexandria, where he studied. He taught rhetoric at Rome about 30 A.D. With extensive knowledge and great oratorical power he combined an unbounded vanity, as the epithet *cymbalum mundi* applied to him by Tiberius seems to imply. Mere fragments of his works remain; the stories of Androclus and the lion and of the dolphin at Puteoli—the largest of these fragments—are preserved in Gellius. Apion headed the embassy sent by the Alexandrians to Caligula complaining against the Jews, 38 A.D. Josephus refutes his misrepresentations of the Jews in the second of his two books "Against Apion."

APIS, a sacred bull worshipped at Memphis from the earliest period, having probably been introduced into the religious system as early as the 2d dynasty by the king Kaiechos, who instituted the worship of Apis and the bull Mnevis. His name in hieroglyphs was *Hapi*, and meant "the hidden," as he had to be discovered amidst the cattle, which was done by certain diacritical marks. According to the hieroglyphic inscriptions which accompany his form, he was the second birth or living incarnation of the god Ptah, the Egyptian Hephæstos or Vulcan. Apis is first mentioned and appears in the monuments of the 4th dynasty. The two bulls Apis and Mnevis are considered to have respectively represented the moon and sun, and seem both to have been buried at Memphis. He was supposed to have been born of a virgin cow, rendered pregnant by a moonbeam or a flash of lightning. The mother of Apis, according to Strabo, had a part of the temple of the Apis reserved for her use; and the hieroglyphic inscriptions record a prophet or priest attached to her service. On the monuments she shares the honours of the bull, and is represented under the attributes of Athor as a goddess with a cow's head. This cow had her especial name, these animals having each a separate appellation. According to the Greek writers Apis was the image of Osiris, and worshipped because Osiris was supposed to have passed into a bull, and to have been soon after manifested by a succession of these animals. The hieroglyphic inscriptions identify the Apis with Osiris, adorned with horns or the head of a bull, and unite the two names as Hapi-Osor, or Apis Osiris. According to this view the Apis was the incarnation of Osiris manifested in the shape of a bull. But besides this title, the monuments style Apis the son of Ptah, who was supposed to be his father by the sacred cow, or the second life of Ptah. Other monuments, indeed, declare him to have had no father, and to have been Onnophris or Osiris, but this conflict of ideas must have arisen from his material and spiritual nature, uniting the soul of Osiris or Ptah mystically with the sacred animal. Besides the mother of the Apis, a cow was annually exhibited to him decorated with the same insignia—that is, a disk between the horns and a housing on the back, to judge from the insignia found on the bronze figures of the Apis—and then slaughtered the same day, for no issue of the divine animal was permitted to exist. According to other authorities several cows were kept in the Apeum. On the announcement of the birth of an Apis, the sacred scribes and priests proceeded to verify the characters of the calf. The marks of the Apis were a black coloured hide, with a white triangular spot on the forehead, the hair arranged in the shape of an eagle on the back, and a knot under the tongue in shape of a scarabæus, the sacred insect and emblem of Ptah, a white spot resembling a lunar crescent at his right side. These marks have been supposed to be for the most part certain arrangements of the hairs of the hide as seen in some animals. A house was built to the calf Apis facing the east, in which for four months he was nourished with milk. When he had grown up he was conducted, at the time of the new moon, to a ship by the sacred scribes and prophets, and conducted to the Apeum at Memphis, where there were courts, places for him to walk in, and a drinking fountain. According to Diodorus, he was first led to Nilopolis, and kept there 40 days, then shipped in a boat with a gilded cabin to Memphis, and he was there allowed to be seen for 40 days only by women, who exposed themselves to him. Like all the sacred animals his actions were oracular, and he had two chambers, his passage into one of which was deemed fortunate, and into the other unlucky. Thus the licking the garments of a visitor was supposed to prognosticate a tranquil but short life, and his refusal of the food offered to him by the hand of Germanicus, the approaching death of that hero. The actions of the children who played around his shrine or accompanied his processions were also considered oracular. The day of his birth was kept as an annual festival. His life was not allowed to exceed 25 years, and should it have attained that maximum reckoned from the date of his enthronisation, the Apis was killed and thrown into a well, in which the priests asserted he had precipitated himself. This well was known to no one, and no one was allowed to reveal the place of burial. If the Apis died before the 25 years he received a splendid burial at Memphis in the Serapeum, for after death he was called the Osor-hapi, or Serapis. This funeral was expensive; his body was placed in a barge, and accompanied by a procession of a Bacchanalian character, passing through the brazen doors of Memphis. As universal joy prevailed at his discovery, so his death threw all Egypt into a general mourning, and every one shaved off his beard. This mourning continued till the discovery of another Apis. His birthday was celebrated by an annual feast, the *natales Apidis*, of seven days' duration, during which it was supposed the crocodiles were innocuous, and a silver cup was thrown on the occasion into a certain part of the Nile, which was considered a flux of Apis. This festival coincided with the rise of the Nile. On the mummy coffins an Apis is often seen on the foot-board of those of the 7th and 6th centuries B.C., bearing on the back the mummy of the deceased to the sepulchre. The discovery by M. Mariette of the Serapeum at Memphis described by Strabo has thrown great light on the worship and history of the Apis, the mode of burial, and the sequence of the bulls. (See SERAPEUM.) The oldest Apis mentioned was one of the reign of Amenophis III., and he was followed in the 18th dynasty by bulls which had died in the reigns of Tutankhamen and Horus. There was a succession under the 19th dynasty, commencing with Seti or Sethos I., besides three which died in the 16th, 26th, and 30th years of Rameses II., and three others, the dates of whose deaths are unknown. Under the 20th dynasty there was an Apis which died in the

26th year of Rameses III., one in the reign of Rameses IX., others of the date of Rameses XI. and XIV., and four others whose dates are not determined, besides three more which died under the 21st dynasty. Of bulls deceased in the 22d dynasty, there is one of the 23d year of Osorkon II., another of the 14th year of Takellothis I., and a third of the 28th year of Sheshank or Shishak III. It is not till the reign of this monarch that the dates connected with the Apis become of chronological importance. On the sepulchral tablet of the Apis which was born in the reign of Shishak III., is found the formula of the date of the birth and inauguration of the bull. It was born on the 20th of the month Payni, in the 28th year of the king's reign, and enthroned on the 1st of Paophi of the same year, having died in the 2d year of the king Pamai, and been buried on the 1st of the month Mechir of the same year. It had attained the age of 26 years. Three other bulls died in the 4th, 11th, and 37th years of Shishak IV. Important statements like these show the intervals of time which elapsed between the regnal years of different kings, and check the chronology of the 22d and subsequent dynasties, but owing to unfortunate lacunæ the chronology of Egypt is conjectural, and not positive till the reign of Tirhakah. The dates of the other Apis are, one which died on the 5th of the month Thoth, in the 6th year of Bekenreuf, or Bocchoris, another of the 2d year of Shabak or Sabaco, and that buried on the 23d Pharmouthi of the 24th year of Tirhakah, 730 B.C. The dates of the other bulls prior to the conquest of Egypt by Alexander the Great, 332 B.C. are—one born in the 26th year of Tirhakah, enthroned on the 9th Pharmouthi, the same year deceased, in the 20th year of Psammetichus I., and buried on the 25th Paophi, of the 23d year of Psammetichus; another deceased in the 52d year of the same king; a third born in the 53d year of Psammetichus I., enthroned on the 12th of Athor of the 54th year, deceased on the 6th of Paophi, and buried on the 10th Choiak of the 16th year of Necho, having lived 16 years 7 months and 17 days; another born on 7th Paophi of the 16th year of Necho, enthroned 9th Epiphi of the 1st year of Psammetichus I., died on the 12th Pharmouthi of the 12th year of Apries, and buried the 21st Payni of the same year, aged 17 years 6 months and 5 days; another born in the 5th year of Amasis, inaugurated on the 18th Payni of the same year, died on the 6th Phamenoth, was buried on the 15th Pashons of the 23d year of the same king, aged 18 years and 6 months. The Apis which died after this, and of which a sarcophagus was found dated in the 4th year of Cambyses, is the one supposed to have been killed by Cambyses on his return from Æthiopia. Another born in the month Pharmouthi of the 5th year of Cambyses, died in the 4th year of Darius, and was buried on the 2d Pashons of the 5th year of Darius, and had lived upwards of 7 years. It is the Apis of Darius, alluded to by Polyænus, for the successor of which Darius offered 100 talents as a reward to the fortunate discoverer. Another Persian king Ochus is said to have killed and eaten an Apis, 338 B.C. The death of an Apis soon after the death of Alexander the Great, 323 B.C., is also recorded. The sepulchral tablets in the demotic characters, according to M. Brugsch, record the birth of an Apis in the month of Phamenoth, in the 20th year of Ptolemy Euergetes I., 231 B.C., which died in the 51st year, 179 B.C.; and another older, probably of Ptolemy Philadelphus II., 253 B.C.; another of the 14th year of Ptolemy Epiphanes IV., 211 B.C.; another in the 20th year of Ptolemy IV., 185 B.C.; another in the 17th year of Ptolemy Philometor VII., 164 B.C.; and another born in the 53d year (118–117 B.C.) of Ptolemy Euergetes II., died 15 years old, 103 B.C., in the reign of Ptolemy XI. In the Roman times the discovery of an Apis in the reign of Hadrian, 121 A.D., caused a tumult at Alexandria; and the last known Apis is that brought to the Emperor Julian II., 362–363 A.D., after which the Apis disappears from Egypt altogether. The Apis was embalmed at great cost, but the operation consisted in preparing with bitumen the skull and a few of the principal bones of the bull made up into an appropriate shape. The second genius of the Karneter, or Egyptian Hades, was also called Hapi or Apis, but he was quite distinct from the bull god and the son of Osiris. His type was that of a human mummy with the head of a Cynocephalus ape. Bronze native figures of the Apis are not uncommon, and those of stone are occasionally found, but porcelain ones are extremely rare.

Lepsius, "Ueber den Apiskreis," *Zeitsch. d. Morgenl. Gesellsch.* vii. Bd. 1853; Brugsch, *Ibid.*; Mariette, *Le Sérapéum de Memphis*, 1857; Jablonski, *Pantheon*, ii. (S. B.)

APOCALYPSE, a designation under which the last book of the New Testament is frequently referred to. It is the title the book has in the Greek, Ἀποκάλυψις, which in the English version is rendered "Revelation." See REVELATION OF ST JOHN. The name is applied generally to predictions relating to the growth and triumphs of the Messiah's kingdom, especially as revealed in visions or expressed by means of symbols. The more important extra-biblical writings of this kind are noticed in the article which immediately follows.

APOCALYPTIC LITERATURE. This branch of later Jewish literature took its rise after the older prophecy had ceased, when Israel suffered sorely from Syrian and Roman oppression. Its object was to encourage and comfort the people by holding forth the speedy restoration of the Davidic kingdom of Messiah. Attaching itself to the national hope, it proclaimed the impending of a glorious future, in which Israel, freed from her enemies, should enjoy a peaceful and prosperous life under her long wished for Deliverer. The old prophets became the vehicle of these utterances. Revelations sketching the history of Israel and of heathenism are put into their mouths. The prophecies take the form of symbolical images and marvellous visions. As the old remained unfulfilled in the progress of events, and doubts arose about their truthfulness, it was necessary to give them a new turn and a more correct interpretation. Working in this fashion upon the basis of well-known writings, imitating their style, and artificially reproducing their substance, the authors naturally adopted the anonymous. The difficulty was increased by their having to paint as future, events actually near, and to fit the manifestation of a personal Messiah into the history of the times. Hence apocalyptists employed obscure symbols and mysterious pictures, veiling the meaning that it might not be readily seen. The artificial imitative character of their productions caused certain peculiarities; and the main object was attained by fastening the spirit of their contemporaries on the immediate fulfilment of their highest aspirations. From the intentionally dark imagery enfolding the ideas, it is difficult to discover the exact times of their appearance and the historical interpretation.

The earliest of such apocalypses is the canonical book of Daniel, in which an old seer in the Chaldean captivity is employed to portray the oppressions of the Jews under Antiochus Epiphanes. This was the model for all later ones. The literature in question was not confined to the Jews. Christians not only used the productions in which the Messiah was described after the Jewish fashion, but composed similar ones themselves,—Jewish Christians in particular. Here the Apocalypse of John is the noblest example, and deserves the honour of naming the entire range of literature.

The most obvious division of apocalyptic works is that founded upon authorship, Jewish or Christian. This, however, cannot be carried out with exactness because of later interpolations, proceeding from Christians who used the Jewish prophecies with the objects of making them more suitable. But it is not easy to trace the extent of subsequent elaborations; and we have only to rely on probable conjecture.

I. Jewish Apocalyptic.

1. *Enoch.*—Under the name of this antediluvian patriarch a book exists which is quoted in the epistle of Jude. After it had disappeared, except the fragments preserved by ecclesiastical writers, it was found in Ethiopia among the Abyssinians, and published by Laurence in 1821; subsequently by Dillmann in 1851, to which the latter scholar added a German translation in 1853. The book has been divided into five parts, exclusive of an introduction and a conclusion. The first contains an account of the fall of the angels, and their intercourse with the daughters of men producing a race of giants, with the consequences of such apostacy; followed by a description of Enoch's travels through heaven and earth under the guidance of holy angels, who explain to him the mysteries of the visible and invisible world (chapters vi.–xxxvi.) The "second vision of wisdom" is occupied with a description of the mysteries belonging to the heavenly kingdom, the angel-world, the Messiah, the growth and completion of His kingdom, the blessedness of the elect, and the condemnation of the unbelieving (xxxvii.–lxxi.) The third part is astronomical and physical, including an account of the movements of the stars, the sun, and the moon; of the four winds, and various earthly objects (lxxii.–lxxxii.) The fourth part describes two dream visions shadowing forth the history of man, from his origin to the completion of the Messianic kingdom (lxxxiii.–xci.) The fifth contains a series of admonitory discourses addressed by Enoch to his own family in the first place, and then to all inhabitants of the earth (xcii.–cv.) Several appendices are subjoined containing a narrative of the wonders which happened at Noah's birth, and a writing of Enoch's about the future retribution of the just and unjust (cvi.–cviii.)

The work contains much curious matter about the secrets and powers both of the visible and invisible world. Besides its historical views which relate mainly to the past, present, and future of the Jewish people, as also to heathen kings and potentates, much of the legendary and hagadic is interspersed. Daniel's seventy weeks, reaching down to the Messianic age, are changed into seventy periods of heathen rulers. The writer has withal a religious spirit. He is a strict moralist, warning and threatening. His imagination is vivid, but incapable of sublimity. The sweep of his prophetic vision is extensive. He has poetic force and vigour. The work is an interesting product of pre-Christian Judaism, multifarious, artificial, rabbinising.

The document consists not only of the prophecy of Enoch, but of extracts from a Noah-prophecy interspersed. The latter are found in places often unsuitable, consisting of chapters liv. 7–lv. 2, lx., lxv.–lxix. 25; perhaps also of xx. and lxx. In cvi., cvii. the same hand may be partly traced. Setting aside these insertions, the book of Enoch itself seems to be composed of three documents, the oldest of which is chapters xxxvii.–lxxi. The other two are not easily collected, but the chapters xci. 3–cv. have the clearest claim to belong to the second, and xxxiii.–xxxvi., lxxxv.–xc. to the third. The rest is all uncertain. The first was written about 144 B.C. as Ewald[1] acutely remarks; the other two fall some years later, *i.e.*, within the reign of John Hyrcanus (136–106 B.C.) The Noah-document is posterior, belonging perhaps to the first century; and all were subsequently put together, forming the present heterogeneous composition. Hilgenfeld contends that chapters xxxvii.–lxxi. proceed from a Christian Gnostic,[2] but his arguments are insufficient. Still more improbable is the hypothesis of Volkmar, that the entire Apocalypse was written 132 A.D.[3] We believe, however, in opposition to Dillmann, that they have been interpolated by a Jewish Christian, since the christology is higher than what Judaism produced; while the eschatology and angelology are developed in a manner which savours of Christianity. Thus, in the 51st and 62d chapters the Messiah is described as sitting on the throne of His glory and taking part in the judgment, while He is also called the Son of woman, the Son of man. To make Messiah the judge of mankind, either as the delegate of the Father, or together with Him, is not a Jewish, but a Christian idea. This differs from the representation in the 90th chapter, where he is symbolised by a white bull with great horns, whom all the beasts of the field and all the birds of heaven feared and entreated at all times. All races are to be changed into white bulls; the first among them became a great animal; and the Lord of the sheep rejoiced over them and all the bulls. Here Messiah is simply the chief of God's people, elevated above the rest, but still of the same nature with them, having no share in the judgment, or in founding the new church of God. He comes into the description by way of appendix, as it were, as though the author could not well omit all notice of Him. His part is entirely subordinate. In the 105th chapter, which, with the next three, show traces of Christian influence, the Messiah is called *Son of God*,—an appellation which seems to carry the idea of His person beyond Judaism, especially in connection with that in the 62d chapter, *Son of woman*, for the two come very near the idea of an incarnation. The whole work presents no trace of Rome as a power dangerous to Israel, so that the latest parts cannot be brought down far into the 1st century. The book had a very limited circulation among the author's countrymen. They do not quote it. It proceeded from a private individual, who may have belonged to a small circle or sect such as the Essenes. But Jude cites it. It has been translated into English by Laurence; into German, but chiefly from Laurence's English, by Hoffmann; and much more correctly by Dillmann in 1853. The translation of the last mentioned scholar has superseded those of his predecessors. See also Ewald's *Abhandlung, u.s.w.*; Lücke's *Versuch einer vollständigen Einleitung in die Offenbarung des Johannes, u.s.w.*, zweyte Auflage, § 11; Koestlin, "Ueber die Entstehung des Buches Henoch" in the *Tübingen Journal of Baur and Zeller* for 1856; Hilgenfeld's *Die Jüdische Apokalyptik*; Davidson in Kitto's *Cyclopædia*, article "Enoch;" Hilgenfeld's *Zeitschrift für wiss. Theologie*, 1860, 1861, 1862.

2. Another apocalyptic production is the so-called *Fourth Book of Esdras*, or *The Prophecy of Ezra*, originally written in Greek, but known now only in versions,—Latin, Ethiopic, Syriac, Arabic, and Armenian. The whole consists of a series of visions, which Ezra, who is put unchronologically into the 30th year of the Babylonian captivity, is supposed to have had. The questions that troubled the seer arose out of the state in which the Jews were at the time. They were deeply oppressed and afflicted. The heathen had trodden them down to the ground. Why had the promises of God to His own people been unfulfilled? Was not Israel still the chosen race, though often sinning? Were they not better than the heathen? The Romans had

[1] *Abhandlung ueber des Æthiopischen Buches Henokh Entstehung Sinn und Zusammenhang*, p. 73

[2] *Die Jüdische Apokalyptik*, p. 148, &c.

[3] "Beitrage zur Erklarung des B. Henoch nach dem Æthiop. Text" in the *Zeitschrift der deutschen morgenländischen Gesellschaft*, 1860, p. 87, &c., and Hilgenfeld's *Zeitschrift*, 1861, 1862.

destroyed Jerusalem, and the Jews were scattered to the four winds; so that the writer was deeply perplexed by the establishment of a heathen power over the Jews, involving an indefinite delay of the Messianic kingdom, or an apparent hopelessness as to its inauguration. Heathenism triumphed over Judaism, rending it to pieces. What had become of the divine faithfulness? The first vision (ch. iv.–v. 20) contains an angelic answer to the questions which the seer had painfully pondered, as in the 3d chapter. After being reminded of his inability to comprehend God's ways, the signs of the end are given. The second vision (v. 21–vi. 34) is similar. The third vision (vi. 35–ix. 25) and the fourth (ix. 27–x. 59) refer to the Messianic future. The fifth, relating to an eagle coming up out of the sea (x. 60–xii. 59), describes the Roman empire, its destination and period of duration, the sixth (ch. xiii.), the setting up of Messiah's kingdom; and the seventh (ch. xiv.), an account of Ezra's re-writing the holy books. It is very difficult to discover the date of this singular book, and the question is not yet satisfactorily settled, though many critics have investigated it. One thing is pretty clear, that the destruction of Jerusalem had taken place, and that Christianity had passed its incipient stage, exercising some influence even upon Judaism. Original sin, a dying Messiah, a general resurrection, &c., point to a Christian origin; so that the passages in which these features appear, and others too, were probably interpolated. Hilgenfeld even thinks that vi. 18–vii. 45 were interpolated by a Christian at the commencement of the 3d century,[1] but his arguments are not cogent, as Langen has shown. As the data for determining the time lie chiefly in the interpretation of the eagle's wings and heads, the diversity of opinion is increased. Perhaps the 30th year after the ruin of the city (iii. 1) points to the like time after the Roman conquest of Jerusalem. The six wings of the eagle on the right side are the six Julian emperors; the six on the left, are Galba, Otho, Vitellius, Vindex, Nymphidius, Piso; and the three heads, the Flavian emperors. Either Titus's or Domitian's reign should be fixed upon; probably the latter, about 96 A.D. Hilgenfeld assigns 30 B.C.; Volkmar seems nearer the truth who gives it to 97 A.D.,[2] though some of his ingenious interpretations are far fetched. It is impossible to tell whether the author lived at Rome or in Egypt. The few internal evidences bearing on the point favour the latter.

The poetic excellence of this production is much greater than that of Enoch. It is, indeed, below the Apocalypse of Daniel; but its merit is considerable. In modern times Messrs Frere and Irving gave it a place beside Daniel and St John,—strangely combining the prophecies of the three into one, as though all were formed upon the same plan, and referred to the same events. Chapters i., ii., and xv., xvi., which need not be separated, seem to have been written by Egyptian Christians; the first two chapters about 201 A.D; the last two about 263 A.D., according to Gutschmid.[3] Like the Fourth Book of Esdras, these were also written in Greek, but exist only in a Latin translation.

The literature and numerous opinions about the date may be seen in the Prolegomena to Hilgenfeld's *Messias Judæorum;* the same work contains the different texts of it. The Latin text alone is presented by Fritzsche in his *Libri Apocryphi Veteris Testamenti Græce*, 1871; and by Volkmar in his *Handbuch der Einleitung in die Apocryphen*, 2 Abtheil., 1863. It is in the English Apocrypha, translated, no doubt, from the Vulgate. Luther left it out of his version, and De Wette followed him. The chief writers on the book in recent times are Volkmar and Hilgenfeld; but the list since Whiston and Semler is very copious.

3. *The Book of the Jubilees,* or *the Little Genesis, ἡ λεπτὴ γένεσις, parva Genesis.*—This work is apocalyptic only in part, though called the Apocalypse of Moses in the notices of it by George Syncellus and George Cedrenus. In the form of a revelation made to Moses during his stay on Mount Sinai, it professes to be intended for future races, and to contain prophetic admonitions relating to coming times. It is predominantly historical and chronological, beginning with the old histories of the creation. From the commencement of the world till the entrance into Canaan is divided into 50 jubilee years; and every event is arranged according to jubilees, years of weeks, and years. Later Jewish ideas are transferred to earlier times, especially to the patriarchal; and difficult questions connected with the ancient worship are solved. Traditional views and hagadic materials appear with Jewish ritual and exclusiveness. The author was an energetic Palestinian Jew, conversant with the history of his people, and conservative, who meant to confirm them in attachment to the faith, by narrating their past fortunes over again, and keeping them alive to their principles. Amid the multifarious contents it is not easy to trace the precise origin of the book, though it is easy to see that the author was a patriotic Jew, whose object was to keep his countrymen firm in their religion at a time when it was in great peril both from without and within. It has been assigned to an Alexandrian, an Essene, and a Samaritan source, none of which opinions can be maintained. The writer has respect to different sects and parties in Judaism, to the various tendencies existing within the old religion when he wrote; and he endeavours to mediate between them by making concessions in this direction and that,—to conciliate and blend them together, that they may be more united against anti-Jewish influences. Hence Samaritan, Essene, Sadducean, and Pharisean peculiarities are found in the work. There is little doubt that he was an orthodox Jew, who had in view the consolidation of Judaism against heathenism and Christianity—the uniting of all sects and shades of belief in the common faith of Levitical monotheism.[4] It is worthy of remark that the Hebrew text he used agrees with the Samaritan more than the Masoretic, though he himself was not a Samaritan, else he would not have mentioned Zion among the four holy places, to the exclusion of Gerizim. The date is the 1st century of our era; and before the destruction of the temple, as may be inferred from the first chapter. The writer seems to have used the book of Enoch; for he speaks in the fourth chapter of Enoch writing out the signs of heaven according to the order of their months. There are also coincident passages which go to prove the same thing. And there is evidence that the writer of the Testaments of the patriarchs employed our book; though this does not necessarily take the latter's origin into the 1st century. So, too, the Fourth Book of Esdras was used, as we infer from what is said in relation to Abraham, Esdras iii. 14, &c., and Jubilees xii. The date cannot be fixed nearer than about 50 A.D.[5] The *Little Genesis* was soon forgotten, and no trace of it appears among the Jews, except perhaps in the title of Bereshit Rabba. Yet its Midrash is of an older type than the other Midrashim; mystic and supernatural in its tendency; its angelology less developed. Jerome refers to it twice by name, and Syncellus thought highly of it. It had been rendered into Greek before the time of Jerome. Dillmann has published the Ethiopic version from two MSS., and

[1] *Messias Judæorum*, p. 49, &c.

[2] *Das vierte Buch Esra und apokalyptische Geheimnisse ueberhaupt*, 1858.

[3] *Zeitschrift für wissenschaft. Theologie*, 1860.

[4] See Roensch's *Das Buch der Jubiläen*, p 523, &c.

[5] *Ibid.*, p. 528.

translated it into German.[1] The original was Hebrew or Aramæan, as all critics allow, except Frankel, who is refuted by Langen.[2] A Greek version existed early, and was subsequently lost. From it the Ethiopic was made. In 1861, Ceriani published from a palimpsest in the Ambrosian library at Milan, considerable fragments of an old Latin version.[3] This has been reprinted in a revised state by Roensch, together with a Latin version of Dillmann's text. The work of this meritorious scholar is accompanied with learned notes and exhaustive dissertations; and Dr Sal. Rubin has taken the trouble to translate it into Hebrew, with an introduction and notes, Wien. 1870. See Treuenfels in the *Literaturblatt des Orients*, 1846; Beer's *Das Buch der Jubiläen und sein Verhaltniss zu den Midraschim*, 1856; Jellinek, *Bet ha-Midrasch Sammlung kleiner Midraschim und vermischter Abhandlungen aus der älteren Jüdischen Literatur*, 1853-1855; Frankel in the *Monatschrift für Geschichte und Wissenschaft des Judenthums*, 1856; Roensch, *Das Buch der Jubiläen oder die kleine Genesis, u.s.w.*, 1874.

The *Life of Adam*, adduced by Syncellus three times with the words ὁ λεγόμενος Βίος Ἀδάμ, seems to have been identical with the book of Jubilees, or perhaps a part of it. If the latter, it may have been another recension, enlarged and modified in various respects.[4]

The *Book of Adam's Daughters, Liber (qui appellatur) de filiabus Adæ sive Leptogeneseos*, mentioned in Gelasius's decree about authentic and apocryphal books, also appears to be the same as the Jubilees.[5]

4. *The Assumption* or *Ascension of Moses*, Ἀνάληψις Μωυσέως, is a prophecy of the future relating to Israel, put into the mouth of Moses, and addressed to Joshua just before the great lawgiver died. Founded upon the book of Deuteronomy, it is brief and unpoetical. But it seems to have been large at first, for according to Nicephorus, it consisted of 1400 stichs, while the Jubilees had only 1100.[6] The work is an appropriate sequel to the Jubilees, but it seems to have proceeded from a different writer, though he lived at the same time. Internal evidence points to its composition after the death of Herod the Great, and before the destruction of Jerusalem. In the third chapter Pompey the Great is clearly depicted; but there is no trace of Jerusalem's overthrow. The author was a Jew who wrote in Hebrew or Aramæan, and his production was afterwards translated into Greek and Latin. We need not assign him to any other place than Palestine, though Fritzsche conjectures that Rome was his abode. Fragments of the Latin version were first edited from a palimpsest at Milan by Ceriani. The version is by the same hand as that of the Jubilees, for both are found in one MS. and agree in character. The translator may have, therefore, taken the two for the work of the same author. After Ceriani, it has been published by Fritzsche. Hilgenfeld has tried to put it into Greek. The same has been done by Volkmar, Schmidt, and Merx. The ancients believed that Jude borrowed from this work his statement as to the dispute between Michael and the devil about the body of Moses. See Ceriani, *Monumenta Sacra et Profana*, tom. i. fascic. 1; Hilgenfeld, *Novum Testamentum extra canonem receptum*, fascic. i. 1866; *Messias Judæorum*, 1869; Volkmar, *Handbuch zu den Apokryphen*, Band 3, 1867; Schmidt and Merx in *Archiv für wissenschaftl. Erforschung des A. T.*, 1868; Fritzsche, *Libri Apocryphi Veteris Testamenti Græce*, 1871.

[1] In Ewald's *Jahrbb.*, Nos. 2 and 3. The original not till 1859 in a separate volume.

[2] *Das Judenthum in Palæstina, u.s.w.*, p. 94, &c.

[3] *Monumenta sacra et profana*, tom. i. fasc. 1.

[4] Roensch, p. 468, &c.

[5] *Sacrosancta concilia*, tom. v. ed. Colet, p. 389.

[6] *Chronogr. Compendiar.*, p. 787, ed. Dindorf.

5. *Apocalypse of Moses*, whose proper title is Διήγησις καὶ πολιτεία Ἀδὰμ, ἀποκαλυφθεῖσα παρὰ θεοῦ Μώυσῇ τῷ θεράποντι αὐτοῦ, διδαχθεῖσα παρὰ τοῦ ἀρχαγγέλου Μιχαήλ, contains an account of the formation of Adam and Eve, their fall, Seth's dialogue with his mother about Adam, and the disposal of the latter's body beside that of Abel. This work was first published in Greek by Tischendorf from four MSS. It was afterwards accurately edited from one of these (D in the Ambrosian library at Milan) by Ceriani. But this text is incomplete, wanting chapters xviii.-xxxv. Tischendorf thinks that Greek is the original, and that its date is about the time of Christ, but it is probably later, though certainly not mediæval, as Dillmann supposes. The λεπτὴ γένεσις was thought by some, perhaps also by Syncellus and Cedrenus, to have been the same as the *Apocalypse of Moses*, and was so called, but it is not. Both, however, are of like character. The *revelation* is said to have been made to Moses when he received the tables of the law and was instructed by the archangel Michael. Tischendorf, *Apocalypses Apocryphæ*, 1866; Ceriani, *Monumenta Sacra et Profana*, v. i.; Roensch, *Das Buch der Jubiläen*, 1874.

6. *The Sibyllines.*—The rise of Jewish apocalyptic literature of a sibylline character probably dates soon after Alexander the Great, when Judaism began to look with a spirit of philosophic inquiry into Greek and Oriental literature, attaching itself to such elements as seemed congenial. A composite product was the result. The Alexandrian Jews were the first to adopt this course by fusing the remnants of Greek sibyllism with their native prophecy. The former seemed to them an indication of an Adamic or Noachic religion which had filtered into heathenism notwithstanding its polytheism. It was a species of natural prophetism, distinct from the priestly oracles, of a more ancient and higher type, in which Jewish gnosis could discover a point of contact, amid its endeavours to trace the pre-Abrahamic religion in the most enlightened Hellenism. As Noah was thought to be the second great progenitor of humanity, who represented the primitive theocratic religion before its division and corruption, the sibyl was his daughter, prophesying of the tower of Babel, and exhorting the people to worship the true God. Her voice was predominatingly threatening, like that of the heathen sibyl, foreshadowing the downfall of paganism. Anti-theocratic kingdoms and cities must be overthrown. There is but one religion, the old Noachic one, which even the heathen sibyl darkly echoed, and her utterances can only be interpreted aright in their relation to the world's history by the Jewish sibyl. Thus Jewish gnosis found support in Hellenism. After using the method and form of the latter in the sibylline oracles, it drew them into a higher region. Uniting them with theosophy and history, it spiritualised them. The prophetic spirit was discerned in the cultus of heathenism, stripped of priestly and polytheistic phenomena. But it was still the main object of the sibyllines to combat heathenism itself, by exposing its idolatry and opposition to the truth, to anticipate its total destruction at the advent of Messiah.

Under this general name there exists a collection of oracles said to proceed from the sibyl, in which Jewish ideas are promulgated and recommended to the Gentiles. The contents, however, are of a mixed character. Instead of a connected whole written by one person at a specific time, we have a heterogeneous assemblage of materials, Jewish, Christian, and heathen, of earlier and later origin, which must be separated and sifted before they can be assigned to their respective origins.

Books i., ii., iii. 1–96 are late. The first begins with the creation and fall of man, enumerates the six races, and characterises them, the first after Noah falling in the golden age. Christ is described in His miracles, sufferings, death, resurrection, and ascension; the apostles, and the cessation of prophets. The Hebrews will be oppressed by a Roman king, and be scattered abroad after the destruction of Solomon's temple. The description is continued in the second book. The world will be shaken throughout, and especially will heathen Rome be destroyed at the time of the tenth race. The whole piece is evidently Christian, for the eschatological ideas rest upon Matthew xxiv., xxv. Hellenic mythology and Hebrew tradition are intermixed with the author's utterances. The date is obscure. Bleek, with whom Lücke agrees, assumes the 5th century. There are, indeed, late views in the books, such as Christ's descent into hell to preach the resurrection, the worship of the Virgin, the intercession of the saints for a class of the condemned. It is also true that millennarianism does not appear, and that no Christian writer of the first four centuries cites them. Still the 5th century is too late. We prefer the second half of the 4th. Ewald assigns about 300 A.D.

The *third* book, taken as a whole, is the oldest portion, at least verses 97–828. It enumerates the kingdoms of the world that followed one another, emphasising the Hebrew one in particular, and mentioning the Roman. Woes are pronounced upon various cities and lands, and the appearance of Messiah is depicted, accompanied with the punishment of the wicked, the downfall of all worldly kingdoms, the conversion of the heathen, and the restoration of Judah to more than former splendour. As the destruction of Carthage by the Romans is alluded to, the date must be after 146 B.C. Various indications point to 124. There is little doubt that the writer was an Alexandrian Jew, whose hopes of a personal Messiah were feeble and vague, for after touching upon a king sent by God from the sun who will put an end to war, and under whose sway Israel will enjoy abundant prosperity, he paints the golden age again without mentioning the king.[1]

The *fourth* book, which is but a short poem of less than two hundred lines, arranges history according to twelve ages, terminating in the Messianic one. The writer's descriptions are general. He evinces no decided Jewish sympathies, nor does he utter ideas distinctively Christian. Sinful heathenism in an indefinite way is the chief object of his veiled descriptions. Hence Friedlieb makes him a Jew; Ewald, a Christian. The passages which have been supposed to show either his Christian or Jewish tendencies[2] are hardly decisive as to the one or the other; and the interpretations of them by Lücke are somewhat strained in support of the strong statement about the Christian character of the contents generally, with which he begins his sketch of the fourth book. Probably he was a Jewish Christian who came out of an Essene circle. The date of his oracle is somewhat later than that of the Apocalypse, since the destruction of the temple is presupposed as well as the eruption of Vesuvius, 79 A.D. The return of a matricidal emperor from beyond the Euphrates to overthrow Rome is also expected. Such allusion to Nero, which is a prominent feature in the Apocalypse, and a few other particulars, incline us to assume Christian authorship, though the absence of evangelical ideas marks a stage not far beyond Judaism. Yet the writer rejects sacrifices. The date may be about 80 A.D.

The *fifth* book presents great difficulty both in separating the component parts, and in assigning them to Jewish or Christian authorship. The absence of ideas characteristic of Judaism or of Christianity marks the poem. Nor is it easy to discover any internal connection, so that the whole might be attributed to the same authorship. The religious views of the author or authors are vaguely expressed. The first part, *i.e.*, 1–51, appears to be of Christian, the rest, *i.e.*, 52–530, of Jewish origin. The former describes in prophetic language the series of Roman emperors from Julius Cæsar to Hadrian. In this way we are brought to the end of Hadrian's reign as the date, about 138 A.D. The second part, which expresses among other things the hope of a temple to be erected in Egypt, in which sacrifices should be offered, and the people of God should enjoy Messianic happiness, points to a Jew of Alexandria living after the destruction of the temple at Jerusalem, about 80 A.D.

The *sixth* book contains a short hymn to Jesus the Son of God, touching upon His doctrine, miracles, and death, with a curse on the Sodomite land which platted His crown of thorns. It is curious that the fire at Jordan on the occasion of the baptism of Jesus, and the representation of the dove, vary from the canonical Gospels, though the former appears in the Gospel of the Hebrews. Something of a Gnostic element shows itself here.

The *seventh* book is a fragmentary collection of oracles loosely connected. The contents are varied. Several pieces treat of Christ; several of the oracles are threatening, some are of the nature of hymns. The baptism at Jordan is mentioned in a peculiar way;[3] and a strange sacrificial rite is recommended.[4] The allusion to the Persians reigning is indefinite; but it is all the historical evidence that bears on the date, which seems about 160 A.D.; though Alexandre puts it between 233 and 235 A.D.[5] As there is a tinge of Gnosticism in the book similar to that of the sixth, they may have proceeded from the same person. He was a heretical man, as Alexandre supposes; but whether he was a Jewish Christian is uncertain.

The *eighth* book contains a prophecy of the judgment of the world. Rome is coming at length to an end. There is also a summary of the history of Jesus, His life, sufferings, and resurrection. The writer commences with Hadrian, to whom he gives three successors of his house. He is also acquainted with the king of another house, Septimius Severus, in whose days, 948 of Rome, the end comes. The date is therefore 211 A.D. It is curious that Antichrist Nero is here made to come with the third from Hadrian, viz., Commodus. In this oracle occurs the celebrated sibylline acrostic, the initial letters of thirty-four lines (verses 217–250) representing Ἰησοῦς Χρειστὸς Θεοῦ υἱὸς σωτὴρ σταυρός. Verses 361–500 are of earlier origin. They contain various fragments of prior poems. It is noticeable that a historical insertion about the birth of Jesus Christ from the Virgin occupies an unsuitable place, having been the product of a late time, when the dogma about the mother of God was developed. With this exception the second part of the book belongs to the 2d century. The whole is thoroughly Christian.

Books xi.–xiv. were discovered in MSS. at Milan and Rome, and published by Mai, in his *Veterum Scriptorum nova collectio*, tom. iii. p. 202, *et seq.* They are of Christian origin, and from Egypt. It is true that the Christian element appears but little. The writer used the preceding books and heathen oracles besides. The date is uncertain, but cannot be earlier than the 5th century. The eleventh book surveys the history of kings and people, till the death of Cleopatra and the end of the Egyptian kingdom; the twelfth recounts the Roman emperors from Augustus till the death of Alexander Severus; the thirteenth continues the history from Alexander Severus till

[1] See verses 652–660, and 702, &c., 766, &c.

[2] See lines 160, &c., where Christian baptism is apparently referred to; 174, &c., where the resurrection and last judgment are indicated. At 25, &c., sacrifices are spoken of in an anti-Jewish way. Ed. Alexandre.

[3] Ver. 66, &c. [4] Ver. 76, &c.

[5] *Oracula Sibyllina*, vol. ii. p. 386.

the reign of Odenatus, and the fourteenth brings down the sketch to Aureolus. The names of the emperors and rulers are partially disguised, and eventually become unrecognisable. See Friedlieb, *Oracula Sibyllina*, 1852; Alexandre, *Oracula Sibyllina*, 1841, 1856; and Ewald, *Ueber Entstehung, Inhalt, und Werth der sibyllinischer Bücher*, 1858.

7. *The Apocalypse of Baruch.*—In this rhetorical production Baruch receives revelations respecting the future of Israel. Though Jerusalem has been destroyed by the Romans, and the calamities of the chosen people seem excessive, the prophet is comforted with the hope of better times, since the Messiah will come shortly to set up his kingdom after the Roman one has been destroyed. Then will be the judgment and the consummation; sinners will be punished, and the righteous rewarded. Part of this production, viz., the epistle of Baruch to the nine tribes and a half (chapters lxxviii.–lxxxvi.), was published in the Paris and London Polyglotts in Syriac and Latin. The Syriac was again edited more correctly by De Lagarde. Whiston translated the Latin into English; and he has been followed by Jolowicz, 1855. The whole book was published from a Syriac MS. in the Ambrosian library by Ceriani, first in a Latin translation[1] and then in the Syriac itself.[2] The Latin is reprinted with a few emendations by Fritzsche. It was written after the destruction of Jerusalem, how long it is difficult to say. The author was acquainted with the Book of Enoch and the Apocalypse of Esdras, for he has many passages which are echoes of sentiments contained in them. He has also later Jewish legends, which point to the 2d century of the Christian era as that in which he wrote; and there is little doubt that Greek was the original. Langen[3] thinks that the author was a Palestinian. From its length and wordiness, with the absence of poetic spirit, the perusal of the document becomes wearisome.

II. Christian Apocalyptic.

Christians followed the example of the Jews in using the sibyl as a vehicle of their ideas. Besides referring to the past, which they did mainly with reference to the person and work of Jesus Christ, they looked forward to the destruction of the world-power, and the consummation of all things at the second coming of Christ. They employed to a considerable extent both Jewish and heathen documents, interpolating or modifying them not very strongly. Often content with non-Christian sources, they adapted them but slightly, so that the ideas peculiar to Christianity shine forth dimly. The prophetic form of the Apocalypse does not demand the enunciation of doctrine, but rather a general indication of historic events, or the threatening announcement of destruction to the enemies of God. It deals with the utterance of principles exemplified by kingdoms and their rulers.

1. *The Sibyllines.*—We have already seen that books i., ii., iii. 1–96, iv., v. 1–51, vi., vii., viii., xi.–xiv., belong to this head, though they incorporate Jewish as well as heathen pieces with small adaptation.

2. *The Apocalypse of Esdras.*—This Greek production resembles the more ancient fourth book of Esdras in some respects. The prophet is perplexed about the mysteries of life, and questions God respecting them. The punishment of the wicked especially occupies his thoughts. Since they have sinned in consequence of Adam's fall, their fate is considered worse than that of the irrational creation. The description of the tortures suffered in the infernal regions is tolerably minute. At last the prophet consents to give up his spirit to God who has prepared for him a crown of immortality. The composition is feeble and tame, a poor imitation of the ancient Jewish one. There are no internal marks of date in it. It may belong, however, to the 2d or 3d centuries of the Christian era. Tischendorf published the Greek text for the first time in his *Apocalypses Apocryphæ*.

3. *The Apocalypse of Paul.*—This work contains a description of the things which the apostle saw in heaven and hell. The text, as first published in the original Greek by Tischendorf, consists of fifty-one chapters, but is imperfect. The narratives descend to minute particulars, and possess no force or poetic power. Imitated from the Revelation of St John, their great inferiority is apparent. Internal evidence assigns it to the time of Theodosius, *i.e.*, about 390 A.D. Where the author lived is uncertain. Dr Perkins found a Syriac MS. of this Apocalypse, which he translated into English, and printed in the *Journal of the American Oriental Society*, vol. viii. This version is an enlarged and exaggerated edition of the Greek, which it supplements and illustrates. See Tischendorf's *Apocalypses Apocryphæ*.

4. *The Apocalypse of John* contains a description of the future state, the general resurrection, and judgment, with an account of the punishment of the wicked, as well as the bliss of the righteous. It appears to be the work of a Jewish Christian, for the bodily appearance of Antichrist is derived from Jewish sources; and there are numerous quotations from the Old Testament, especially from David. The date is late, for the writer speaks of the "venerable and holy images," as well as "the glorious and precious crosses and the sacred things of the churches,"[4] which points to the 5th century, when such things were first introduced into churches. We cannot put it earlier than the 5th. This Apocalypse was first published by Birch,[5] but incorrectly; afterwards by Tischendorf. The Greek appears to be the original. It is a feeble imitation of the canonical Apocalypse, devoid of literary value, and with the marks of a corrupted Christian age on its face.

5. *The Apocalypse of Peter* contains a narrative of events from the foundation of the world till the second advent of Christ. The book is said to have been written by Clement, Peter's disciple. This Arabic work has not been printed, but a summary of the contents is given by Nicoll in his catalogue of the Oriental MSS. belonging to the Bodleian.[6] There are eighty-eight chapters. It is a late production; for Ishmaelites are spoken of, the Crusades, and the taking of Jerusalem.

6. *The Revelations of Bartholomew.*—In the year 1835, Dulaurier[7] published from a Parisian Sahidic MS., subjoining a French translation, what is termed a fragment of the apocryphal Revelations of St Bartholomew, and of the history of the religious communities founded by St Pachomius. After narrating the pardon obtained by Adam, it is said that the Son ascending from Olivet prays the Father on behalf of His apostles; who consequently receive consecration from the Father, together with the Son and Holy Spirit—Peter being made archbishop of the universe. The late date of the production is obvious.

7. *The Apocalypse of Mary*, containing her descent into hell, is not published entire, but only several portions of it from Greek MSS. in different libraries, by Tischendorf in his *Apocalypses Apocryphæ*.

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[1] *Monumenta Sacra et Profana*, tom. i. fasc. 2, p. 73, &c.
[2] *Ibid.*, v. fasc. 2.
[3] *De Apocalypsi Baruch, etc., commentatio*, pp. 8–10.

[4] Tischendorf, ch. xiii.
[5] *Auctarium Codicis Apocryphi N. T. Fabriciani*, p. 261, &c.
[6] *Bibliothecæ Bodleianæ codd. MSS. Orientalium catalogi* partis secundæ vol. primum, etc., p. 49, xlviii.
[7] *Fragment des Revelations Apocryphes de Saint Barthelemy*, &c. Paris, 1835.

8. *The Apocalypse of Daniel* has been published only in part (a little more than the half), by Tischendorf from Greek MSS., in St Mark's, Venice, and in Paris. The date of the document is determined by the monarch going to Jerusalem to deliver up his kingdom to God, and being succeeded by his four sons, who reside in different and distant cities.

9. *The Ascension and Vision of Isaiah.*—The first portion of the work called the Ascension of Isaiah in the Ethiopic text, gives an account of Isaiah's being put to death by the saw, under the reign and at the command of Manasseh. The prophet had had a vision respecting Christ, His crucifixion and ascension, as well as of the general apostacy which should take place in the early churches, of the descent of Berial in the form of a matricidal king, the duration of his reign, the descent of the Lord from heaven to destroy the wicked, and cast the ungodly into the fire. For this vision and prophecy Isaiah is condemned, and dies the death of a martyr (chapters i.–v.) The second part (chapters vi.–xi.) is essentially the same as Isaiah's vision in iii. 14–iv. 22. The prophet is transported in an ecstatic state into the seven heavens successively, and describes what he sees in each, the chief object being Christ himself. It is not the future of Christianity and of the world which fills the mind of the seer, but the past, the first advent of Christ. The two divisions form distinct works. The first is based on the Jewish legend of Isaiah's martyrdom, and may be merely the Christian expansion of a Jewish writing embodying it. Indeed, with the exception of the Christian interpolations (i. 5, iii. 13–iv. 22), the whole is Jewish. Both Tertullian and Origen knew the martyrdom part of the document. The date must, therefore, be the 2d century. The second, or the *Vision* of Isaiah, properly so called, has a Gnostic colouring. Its christology bears a Docetic stamp. As it presupposes an acquaintance with the first it may have originated in the early part of the 3d century. Epiphanius speaks of it, and gives an extract.[1] Laurence published the Ethiopic text, with a Greek and Latin version, in 1819. The Greek original is lost; and the Latin version, published at Venice in 1522, and again by Gieseler in 1832, is of late origin. Fragments of an older one were printed by Mai in his *Veterum Scriptorum nova collectio*, p. ii. 1828. Jolowicz translated it into German, 1854. See Lücke's *Versuch einer vollständigen Einleitung in die Offenbarung des Johannes, etc., das erste Buch.*

10. *The Shepherd of Hermas.*—This production belongs in a certain sense to the present class of writings, and is usually reckoned among the apostolic fathers. It is not, however, apocalyptic in the proper acceptation of the epithet, because it wants the form. The apocalyptic idea has a different phase. (See Apostolic Fathers.) The same remark applies to—

11. *The Testaments of the Twelve Patriarchs.*

Many apocalyptic writings, both Jewish and Christian, are mentioned in ancient works of which nothing is now known. Time has swept them away beyond recovery. It would be useless to collect the scattered notices of them. Such as wish to see these notices may consult the articles of Dillmann and Hofmann, in the 12th volume of *Herzog's Encyklopædie*, Lücke's *Einleitung*, and the Prolegomena to Tischendorf's *Apocalypses Apocryphæ*, where he will find references to other works. Since the very able treatise of Bleek and the valuable publications of Gfrörer, which were followed by the masterly review of the whole subject in Lücke's second edition, the literature has greatly increased. Hilgenfeld and Volkmar, Ewald and Dillmann, Ceriani and Langen, Fritzsche, Gutschmid, Merx, and others, have thrown welcome light upon it.

The line between *Apocryphal* and *Apocalyptic* literature is not exact. The works now described are those which properly belong to the latter, and are extant, or have been published, if not entire, at least partially. Notices of many others lost or hidden occur in various sources and catalogues of MSS. belonging to public libraries. The apocalyptic idea passed into the life and belief of the church. It became an element of dogma and of morals, finding expression in works somewhat different from the proper apocalyptic. Taking a millennarian direction, using the typical extensively, developing eschatological ideas more or less fantastic, the apocalyptic element receded before other conceptions to which it had given rise. These, indeed, did not suppress it; they merely shaped and developed it into other forms, widening the sphere of its action, and giving it more realism. (S. D.)

[1] *Hæres.*, 67, 3, vol. ii., p 175, ed. Migne. See also *Hæres.*, 40, 2.

APOCRYPHA. This term is a Greek word meaning *hidden, secret*. It occurs, for example, in Col. ii. 3, "In whom are *hid* all the treasures of wisdom and knowledge," and elsewhere in the New Testament. It is first found applied to writings in Clemens Alexandrinus, *Stromata*, iii. c. 4. When applied to writings (ἀπόκρυφα sc. βιβλία) the name may be supposed to have first expressed the nature of their contents; the writings were *secret*, embodying an esoteric teaching, profounder than that contained in the ordinary books of the system, and unknown to the ordinary people who professed it. Such writings were held to exist in connection with almost all the ancient systems of religion.

From the nature of the case, the same word might very well describe such writings further, either in respect of their *use* or in respect of their *origin*. In use these writings were, of course, like the doctrines they contained, private and secret; they were not read in general meetings, and did not belong to the publicly recognised books of the system. Only some were admitted to the knowledge of them. That which formed the subject of public reference and instruction was the general doctrines of the system, while these peculiar and more recondite works were at most brought forward on rare occasions. And naturally the same secrecy which hung over their use generally also shrouded their origin. In some cases this might be a real mystery; the books were sometimes of ancient and uncertain date, and their authorship unknown. But oftener the mystery was fictitious, created for the purpose of securing respect for the doctrines inculcated in the writings, which themselves were forgeries of very recent times. Works of this kind were of very common occurrence in the East during the centuries immediately preceding and following the birth of Christ. In order successfully to float them and give them impulse, they were generally launched under some ancient and famous name; and books existed, bearing to be the productions of almost every renowned patriarch or sage from Adam downwards. Even when sent out anonymously, and of an historical rather than a doctrinal character, the scene of their narratives was laid in far back times, and famous personages were introduced acting and speaking, the design being to recommend to the living generation the conduct pursued or the sentiments expressed by the ancient hero or saint.

The term *Apocrypha* appears in this way to have passed through several stages of meaning, and from expressing a meaning good, or at least neutral, it came at last to have a very bad sense, differing very little from *spurious*. From the use of the word in ancient writers it does not appear that this progress from a good or indifferent to a bad sense was a matter of time, for the indifferent and bad meanings of the word seem to have existed side by side. Some ecclesiastical writers divide the sacred books into three classes,—recognising first, some that are canonical; second, some that are not canonical, but of inferior value, profitable to be read for moral uses, but not to be founded on for doctrine—to this class the name *ecclesiastical* was sometimes given; and third, some that are apocryphal. Other writers know of only two classes, embracing both the second and third classes of the former division under the name apocryphal. This difference indicates a milder and a severer use of the term.

Besides those books known distinctively as the Old Testament Apocrypha, a very large number of apocryphal writings were in existence in the early centuries of our era. Some of these are still extant, but many of them have perished, or are known only through MS. translations lying in our great libraries. Our only information regarding many of them is derived from references to them in ecclesiastical writers. These references are sometimes so general that we cannot be sure whether the book referred to was a Jewish or a Christian production. By far the largest number even of those bearing Jewish titles were works by Christian writers. Of the extant writings of this class the most important are fully treated in the article APOCALYPTIC LITERATURE immediately preceding. In addition to those discussed there may be mentioned the very interesting collection of hymns called the *Psalms of Solomon*. This small work consists of eighteen poems of varying length, to appearance all by one writer, and existing now only in Greek, though in all probability originally written in a Shemitic dialect. These poems arose in a time of trouble to the Jewish people, most probably in the Greek persecution, and they were designed to sustain the nation under its trials, partly by moral considerations, but chiefly by picturing the certain glories of the Messianic kingdom. The hymns are remarkable no less for the vigour of their poetry than for the fervid theocratic hopes and distinct faith in the resurrection and kindred doctrines which find expression in them. O. F. Fritzsche has appended this little work, along with other select *Pseudepigraphi* of the Old Testament, to his edition of the Old Testament Apocrypha.

APOCRYPHA OF THE OLD TESTAMENT.—The books bearing this name are not contained in the Jewish or Palestinian Canon, *i.e.*, in the Hebrew Bible, but in the Alexandrian Canon, *i.e.*, in the Greek translation known as the Septuagint. Considerable obscurity hangs over the date and the circumstances of the close of the Hebrew Canon, and the principles which guided the collectors in their selection of books to be embodied. It is most probable that the *three* divisions referred to in the New Testament, of law, prophets, and writings (Psalms) are of ancient origin; that the first two divisions were closed while prophetic men were still living, that is, considerably anterior to the close of the Persian period, while the third still remained open; and that at whatever time the third was closed, the books added to it were added under the impression that they were books composed before the succession of Prophets had ceased. This is the view expressed by Josephus (*Con. Ap.*, i. 8), and may be considered the general Jewish tradition regarding all books in the Hebrew Canon.

With the Greek or Alexandrian Canon the case was very different. This was, properly speaking, not an ecclesiastical, but a literary collection at first, for the tradition that it was commenced under the auspices of Ptolemy Philadelphus cannot be altogether set aside. At first only the books of Moses and perhaps Joshua were translated, the interest felt in the book being confined to the law. Only gradually and at intervals other books were added, for the translations are not only by different hands, but of very different dates. But it is evident that the collection was formed under the guidance of a principle quite different from that which guided the Palestinian collectors. The feeling in Palestine was that prophecy had ceased (1 Macc. ix. 27, comp. ch. xiv. 41), and no books were held worthy of a place in the Canon which were composed after the succession of prophets had come to an end. In Egypt this theory did not prevail, or rather another theory seems to have prevailed. The doctrine of the *Wisdom* which appears in Proverbs, ch. i.-viii., received a fuller development in successive ages even in Palestine, and naturally much more in Alexandria, where the speculative Jews came under the influence of Greek thought. This *Wisdom* is spoken of in a way which at times almost identifies it with the Spirit of God, and at other times almost with the *Logos* or Word. But at any rate this divine Wisdom is all-pervading, and subject to no interruption in the constancy of its influence. The famous passage, Wisdom of Solomon, ch. vii. 22, *f.*, in which the attributes of wisdom are counted up to the number of twenty-one, speaks of her as "going through all things by reason of her pureness," and at last says of her, that "in all ages entering into holy souls she maketh them friends of God and prophets." The particularism of Judaism gave way in Alexandria before the universalistic principles of Western speculation. Prophecy was the product of the Wisdom, and Wisdom was like a subtle element, all-pervasive and incessant in its influence; and consequently a break in the line of prophets, or any distinction between the productions of one age and those of another except in degree, was hardly to be conceived. Thus to the Alexandrian the varied Jewish literature of the post-prophetic times was precious as well as the books that were more ancient, and he carefully gathered the scattered fragments of his national thought, as far as they were known, within the compass of his Canon.

The following books form the Apocrypha of the English Bible. They are given in the order in which they stand there:—1. I. Esdras. 2. II. Esdras. 3. Tobit. 4. Judith 5. The additions to the Book of Esther. 6. The Wisdom of Solomon. 7. The Wisdom of Jesus, the son of Sirach, or Ecclesiasticus. 8. Baruch. 9. The Song of the Three Holy Children. 10. The History of Susanna. 11. The History of the Destruction of Bel and the Dragon. 12. The Prayer of Manasses, king of Judah. 13. The First Book of Maccabees. 14. The Second Book of Maccabees.

A few statements may be made regarding the general characteristics of the Apocrypha.

1. These books are of very great interest and value as a reflection of the condition of the fragments of the scattered nation, and of the feelings and aspirations which they cherished for a period of several hundred years, and in all the chief countries of the world. Some of the books, such for example as *Tobit*, belong to the Persian period, and were composed in the East, in Babylon or Persia, and describe the external life as well as the feelings and hopes of the exiles there; others arose in Palestine, such as *Ecclesiasticus*, and reflect the condition of life and the shades of religious speculation in the home country; while others, such as the *Wisdom of Solomon*, originated in Egypt, and afford means of estimating the influence of Greek thought upon the native doctrines of the Old Testament; and perhaps in the *2d Esdras* there may even be detected traces of Christian influence. The broad undivided stream of Old Testament doctrine and hope breaks at the era of which we are speaking into three channels. The largest, and that which best preserves its primary directions continues to run in Palestine, diverging to some extent, and widening under the contributions which time and a very chequered experience and reflection made to it while on each side of this another runs, one on the east and one on the west, directed and partly fed by the ideas of Persia and Greece respectively. To a certain extent the streams reunite further on, and pour their united contributions into the great sea of Christian thought. The central stream

is, of course, the most interesting, although to estimate it properly the books of the English Apocrypha are quite insufficient, other works belonging to the same region must also be taken into account, such as the great *Book of Enoch*, and several more. The two collateral currents are also of extreme interest although it is far from easy to analyse their waters, and say with assurance what elements belong to the primary Old Testament sources and what are local contributions. Many have discovered traces of Persian ideas even in the canonical books of the Old Testament, particularly in the doctrine of angels in the later books, but the trustworthiness of such discoveries may be very fairly questioned. At the same time, there either is, in the book of *Tobit*, an advance absolutely on the Old Testament doctrine of angels and demons, or there are traces of a method of interpreting the history in Gen. ch. vi., and a carrying out of the method to further consequences, which are both unknown to the canonical Scriptures (below No. 3). And if in the Alexandrian *Wisdom of Solomon* a progress directly *in advance* of what is found in Prov. viii., on the doctrine of *Wisdom*, may be justly contested, there is certainly what may be called a progress *round about*, the ideas about Wisdom are expanded and placed in new lights, and made to enter into new relations, in such a way that a general approximation to the New Testament doctrine of the Logos is the result. But in general, as a means of estimating the changing shades of feeling, the rise and fall of hopes, or rather the steady glow of a hope which no hardship could extinguish, the efforts to accommodate faith to circumstances and hold it fast in spite of all that was against it, in a word, as a means of estimating the inner life of a most interesting people in the very crisis of their history, the apocryphal books are invaluable. No more beautiful picture of piety and disinterested benevolence and patriotic warmth could be seen than is presented in the book of *Tobit;* neither could religious zeal and courageous, even almost reckless, patriotism, easily find higher expression than in the first book of *Maccabees*, or even in the unhistorical tale of *Judith;* while the under current of observant thoughtfulness, that contemplates but hardly mixes in life, runs in a deep, if calm and passionless stream in the proverbs of the Son of Sirach. At no time was the nation idle. A people that had conceived such hopes, hopes which at last culminated in Christianity, could not be idle or even anything less than restless and turbulent. There is no form of deed celebrated in the ancient history of the people that they did not try to reproduce, and no form of literary composition which, in those mournful centuries so full of oppression, they did not strive to imitate, with an inextinguishable life and hopefulness. This last fact, perhaps, might furnish the means of a classification of the books different from that suggested above, and similar to the division usually adopted in the Old Testament Scriptures. (1.) Historical, such as 1*st Maccabees*, although most that assume the historical form, such as *Judith*, are simple romances, and can be used only as an index of ideas and feelings, not in proof of facts; while others, like *Bel and the Dragon*, are completely fabulous. (2.) Prophetical, such as *Baruch* and 2*d Esdras*. In these the religious hopes of the people are most fully exhibited; for example, the Messianic expectations. Fully to understand these, however, other works, such as the book of Enoch, not contained in the recognised Apocrypha, have to be included. The prophetic literature almost always assumes the form called apocalyptic. (3.) Philosophical, or books coming under the Hebrew name of Wisdom. Here belong the *Son of Sirach*, the *Wisdom of Solomon*, to which must be added others not included in the English Apocrypha, *e.g.*, the *Psalter of Solomon* and 4*th Maccabees*.

2. It has already been said that the Hebrew or Palestinian Canon was formed on the feeling that, before the close of the Persian period, the succession of prophets ceased. It is too evident that this feeling was a true one. The restoration from exile was little more than an external form with almost no real life within. The new community was feeble in the extreme. It had no productive power of its own. It must fall back entirely upon the past. The most and the best it could do was to conserve the forms and, if possible, the spirit of what was ancient. But the spirit, which should also have been its own, was lacking. Hence everything in the new state was mechanical and rigid. Even the canonical writings of this epoch, such as Chronicles, are mere compilations. And the further off from the ancient times the people removed, the stiffer and more mechanical they grew. No doubt a certain energy was infused into the people at various epochs, particularly in the Maccabean struggles, yet even then there is a certain stiffness and awkwardness both in the acts and writings of the time, as when old age girds itself up for deeds to which it is no longer equal. This loss of the prophetic and productive power, and the consciousness of the loss, explains most of the characteristics of the apocryphal literature. For example, there is wanting in it, even where most genial and natural, that original freshness which is so charming in a book like Ruth; and even the proverbial philosophy of the Son of Sirach, instead of bubbling up in living springs, as in Solomon, often appears forced and unwilling in its flow; while in others of the philosophic books there is an elaborate redundancy of language, and a floridness of rhetoric, most unlike the simplicity and terseness of the ancient Wisdom.

Again, the consciousness of the loss of real creative power and complete dependence on the past explains another peculiarity of these books—their pseudonymous character. They do not come forth as the products of their own time, and with the authority of their real authors; they are transferred into the distant past, into the stirring times of living Israelitish history, and their authors are made to be the great historic names of the nation. The Alexandrian philosopher calls his work the *Wisdom of Solomon*. The author of *Judith* pitches his romance in Assyrian times. In this way effect is sought, and truths and actions are commended by an authority that is felt no longer to exist.

A defective sense of truth very naturally becomes more serious. To compose a work in what is believed to be the spirit of some ancient sage or hero, and put it forth under his name, may seem a venial wrong. Yet in an uncritical age it often led to very unfortunate results. Neither might it seem greatly amiss to advocate a cause and recommend an action by exhibiting ancient names uttering similar sentiments, or following the same course, and in an age like our own little evil might follow. Yet the next step downward is the direct forgery of documents, such as the Letters of Artaxerxes, which we find in the additions to Esther, or the Epistles at the beginning of 2 Maccabees. The apocryphal books everywhere demonstrate that all true historic consciousness was deserting the people; and though we may gather truth out of the Apocrypha, it is rarely truth directly stated, but reached by our own inferences from the character of the writings and the objects the author plainly enough had in view.

3. One of the most interesting inquiries connected with the Apocrypha is, as to the advance in doctrine and opinion over the Old Testament to be found in it, and its nearer approach to the New Testament. This is a very delicate inquiry, although the existence of a certain advance cannot be denied, and is most certainly to be expected. For the church did not cease to exist in these centuries, and if she was to appearance barren, yet in fact she was maturing into life the seed which she had already conceived

Parallel to this inquiry, or almost a part of it, runs another, viz., that as to the origin and development of the *parties* which figure so prominently in the pages of the New Testament. All these parties date in their germs from the times of the Restoration, or those not greatly posterior, and may roughly be divided into *two*—those who rigidly adhered to their native Judaism, of whom the Pharisees may be considered the chief representatives; and those who ethnicised, either attaching themselves exclusively to Gentile culture, or combining elements of foreign thought and worship with their native faith, the most prominent sect in this class being the Sadducees. We may expect to come in the Apocrypha upon many traces of such diverging opinions. A specimen here and there will illustrate the position of things in these books.

The want of real life at the time of the Restoration, and the consequent mechanical adherence to ancient forms, was the direct parent of the Pharisaic morality so well known. Already this appears in Tobit. The Pharisee, who went up to the temple to pray, might almost have gathered the elements of his prayer from this book. "Prayer is good with fasting, and alms, and righteousness. . . . . For alms doth deliver from death, and shall purge away all sin" (ch. xii. 8, comp. ch. xiv. 11, and Judith viii. 6, xi. 11, *ff.*) On the other hand, traces of quite a different morality, allied to asceticism, appear elsewhere, as in the statement of Wisdom ix. 15, regarding the body: "For the corruptible body presseth down the soul, and the earthly tabernacle weigheth down the mind that museth upon many things." On the general doctrine of God no advance perhaps was possible. Very lofty things are said by the author of Ecclesiasticus, *e.g.*, ch. xliii. 30, and in many places, but nothing to surpass or even equal what is said in the Old Testament. Perhaps a certain effort is discernible to emphasise the spirituality of God, both directly and by avoiding anthropomorphic images. This effort is far less discernible in the Apocrypha than in the other productions of the same and succeeding ages, such as the Septuagint, the Targums, &c., which are apt to use circumlocutions like the *Word of God*, the *Shekinah*, &c., for God.

As to the doctrine of the Wisdom there is no doubt a certain development of it in these books. But it is doubtful if Wisdom be anything more anywhere than a personification, to which attributes are given that sometimes make it closely resemble the Spirit, and sometimes the Word or Messiah of the New Testament. Certainly the Wisdom is nowhere in these books identified with the Messiah, although the predicates of Wisdom are applied to the Messiah in the New Testament. (Comp. Wisdom vii. 26, with Hebrews i. 3, and the general descriptions of Wisdom, Wisdom ix. 4, 9, *ff.*, vii. 12, *ff.*, &c., Ecclesiasticus, ch. i.) The doctrine of the existence of spirits intermediate between God and man, through whom God's providence is often executed, is certainly found in the Old Testament. These spirits seem mostly benevolent, although there is one whose office it is to accuse and detract, called *Satan*, whose character seems evil. This spirit appears formally in the prologue to Job, and in Zech. ch. iii; comp. 1 Chron. xxi. 1. And some have found traces of the belief in evil spirits in the word "Azazel" (Lev. xvi.), as well as in the "satyrs" of Isaiah (xxxiv. 14). In the book of Daniel the doctrine of angels receives a certain addition, inasmuch as—first, the general activity and superintendence of these spirits is indicated by the name given to them of "watchers" (ch. iv. 10, *ff.*); and second, it is intimated that every kingdom has its guardian spirit (Dan. x. 13, 20). The Apocrypha repeats this last idea, Eccles. xvii. 17, and so does the Septuagint on Deut. xxxii. 8. But the angelology of the book of Tobit makes a double step forward—first, in the direction of teaching a hierarchy among angels—"the seven holy angels, ... which go in and out before the glory of the Holy One" (ch. xii. 15, though comp. Dan. x. 13); and second, in assigning special functions to angels, they "present the prayers of the saints," and assume the care of individuals (ch. v. *ff.*) And demonology receives even a more striking though grotesque development. A wicked spirit, named Asmodeus, is represented as falling in love with Sara, daughter of Raguel, and slaying out of jealousy the seven young men to whom she had been successively married, but is at last put to flight by the fumes of the heart and liver of a fish, and bound in chains in the utmost parts of Egypt (ch. iii. 8, vi. 14, viii. 3).

Even more instructive is it to trace the advance towards clearness of the doctrines concerning the state of man. Many times what is implied in the Old Testament is stated with explicitness. For example, "God created man to be immortal, and made him to be an image of his own eternity; nevertheless, through envy of the devil, came death into the world, and they that do hold of his side do find it" (Wisdom ii. 23.) Again, "Of the woman came the beginning of sin, and through her we all die" (Ecclesiasticus xxv. 24). The references given above will suffice to indicate what lines of study may be pursued in the Apocrypha, and what advantages may be expected to be derived from them.

4. The degree of estimation in which the apocryphal books have been held in the church has varied much according to place and time. As they stood in the Septuagint or Greek Canon, along with the other books, and with no marks of distinction, they were practically employed by the Greek fathers in the same way as the other books; hence Origen, Clement, and others, often cite them as "Scripture," "divine Scripture," "inspired," and the like. On the other hand, teachers connected with Palestine, and familiar with the Hebrew Canon, rigidly exclude all but the books contained there. This view is reflected, for example, in the canon of Melito of Sardis, and in the prefaces and letters of Jerome. Augustine, however, *De Doct. Christ.* ii. 8, attaches himself to the other side. Two well-defined views in this way prevailed, to which was added a third, according to which the books, though not to be put in the same rank as the canonical Scriptures of the Hebrew collection, yet were of value for moral uses and to be read in congregations,—and hence they were called "ecclesiastical." Notwithstanding the decisions of some councils held in Africa, which were in favour of the view of Augustine, these diverse opinions regarding the apocryphal books continued to prevail in the church down through the ages till the great dogmatic era of the Reformation. At that epoch the same three opinions were taken up and congealed into dogmas, which may be considered characteristic of the churches adopting them. In 1546 the Council of Trent adopted the Canon of Augustine, declaring "He is also to be anathema who does not receive these entire books, with all their parts, as they have been accustomed to be read in the Catholic Church, and are found in the ancient editions of the Latin Vulgate, as sacred and canonical." The whole of the books in question, with the exception of 1st and 2d Esdras and the Prayer of Manasses, were declared canonical at Trent. On the other hand, the Protestants universally adhered to the opinion that only the books in the Hebrew collection are canonical. Already Wycliffe had declared that "whatever book is in the Old Testament besides these twenty-five (Hebrew) shall be set among the Apocrypha, that is without authority of belief." Yet among the churches of the Reformation a milder and a severer view prevailed regarding the Apocrypha. Both in the German and English translations (Luther's, 1537; Coverdale's, 1535, &c.) these books are separated from the others, and set by themselves; but while in some con-

fessions, *e.g.*, the Westminster, a decided judgment is passed on them, that they are not "to be any otherwise approved or made use of than other human writings," a milder verdict is expressed regarding them in many other quarters, *e.g.*, in the "argument" prefixed to them in the Geneva Bible; in the 6th Article of the Church of England, where it is said that "the other books the church doth read for example of life and instruction of manners," though not to establish doctrine; and elsewhere.

Somewhat bitter controversies have raged over the Apocrypha in recent times. One was carried on in Scotland in 1825 and following years, which had the effect of inducing the British and Foreign Bible Society to employ its funds for the circulation of the canonical Scriptures only. Abundant materials for a history of this controversy may be found in the pages of the *Christian Instructor* for the years just named. More recently a similar controversy has been waged in Germany, where Stier and Bleek and Hengstenberg were found on the side of the Apocrypha, and Keerl with others against. See *Die Apokryphenfrage, mit Berücksichtigung der darauf bezüglichen Schriften Dr Stier's und Dr Hengstenberg's, aufs Neue beleuchtet*, von P. F. Keerl, Leip. 1855. Useful works on the subject are—Fabricii *Codex Pseudepigraphicus Vet. Test.*, Hamb. and Leip. 1713 and 1741; *Libri Apocryphi Vet. Test. Græce*, recensuit et cum Commentario critico edidit Otto Frid. Fritzsche, Lipsiæ, 1871; *Kurzgefasstes Exegetisches Handbuch zu den Apok. des Alt. Test.*, bearbeitet von Dr O. F. Fritzsche u. Dr C. L. W. Grimm, in 6 Lieferungen. Compare also, Ewald, *History of Israel*, vol. v. (trans.) Lond. 1874, Schürer, *Lehrbuch der Neutest. Zeitgeschichte*, Leip. 1874; Langen, *Das Judenthum in Palestina zur Zeit Christi*, Freiburg, 1866; Nicolas, *Des Doctrines Religieuses des Juifs, pendant les 2 siècles antérieurs à l'ère chrétienne*, Paris, 1860. Much information may also be found in the Introductions to the Old Testament, *e.g.*, Davidson's, vol. iii., and in the articles "Apocrypha," "Canon," and those on the individual books in Smith's and Kitto's *Bible Dictionaries* and Herzog's *Encyklopädie.* (A. B. D.)

APOCRYPHAL BOOKS OF THE NEW TESTAMENT.—These may be divided into two classes—those books which were actually held as inspired by some portion of the Christian church, and those which were never acknowledged as canonical. Among the first are some of the writings ascribed to the apostolical fathers. The First Epistle of Clement was read in the churches, is quoted in the same manner as Scripture by Irenæus, and is found in the Codex Alexandrinus. The Pastor of Hermas was also read in the churches, is mentioned as inspired by Irenæus, Clemens Alexandrinus, and Origen, and is found in the Codex Sinaiticus. Somewhat similar respect was paid to the Epistle of Polycarp and the Epistle of Barnabas. Besides these books there were different gospels in use in the early period of Christianity. The most famous of these was the Gospel according to the Hebrews. Some critics regard it as the earliest gospel of which we know anything. Its relation to our Gospels thus becomes a very important question, the discussion of which, however, must be reserved for the article on the GOSPELS (*q.v.*) The Ebionites used this gospel. It was written in Aramaic. It goes sometimes by the name of the Gospel of the Nazarenes, or by the Gospel according to the Apostles; and some think that it was also called the Gospel of Peter. This gospel no doubt underwent alterations; and Hilgenfeld, in his *Novum Testamentum extra Canonem Receptum*, gives the fragments of what he considers the earliest form of the Gospel according to the Hebrews, then those of the Gospel of the Ebionites, which he considers very late, and then those of the Gospel of Peter which he thinks occupied an intermediate place. We know very little more of the other gospels and apocryphal books than their names. Eusebius mentions the Acts of Peter, the Preaching of Peter, and the Revelation of Peter; the Acts of Paul, and the Doctrines of the Apostles. Origen mentions also the Gospel according to the Egyptians, the Gospel of Basilides, and the Gospel according to Thomas, and according to Matthias. Jerome, in addition to these, notices the Gospel according to Bartholomew, and the Gospel of Apelles. Marcion also used a special gospel for his sect, but whether it was the Gospel of Luke, entire or mutilated, is keenly debated. And the book of the Prophet Elxai was held in high estimation by some sects. All these works have perished, and criticism can only conjecture, from a few scattered hints and fragments, what was their nature. The other set of apocryphal books consists of works that have come down to us relating to Christ and his apostles, but which were never regarded as inspired by any sect. Some of these had a wide circulation in the Middle Ages, were translated into various languages, and, as might be expected, were subjected to all kinds of interpolations and alterations. Several of them refer to the infancy and boyhood of Jesus; such as the Protevangelium of James, the Gospel of Thomas, the Arabic Gospel of the Infancy; and some deal with his death, as the Gesta Pilati or the Gospel of Nicodemus, and the narrative of Joseph of Arimathea. There seems reason to believe that the first form of the Protevangelium of St James and the first form of the Gesta Pilati were written in the second century; but there can be no reasonable doubt that the forms in which we now have them belong to a much later date. There are also apocryphal Acts of Apostles and apocryphal Revelations of Apostles. These seem all to belong to a later date than the earliest of the apocryphal gospels. The fragments of the gospels used by the early church and the sects are given in Hilgenfeld's *Novum Testamentum extra Canonem Receptum* (Lipsiæ, 1866). The extant apocryphal Gospels, Acts, and Revelations have been edited in three separate volumes by Tischendorf, and have been translated by Mr Walker in vol. xvi. of Clark's *Ante-Nicene Christian Library*. These works contain references to the extensive literature on the subject. Special mention may be made of Michel Nicolas's work, *Etudes sur les Evangiles Apocryphes* (Paris, 1866), but almost all works on the Canon contain an account more or less full of the apocryphal books of the New Testament.

APOLDA, a town of Germany, in the grand-duchy of Saxe Weimar, situated near the river Ilm, 9 miles east of Weimar, with which it is connected by railway. Hosiery and cloth are the chief manufactures of the town, besides which it contains pin and button factories, and bell foundries. There are mineral springs in the neighbourhood. Population in 1871, 10,507.

APOLLINARIS SIDONIUS, CAIUS SOLLIUS, an eminent Christian writer and bishop, was born in Lyons about 430 A.D. Belonging to a noble family he was educated under the best masters, and particularly excelled in poetry and polite literature. He married Papianilla, the daughter of Avitus, who was consul, and afterwards emperor, by whom he had three children. But Majorianus, in the year 457, having deprived Avitus of the empire, and taken the city of Lyons, Apollinaris fell into the hands of the enemy. The reputation of his learning led Majorianus to treat him with the greatest respect; in return for which Apollinaris composed a panegyric in his honour, which was so highly applauded, that he had a statue erected to him at Rome, and was honoured with the title of *Count*. In 467 the Emperor Anthemius rewarded him for the panegyric which he had written in honour of him, by raising him to the post of governor of Rome, and afterwards to the dignity of a patrician and senator. But he soon quitted these secular employments for the service of the church; and, in 472, was chosen to succeed Eparchius in the bishopric of Clermont. On the capture of that city by the Goths in 480 he was obliged to retire, as he had taken an active part in its defence; but he was soon restored by Evaric, king of the Goths, and continued to govern the church as before. He died 482 or 484 A.D. His extant works are his *Panegyrics* on different emperors, and a collection of *Letters* and *Poems*, and their chief value consists in the light they shed on the political and literary history of the 5th century. The best edition is that by Sirmond, published in 1614, and republished in 1652.

APOLLINARIS, SULPICIUS, a learned grammarian of Carthage, lived in the 2d century, under the Antonines. He is the reputed author of the poetical arguments prefixed to the comedies of Terence. He had for his pupils Helvius Pertinax, who afterwards became emperor, and Aulus Gellius, who speaks of the acquirements and character of his master in terms of the highest praise.

APOLLO. The influence of the sun on nature in a country like Greece, either brightening the fields and cheering mankind, or scorching and destroying with a pestilence, or again dispelling the miasma collected from marshes by night, was taken by the Greeks to be under the control of a divine being, to whom they ascribed, on human analogy, a form and character in which were reflected their own sensations. That divine being they called Apollo, a name which applied to him in two ways, either as ἀπολλύων, from ἀπόλλυμι, "the destroyer," or as ἀπέλλων, from ἀπέλλω = ἀπείργω, the "repeller of ills." Apellon is both the Doric and the old Roman form of his name. Under the frequent title of Phœbus, he was hailed as god of the streaming light of the sun. Next to its daily course, which, however, was under the guidance of a special subordinate deity, Helios, the most obvious and invariable phenomenon of the sun was its withdrawal in winter and return in summer, and accordingly on this was based one of the principal features in the character of the god, which was also recognised in annual festivals in his honour, and made more explicit by the myth, in which after his birth, amid the splendid summer light of Delos, he is carried off in a car drawn by swans to the fabulous region of the Hyperboreans, where the sun was believed to tarry during the winter. The other class of solar phenomena, being variable in their occurrence, appeared to be directed by a precarious will, and from this was evolved for Apollo the double character of a god possessed of power over the sun, and a the same time guided in the exercise of it by the conduct of mankind. Hence the prominence of expiatory offerings in the worship of a god whom no act of wrong escaped. By his knowledge of what transpired on earth and in the councils of Olympus, he was prepared to be the god of oracles, which threw light on the future and banished the monsters begotten of terror at its obscurity. From observing the jubilant voice of nature greeting the sunshine, it was an easy step to regard Apollo as the god of music; while again the function of a god of medicine was peculiarly appropriate to a deity who, if he destroyed life, also saved it. In many ways the sun gladdened the herdsman and favoured his flock. Hence both Apollo and Helios (Sol) had sacred herds of cattle of their own, while the former when in exile on earth himself acted as a herdsman.

Apollo. From silver coin of Clazomenæ. Brit. Mus.

The honour of having been the birth-place of Apollo was claimed by many districts, but chiefly by Xanthus in Lycia, and the island of Delos, the latter being at last generally agreed upon. In Lycia his worship was of high antiquity, and its extent is vouched for by the identity of the name of that country with one of the favourite epithets of the god, Λυκεῖος, from root λυκ, as in λυκόφως, Lat. *luc-s = lux*. There also his mother Leto (Latona) appears to have been widely worshipped, and thither the solar hero Bellerophon goes to accomplish his labours, showing a community of religious belief between Lycia and Argolis, the home of Bellerophon, for which there is also other evidence. But when the myths concerning Apollo came to be shaped by the poets, his worship had acquired an independent standing in Delos, and had established for that island a claim to the honour of being his birth-place. The belief was that Leto, pursued by the jealous Hera (Juno), after long wandering, found shelter in Delos, and there bore to Zeus (Jupiter) a son, Apollo. To this it was added, after the time of Pindar, that Delos had before been a barren rock floating about in the sea, but had been for this purpose and for ever after fastened down by pillars, as also happened to the island of Rhodes, the centre of the worship of Helios. The labour of Latona lasted nine days and nine nights. Then she seized hold of a palm tree, and when the boy was born all the island was dazzled with a flood of golden light. Sacred swans flew in a circle round the island seven times. The day was the 7th of the month Thargelion (May). The 7th of every month was sacred to him. He was styled Ἑβδομαγενής, and otherwise the number seven played a part in his worship. His first step was to seize a bow and to announce his will to found an oracle. To this end his father Jupiter gave him, besides a lyre, and a mitra to bind his hair, a car drawn by swans, with which to proceed to Delphi. But the swans carried him off to their home among the Hyperboreans. Returning with the summer to Delphi, he slew with an arrow the Python, a monster dragon, which was then laying waste the district, established his oracle, and took the title of Pythios. Gæa (Terra) first, and next Themis had previously given oracles there. But this, though the current belief, is at variance with the Homeric Hymn to Apollo, which describes him as selecting Delphi for its site alone, and then relating how, after a temple was built, the difficulty of finding priests was overcome. Seeing a trading ship from Cnossus in Crete, under way for Pylus, the god threw himself on board in the form of a dolphin and guided it to Crissa, the harbour of Delphi, where, like the flash of a star, he resumed his divine form, appointed the traders his priesthood, and with his lyre led the first pæan there. Hence his title of Delphinios. But here a confusion has been effected; for, while in one sense Apollo Delphinios was god of the sunny voyages, in another sense he may have derived that epithet from having slain the dragon, the proper name of which was Delphine. Except on the latter theory, there seems to be no explanation of this, among other facts, that his sanctuary at Athens, the Delphinion, was a court for the trial of bloodshed. It may then be supposed that the Dorians from Crete, who had in early times established themselves on the coasts of the Peloponnesus and at Crissa, having an Apollo whose symbol was a dolphin, and finding at Delphi an Apollo styled Delphinios for another reason, combined the two in the new myth which is found in the Homeric Hymn. Besides at Delphi, which however retained the first place, Apollo gave oracles also at Colophon, and at Didymi near Miletus; in the latter place through the priestly family of the Branchidæ. To certain mortals he communicated the prophetic gift, as to Cassandra, the Cumæan sibyl, and the seer Epimenides. With his oracular power was associated his function as god of music (Citharœdus), and leader of the Muses (Musagetes), in which capacity he caused Marsyas to be flayed alive because he had boasted superior skill in playing the flute, or again, caused the ears of Midas to grow long because he had decided in favour of Pan, who contended that the flute was a better instrument than the lyre. But that which brought Apollo most closely home to the hearts of the people was his character of a destroying but yet an appeasable god. Pestilence and death by an unseen cause, or in the beauty of youth, were traced to him, and to prevent doubt as to his having a good reason in each case, there were the myths which told how, for example, he sent a pestilence on the Greeks before Troy, because Chryseis, the daughter of his priest, was retained in captivity by Agamemnon, or again, how with the aid of his sister Artemis (Diana) he slew the children of Niobe, because she had boasted of their beauty. A typical instance of his causing death undesignedly is that of his favourite, the beautiful young Hyacinthus, who was killed by the disc (a symbol of the sun) which Apollo had thrown in play. Besides accepting atonement in such cases, he was the god of the penitent generally, but especially of those, like Orestes, guilty of a crime which required years of expiation. For such he was himself the prototype, having been twice banished from Olympus, and compelled first to act for a period as herdsman to Admetus, the king of Pheræ, and next to assist Poseidon (Neptune) in building the walls of Troy for Laomedon. While thus the power of the sun god was recognised with varying feelings according to occasion, it was, on the other hand, always kept in view as an active principle in nature by the regular system of festivals. Of these the most remarkable was that called Carneia, which was annually held at Sparta in August, the whole population withdrawing from the town for several days, and living in tents to avoid the effect of intense heat. In July, also, the Spartans held a festival of nine days in his honour, called Hyacinthia, the burden of the ceremony being the transitoriness of life mingled with trust in its return. In Athens the festival of Thargelia was held in his honour in May, to celebrate the ripening of the fruits of the field; while in the Metageitnia, in August, he was regarded as the god of plenty, and as the source of neighbourly feeling. At Delphi, among a constant round of ceremonies, two festivals were conspicuous · at the beginning of winter, when the god was supposed to go away to the Hyperborean region, and at the beginning of summer, when he was believed to return; the latter event being hailed with every expression of delight in music and song. At Thebes was held every eighth year a peculiar ceremony, Daphnephoria, in honour of Apollo Ismenios, consisting of a procession in which was carried a branch of olive, hung with wreaths and representations of the sun, moon, planets, and stars, the number of wreaths being 365. This object was called the Kopo. In May the ancient national festival at Delos was celebrated. It remains to notice the very prevalent association of Apollo as sun-god with Artemis (Diana) as moon-goddess, the aspect of these two luminaries having readily suggested that their presiding deities were twins. But Apollo and Diana resembled each other also in many attributes of their character as well as in appearance. Just as he was god of the influence of the sun on nature, with a subordinate deity Helios (Sol) to guide the orb, so she personified the power of the moon, delegating its course to the goddess Selene (Luna). In Rome the worship of Apollo was not introduced until 320 B.C., in which year the city had been visited with a pestilence. The most frequent symbols of Apollo are the bow and the lyre; the tripod, suggesting his oracular power; the laurel, which was carried by penitents as well as worn by victors, and into which Daphne was changed for not yielding to his love; the palm, the wolf, the deer, and the raven. In the ripe period of art Apollo appears in a form which seeks to combine manhood and eternal youth. His long hair is usually tied, like that of his sister Diana, in a large knot above his forehead. As leader of the Muses, he wears long ample drapery girt at the waist, his tresses falling on his shoulders.

APOLLO BELVIDERE, a marble statue of Apollo, found towards the end of the 15th century near Antium (*Capo d'Anzo*), a favourite resort of Roman emperors. Julius II., while yet a cardinal, purchased it; and on becoming Pope allowed it to be placed, through Michael Angelo, in the Belvidere of the Vatican, whence it was taken by the French in 1797, but restored in 1815. The marble some believe to be Greek, though perhaps the best autherities call it Carrara. In any case the statue is not an original work, but a copy apparently from a very fine Greek statue of about the beginning of the 3rd century B.C., of which another copy has been identified in a bronze statuette now in St Petersburg, known as the Stroganoff Apollo. Lately also a marble head has been found at Rome, corresponding closely in measurement and in style, confirming what is suggested by the statue, viz., that the original was of bronze. From the bronze statuette it is found that the Apollo Belvidere held forward in his left hand, not a bow as was thought, but the *ægis*, in the attitude of spreading consternation among an enemy, as he did among the Trojans, and it is usual to adopt as the occasion for the production of this statue the invasion of the Gauls, whom, in 278 B.C., the god drove in alarm from his sanctuary at Delphi. The extraordinary praise bestowed on it by Winckelmann secured for this statue a fame from which the discovery of true Greek sculptures since then has gradually detracted, to this extent, that even its original cannot now be placed in the best period of Greek art.

APOLLODORUS, a celebrated painter of Athens who lived about 408 B.C. From the improvements he introduced into the art of mingling colours, and the use he made of shading, he obtained the surname, Σκιαγράφος.

APOLLODORUS, an Athenian grammarian, son of Asclepiades, and disciple of Aristarchus, lived about 140 B.C. His most famous production is his *Bibliotheca*, which treats of the gods and the heroic age; and though the extant work is possibly only an abridgment by another hand of the original, it is of great value in mythological inquiries. The best edition is that of Heyne, 2 vols. 8vo, published in 1803.

APOLLODORUS (60–130 A.D.), an architect, born at Damascus, a favourite of Trajan, for whom he constructed the stone bridge over the Danube (104 A.D.), which was esteemed the most magnificent of all the works of that emperor. He also planned a gymnasium, a college, public baths, the Odeum, and the Forum Trajanum, within the city of Rome; and the triumphal arches at Beneventum and Ancona. The Trajan column in the centre of the Forum is celebrated as being the first triumphal monument of the kind, and the model of many others in different cities, as Paris, London, St Petersburg, &c. On the elevation of Hadrian to the throne, Apollodorus was banished from Rome, and shortly afterwards, being charged with imaginary crimes, was put to death (Dion Cassius, lxix.)

APOLLONIA, the name, derived from the god Apollo, of several cities of antiquity. The most important are— 1. An Illyrian city on the right bank of the Aous, which owed its foundation to the Corinthians and Corcyreans. It soon became a place of commercial prosperity, was at a later period regarded as of military importance, and towards the close of the Roman republic acquired fame as a seat of literature and philosophy. It seems to have sunk with the rise of Aulon, and few remains of its ruins are to be found. 2. A Thracian city (afterwards Sozopolis, and now *Sizeboli*), colonised by the Milesians, and famous for its colossal statue of Apollo, which Lucullus removed to Rome. 3. The port of Cyrene (afterwards Sozusa, now *Marsa Sousah*), which at length outgrew the greatness of Cyrene itself, and has left ample evidence of its magnificence in the ruins of its public buildings. It was the birth-place of Eratosthenes, usually known as of Cyrene.

APOLLONIUS, surnamed Molo, a distinguished Greek rhetorician, the instructor of Cæsar and of Cicero. Born at Alabanda, he settled at Rhodes, and in the dictatorship of Sulla, was sent as ambassador from the Rhodians to Rome. He was the first Greek who addressed the senate without the aid of an interpreter. Cicero renewed his studies under him when he afterwards visited Rhodes on his return from Asia. The works of Apollonius have perished.—Another rhetorician of the same name, likewise a native of Alabanda, and an inhabitant of Rhodes, was surnamed The Effeminate (ὁ Μαλακός). Both are mentioned by Cicero with high respect.—Cicero, *Brutus*, 89, 90, 91; *De Inv.* i. 56, *De Orat.* i. 17, 28; Quintil. iii. 1, § 16, xii. 6, § 7, &c.

APOLLONIUS, surnamed Dyscolus (Δύσκολος), or The Crabbed, was a native of Alexandria, and lived in the reigns of Hadrian and Antoninus Pius. He was the first systematic writer on grammar, and is styled by Priscian "*Grammaticorum Princeps.*" Of his extant grammatical works the principal one is the treatise *On Syntax*, the best edition of which is that of Bekker, Berlin, 1817

APOLLONIUS, a Greek epic poet, surnamed Rhodius, from his long residence in Rhodes, though he is supposed to have been a native of Alexandria. He is known to us as the author of the *Argonautica*, a poem which he began while in youth, studying under the poet Callimachus. His master is supposed to have slighted the production of the youthful Apollonius, and their connection ended in the most violent enmity, though we are ignorant of the particulars of their quarrel. The disappointed youth retired to Rhodes, where he is conjectured to have polished and completed his work, supporting himself by the profession of rhetoric, and receiving from the Rhodians the freedom of their city. He was at length recalled to Alexandria to succeed Eratosthenes in the care of the great library about 194 B.C., in the reign of Ptolemy Euergetes, who had been educated by Aristarchus, and rivalled his predecessors in the munificent encouragement he gave to learning. The only extant work of Apollonius is his poem above mentioned, in four books, on the Argonautic expedition. Both Longinus and Quintilian have assigned to this work the mortifying character of mediocrity. It was first printed at Florence in 1496, with the ancient Greek Scholia, in a 4to volume, now exceedingly rare. An excellent edition was published by Brunck in 1780, and another by Beck, in 1797; but the best is that of Professor Schafer (Leipsic, 2 vols. 8vo, 1810–13). The poem was translated into English verse by Fawkes and Green in 1780; another translation in English verse, with critical notes, was published by W. Preston in 1803.

APOLLONIUS of Tralles and his brother Tauriscus were the sculptors of the famous Farnese Bull, a group representing Zethus and Amphion tying the revengeful Dirce to the tail of a wild bull. This work is now at Naples. There were several other sculptors named Apollonius.

APOLLONIUS, a grammarian of Alexandria, author of a Homeric Lexicon, Λέξεις Ὁμηρικαί, which was first published by Villoison, in two vols. fol., at Paris, in 1773.

APOLLONIUS of Perga (Pergæus), next to Archimedes the most illustrious of the ancient Greek geometricians, was born probably about 250 B.C., and died during the reign of Ptolemy Philopator (222–205 B.C.), flourishing thus about forty years later than Archimedes. He studied at Alexandria under the successors of Euclid, and is one of the brightest ornaments of that famous mathematical school.

But few of the mathematical works of Apollonius have escaped the ravages of time. Of the greater part we have merely the names and general description given by Pappus in his preface to book vii. of the *Mathematical Collections*. His treatise on the *Conic Sections* gained him the title of The Great Geometer, and is that by which his fame has been transmitted to modern times. It is not, indeed, to be for a moment supposed that Apollonius discovered all, or even the greater part, of the demonstrations which he gives, any more than that Euclid devised the propositions that go by his name. Pappus mentions several treatises on conics known to have existed previously—in particular the five books of Aristæus "The Ancient" (350 B.C.) on Solid Loci; and there can be little doubt that Apollonius availed himself of these, as well as of the discoveries of Conon, Euclid, Eudoxus, Menechmus, Nicoteles, Thrasidæus, and others, who had explored the way before him. At this distance of time we cannot distinguish the original from the borrowed propositions; but, though it is certain that he both added to and improved upon the existing theory of conics, the mere embodying in a complete and logical treatise of a number of miscellaneous theorems was in itself a work of great mathematical genius. Eutocius informs us that Apollonius was the first to show that all the three sections may be cut from the same cone, by varying the position of the intersecting plane, for previous authors had supposed the plane of section always perpendicular to the slant side of the cone,—an hypothesis which requires that the three sections be cut from cones of different species, namely, the parabola from a right-angled cone, the ellipse from one with an obtuse, and the hyperbola from one with an acute vertical angle. But Archimedes, as Ubaldus shows in his commentary on the *Æquiponderantes*, had been acquainted with this fact. Pappus ascribes to Apollonius the names by which the three sections are now distinguished; the term *Parabola*, however, occurs in the writings of Archimedes. Of the *Conicorum Libri Octo* of Apollonius, unfortunately only four have reached us directly through the original Greek. Three more have been preserved in an Arabic version, but the eighth has never been found. Though many attempts had been made to discover the last four books, they continued to be regarded as lost till 1658, when Borelli, the celebrated author of the treatise *De motu Animalium*, discovered in the Medici library at Florence an Arabic manuscript, entitled *Apollonii Pergæi Conicorum Libri Octo*. With the assistance of Abraham Ecchellensis he translated and published in 1661 the fifth, sixth, and seventh books; but the eighth, notwithstanding the title, was wanting. Some years previously Golius, Oriental professor at Leyden, had returned from the East with an Arabic version of the whole seven books, and had projected the publication of a translation; but it never appeared. A note appended to the MS. of Golius stated that the eighth book had never been translated into Arabic. It was long a favourite problem with geometers to attempt to restore the lost books of Apollonius, that is, to infer from the general nature of their contents, as described by Pappus, the propositions they had contained. Maurolycus, a Sicilian geometer of the 16th century, Viviani, the last favourite pupil of Galileo, Fermat, Halley, Simson, and a number of others, all attempted this with more or less success. Halley, guided by the descriptions of Pappus, and the assertion that his preliminary lemmas to the seventh book really belonged to the eighth, as well as by the statement of Apollonius himself that the eighth was a continuation of the seventh book, restored this book for the edition issued by the Oxford Press in 1710, the only edition of the Greek text that has as yet appeared. The last four books of the conics of Apollonius formed the chief part of the higher geometry of the ancients; and they present some elegant geometrical solutions of problems, which offer considerable difficulty even to the modern analytical method. For example, the fifth book treats of the greatest and least lines that can be drawn from given points to the peripheries of conics, and contains the chief properties of normals and radii of curvature.

The other treatises of Apollonius mentioned by Pappus are—1*st*, The Section of Ratio, or Proportional Sections; 2*d*, the Section of Space; 3*d*, the Determinate Section; 4*th*, the Tangencies; 5*th*, the Inclinations; 6*th*, the Plane Loci. Each of these was divided into two books, and, with the *Data* of Euclid and the *Porisms*, they formed the eight treatises which according to Pappus, constituted the body of the ancient analysis.

1*st*, *De Rationis Sectione* had for its subject the resolution of the following problem: Given two straight lines and a point in each to draw through a third given point a straight line cutting the two fixed lines, so that the parts intercepted between the given points in them and the points of intersection of this third line, may have a given ratio.

2*d*, *De Spatii Sectione* discussed the similar problem, which requires that the space contained by the three lines shall be equal to a given rectangle.

Dr Halley published in 1706 a restoration of these two treatises, founded on the indications of their contents given by Pappus. An Arabic version of the first had previously been found in the Bodleian library at Oxford by Dr Edward Bernard, who began a translation of it, but broke off on account of the extreme inaccuracy of the MS.

3*d*, *De Sectione Determinata* resolved the problem: In a given straight line to find a point, the rectangles or squares of whose distances from given points in the given straight line shall have a given ratio. Several restorations of the solution have been attempted, one by Snellius, another by Alex. Anderson of Aberdeen, in the supplement to his *Apollonius Redivivus* (Paris, 1612), but by far the most complete and elegant by Dr Simson of Glasgow.

4*th*, *De Tactionibus* embraced the following general problem: Given three things (points, straight lines, or circles) in position, to describe a circle passing through the given points, and touching the given straight lines or circles. The most difficult case, and the most interesting from its historical associations, is when the three given things are circles. This problem, though now regarded as elementary, was proposed by Vieta in the 16th century to Adrianus Romanus, who gave a very clumsy solution. Vieta thereupon proposed a simpler construction, and restored the whole treatise of Apollonius in a small work, which he entitled *Apollonius Gallus* (Paris, 1660.) Both Descartes and Newton have discussed this problem, though they failed to give it that simplicity of character which it has since been shown to possess. A very full and interesting historical account of the problem is given in the preface to a small work of Camerer, entitled *Apollonii Pergæi que supersunt, ac maxime Lemmata Pappi in hos Libros, cum Observationibus*, &c. (Gothæ, 1795, 8vo).

5*th*, *De Inclinationibus* had for its object to insert a given straight line tending towards a given point, between two given (straight or circular) lines. Restorations have been given by Marinus Ghetaldus, by Hugo de Omerique (*Geometrical Analysis*, Cadiz, 1698), and elegantly by Dr Horsley (1770).

6*th*, *De Locis Planis* is merely a collection of properties of the straight line and circle, and corresponds to the construction of equations of the first and second degrees. It has been successfully restored by Dr Simson.

The great estimation in which Apollonius was held by the ancients, and the great value attached to his productions, are manifest from the number and celebrity of the commentators who undertook to explain them. Among these we find the names of Pappus, the learned and unfortunate Hypatia, Serenus, Eutocius, Borelli, Halley, Barrow, and others. Various discoveries in other departments of mathematical science were also ascribed to him by the ancients. Pappus says that he made improvements on the modes of representing and multiplying large arithmetical numbers The invention of the method of projections has been attributed to him; and he has the honour of being the first to found astronomical observations on the principles of geometry.

The best editions of the works of Apollonius are the following:—1. *Apollonii Pergæi Conicorum libri quatuor, ex versione Frederici Commandini.* Bononiæ, 1566, fol. 2. *Apollonii Pergæi Conicorum libri v. vi. vii. Paraphraste Abalphato Asphanensi nunc primum editi: Additus in calce Archimedis Assumtorum Liber, ex Codicibus Arabicis Manuscr. Abrahamus Ecchellensis Latinos reddidit. J. Alfonsus Borellus curam in Geometricis Versioni contulit, et Notas uberiores in universum opus adjecit.* Florentiæ, 1661, fol. 3. *Apollonii Pergæi Conicorum libri octo, et Sereni Antissensis de Sectione Cylindri et Coni libri duo.* Oxoniæ, 1710, fol. (This is the splendid edition of Dr Halley.) 4. The edition of the first four books of the Conics given in 1675 by Barrow. 5. *Apollonii Pergæi de Sectione Rationis libri duo: Accedunt ejusdem de Sectione Spatii libri duo Restituti: Præmittitur,* &c. *Opera et Studio Edmundi Halley.* Oxoniæ, 1706, 4to.

See Bayle's *Dictionary*; Bossut, *Essai sur l'Hist. Gén. des Math.*, tome i.; Montucla, *Hist. des Math.*, tome i.; Vossius, *De Scient. Math.*; Simson's *Sectiones Conicæ*, preface; and Hutton's *Mathematical Dictionary*.

APOLLONIUS, surnamed TYANÆUS, a Pythagorean philosopher, born at Tyana, the capital of Cappadocia, shortly before the Christian era. According to his biographer Philostratus, he studied grammar and rhetoric at Tarsus under Euthydemus, but he soon left that gay and luxurious city for the quiet town of Ægæ in the vicinity, where he spent his time in the company of philosophers and priests within the temple of Æsculapius. Among these he met Euxenus, one of the followers of Pythagoras, and from him he learned with enthusiasm the doctrines of the Samian sage. While yet a mere youth he renounced all the ordinary pleasures of life. Abjuring the use of flesh and wine, he lived on the simple fruits of the soil, wore no clothing but linen and no sandals on his feet, suffered his hair to grow, and slept on the hard ground. He strictly observed the Pythagorean penance of five years' silence, suffering often the most painful trials of his patience without a murmur. Philostratus relates so many wonderful stories of his hero—how on one occasion, for instance, he awed an excited populace to silence by the mere waving of his hands, how he performed many miracles with a word, and how he knew all tongues without ever having learned them—that some have questioned the very existence of Apollonius; while others, admitting with reason the fact of some such ascetic having lived about this time, regard him as a compound of magician, impostor, and religious fanatic.

After spending some time in the cities of Cilicia and Pamphylia, Apollonius extended his travels into the East, and wandered on foot over Assyria, Persia, and India, conversing with Magi, Brahmins, Gymnosophists, and priests, visiting the temples, preaching a purer morality and religion than he found, and attracting wherever he went admiration and reverence. At Nineveh he met with Damis, who became his adoring disciple and the companion of his journeyings, and left those doubtful records of his life which Philostratus made use of, and probably improved upon. The account of his exploits during his wanderings in India reads like the tales of the Arabian Nights; and where Damis cannot vouch for having seen the prodigies he mentions, he unhesitatingly adduces in support of them the authority of his master. From his visit to the Hill of Sages (described in the third book), Apollonius returned an accomplished sage himself, able to foretell earthquakes and eclipses, to cure the plague, to summon spirits from the unseen world, and to restore the dead to life.

On his return from the East he had the greatest reverence paid him everywhere by Grecian priests and oracles. He visited Crete and Rome, where he astonished the magistrates by raising to life the dead body of a noble lady. Spain, Sicily, Egypt, Ethiopia, Greece, and Asia Minor became in time the scenes of his wanderings and his wonder-workings; and so distinguished had he become that even during his life he was raised almost to the rank of a divinity.

He is supposed to have died at Ephesus at a very great age, but his biographer finds it convenient to represent his end as involved in mystery, in order to heighten the reverence due to his hero. The words of the biographer are: "Here ends the history of Apollonius the Tyanæan, as written by Damis. Concerning the manner of his death, *if he did die*, the accounts are various." Like Pythagoras, his master, he left no indication of his age; and Philostratus could not ascertain whether he died at Ephesus, or *vanished* at Lindus, or in Crete.

After his death Apollonius was worshipped with divine honours for a period of four centuries. A temple was raised to him at Tyana, which obtained from the Romans the immunities of a sacred city. His statue was placed among those of the gods, and his name was invoked as a being possessed of superhuman powers. The defenders of paganism, at the period of its decline, placed the life and miracles of Apollonius in rivalry to those of Christ; and some moderns have not hesitated to make the same comparison. There is no reason to suppose, however, that Philostratus entertained any idea of this sort in composing his life of Apollonius. That biography was undertaken by order of Julia, wife of the Emperor Severus, more than a century after the death of the subject of it; and it is extraordinary that Apollonius, if so renowned and widely known in his day, found no place in history for 120 years after his decease. The preamble of Philostratus, in which he professes to set forth things with which men were before unacquainted, is in striking contrast with the commencement of the Gospel of Luke.

Apollonius is not to be looked upon as a shallow and vulgar impostor, though to influence men's minds he had recourse to artifices and pretensions unworthy of a true philosopher. With some of the spirit of a moral and religious reformer, he appears to have attempted, though vainly, to animate expiring paganism with a new and purer life. See PHILOSTRATUS.

APOLLOS, a Jew of Alexandria, who came to Ephesus during the absence of St Paul at Jerusalem (Acts xviii. 24). Apollos was a learned man (λογίος, in the authorised version translated *eloquent*), "mighty in the Scriptures," and preached "boldly" in the synagogue the doctrine of a Messiah, knowing as yet "only the baptism of John." Aquila and Priscilla having heard him, instructed him more fully in the doctrines of the gospel. Some time after this he went to Corinth, and was there very useful in convincing the Jews out of the Scriptures that Jesus was the Christ. Thus he watered what St Paul had planted in that city (1 Cor. iii. 6). The division in the church at Corinth, in which one of the parties called itself by his name (1 Cor. i. 12), was not prompted by him, and did not disturb the friendly relations that existed between him and St Paul. Apollos hearing that the apostle was at Ephesus, went to meet him, and declined to return to Corinth, though St Paul "greatly desired" him to do so (1 Cor. xvi. 12). St Jerome says that Apollos was so dissatisfied with the division at Corinth, that he retired into Crete with Zenas, a doctor of the law; and that the schism having been healed by St Paul's letter to the Corinthians, Apollos returned to the city, and became its bishop. Less probable traditions assign to him the bishopric of Duras, or of Iconium in Phrygia, or of Cæsarea.

APOLOGETICS is, properly speaking, that part of theology which vindicates the right of theology in general, and of Christian theology in particular, to exist as a science, and is occasioned by the presence of anti-theological and antichristian speculation. Apologetics is therefore the scientific representation of the grounds on which Christian theology, in so far as it is a part of human knowledge, rests and may be vindicated. So long as Christianity lies hid, as it were, in the mind of man or in the consciousness of the church, without assuming an external or objective form, so long as it remains only in the form of a force impelling men to action, so long as it is content to manifest itself on the active or practical side only, there is no great need of Apologetics; but whenever Christian dogmatics arise, whenever Christianity objectifies itself on its intellectual side, and begins to force its way into the circle of the sciences, its entrance is disputed, it has to face hostile criticism, and begins to form an apologetic.

Apologetics is therefore the logical antecedent but the historical consequent of dogmatics; it is the introduction to dogmatics, it prepares the way for it logically by justifying its claim to exist, but it actually comes after dogmatics in the history of the intellectual manifestation of Christianity, because, as a matter of fact, men do not feel called on to justify Christian theology until it actually exists in a dogmatic form. Thus, Apologetics may be compared to psychology, and in some respects is to dogmatics what psychology is to metaphysics. Just as psychology is the link between physics and metaphysics, just as in psychology the two spheres of impersonal and personal life touch each other, and the two sets of natural and spiritual laws are seen in conjoint action, so Apologetics lies between human and superhuman science, in it the two spheres of human life and revelation meet, and the various and different laws which regulate each adjust themselves to each other's varying action; and psychology, which is historically consequent to metaphysics, is logically its antecedent and introduction. The position of Apologetics necessarily gives it a somewhat changeable nature. All sciences change, but they do so according to an inward development of their own, and their change is so far orderly and progressive; but the course of Apologetics must always be more or less erratic, because it has to do with the varying relations of the two spheres of human life and revelation, and has to adjust itself afresh at each change in these relations. The special form, too, which Apologetics has for the most part assumed—a defence or vindication of Christianity—has made it more changeable. It has been compelled to change its front from time to time to meet the altered form of attack.

In one aspect the general science of Apologetics and the number of treatises upon the subject mark the imperfection of dogmatics and the neglect of its study; for with the advance of theology, general Apologetics tends to disappear, and in its stead comes an apologetic introduction, justifying each of the fundamental doctrines of dogmatics; or, in other words, with the advance of theology, Apologetics gives place to speculative theology, which shows the various relations in which each particular dogma stands to all other dogmas, whether theological or other.

Apologetics, as the justification and vindication of Christian theology, has to deal with two great questions; (1), Can man know God? and (2), Does man know God? Is a theology possible? and if so, is Christianity true and the theology which it gives, the true theology?

Under the first question are discussed all the various topics concerning man and his natural capacities for a knowledge of God and the things of God, the natural craving for a knowledge of the supernatural, the intimations more or less obscure of a higher than merely natural life.

Under this head comes every discussion concerning the capacities in man for the knowledge of God, and concerning the actual amount of knowledge which man has had of God apart from revelation The apologist endeavours to show from psychology, metaphysics, and other sources of knowledge capable of aiding him in his research, that man is a religious as well as an intelligent being, that theology on its formal side has a real basis in the human mind, and that whenever the objects of theological science are presented to the mind, they may be assimilated by these faculties. Many delicate questions arise here—the whole question of anthropomorphism, for example. It is argued that because our knowledge of God and of divine things must pass through and be assimilated by human faculties, it must necessarily be as much human as divine, and in this way the divine is more or less transformed into the human, and becomes anthropomorphic. The doctrine of the personality of God is often instanced as a notable example of anthropomorphism in theology. Apologetics vindicates theology from this charge by ascertaining from psychology whether the human factor tends to vitiate all human knowledge, and what is the precise influence of the formal element, or that element which the mind supplies, upon the material of human knowledge, and in this way tries to show that theology, while it is knowledge which passes through the mind of man, is not necessarily anthropomorphic.

But man has not merely capacity to know God and divine things, he actually does know something about these things; they have actually become objects or material of human knowledge. This brings us within the range of natural theology, which is just the sum of the knowledge which man, apart from revelation, has about God. Natural theology may be studied and its results presented in two different ways. Paley, Butler, and Chalmers, for example, have endeavoured, from an analysis of the human mind and character, to describe the kind and amount of knowledge which man has of the being and attributes of God, of the moral government of the world, of the immortality of the soul, and of the future state of reward and punishment. This method of inquiry is open to the objection, that it is very difficult to separate between what man has acquired by revelation and what he possesses without revelation, if the mind analysed be one already impregnated by Christianity. Hence it is well to supplement and correct the knowledge obtained in this way by an historical survey of what man has actually known and taught concerning God and divine things in the great natural religions which have existed, and still exist. Natural theology, in this sense of the word, is the result of a comparative history of religions, and contains a methodical summary of all the various religious ideas which have been evolved in the religious experience of mankind. The historical method is useful to correct the analytic, and the analytic gives order and method to the historical. This historical method is as yet in its infancy, but few historical sciences are engaging more attention than the new science of religions, and its growth cannot fail to have a considerable effect upon the future course of Apologetics. It looks upon all religions as more or less related to each other, and seeks to find the real course of the development of religious ideas, and natural theology becomes in this way the orderly statement of the various religious truths which each natural religion has contributed to the sum of the religious knowledge of the race; and every great religion is conceived to leave behind it a residuum which is its contribution to natural theology. But while Christian Apologetics thankfully acknowledges the contributions made by natural theology to our knowledge of God and His relations to us, it is always much more disposed to regard them as of indirect than of direct value. They are of more use in showing that man has capacities whereby he may arrive at a knowledge of theology, that he has aspirations which can only be satisfied by theology, than in furnishing actual and reliable information about God and His relations to us. They serve to prove that man is able to learn truths about God if the true materials of information were presented to him, or, in other words, in Apologetics natural theology has a *formal* rather than a *material* value.

2. *Does* man know God? Is the Christian theology *true?* Christianity is founded on certain presuppositions, can these be vindicated? The most important of these is the presupposition of the possibility and actual existence of a divine revelation, or a superhuman source of knowledge of God and His relations to us, and the most important task of Apologetics is to vindicate the possibility and existence of the Christian revelation. It is because it possesses this revelation that Christianity claims for itself a position altogether different from other religions, and hence the possibility and fact of a revelation have always been attacked by antichristian speculation. The precise point of attack has varied continually, but in the present day the chief objection to a revelation, in the Christian sense of the word, is based upon the fact, that an historical study of religions shows that every religion has professed to be founded upon a divine revelation, and claims for itself the same supernatural sanction which the Christian theologian declares to be the exclusive possession of Christianity. To this the apologist answers, that the fact that numberless false claims have been made is not a sufficient ground for summarily rejecting the claim of Christianity, which has to be judged upon its own merits, he then proceeds to point out, that just as Christianity professes to be different in kind, and not in degree only, from other religions, so the Christian revelation is one generically distinct, even in the external form which it assumes, from all other supposed revelations. While most pretended revelations claim to be the promulgation of divine truths, the Christian revelation is the manifestation of a divine life in the world, the intrusion into human history of a divine force, which, flowing on from generation to generation, at last condenses itself in the presence and person of the Lord Jesus Christ, the perfect revelation of God. It is sufficient to disprove the claims of any pretended revelation, to show that the truths it teaches might have been reached without any special and supernatural communication, but before the Christian revelation can be discredited, it must be shown that the divine life in the world, which reached its most perfect development in Jesus Christ, is not specifically different from the life of man,—that Jesus Christ was a mere man, not different in kind from other men. The great difference, then, between the Christian and other so-called revelations is, that it ends and is summed up in the person and work of Christ, and so is a consistent whole; while they do not end in a life like that of Christ, and lacking this to bind them together into a unity, are merely a more or less disjointed series of statements—not even the record of supernatural manifestation, still less that manifestation itself.

The first thing, therefore, that Apologetics has to do, in this its second and most important division, is to describe the character and meaning of revelation, discuss the possibility of the thing from all sides,—logical, metaphysical, and moral,—show that it can be known by man, and prove its necessity for the religious life of mankind.

The apologist must describe carefully the character and course of this divine life which has entered into history for the purpose of redemption, explaining it both on its objective side of manifestation and on its subjective side of inspiration. He has to show how it appears in miracle, and is apprehended by the mind specially fitted for this apprehension; and he points out that such a conception as that of the Christian revelation, such an idea as that of the continuous manifestation of God in the world, does not belong to any pagan religion or theology.

This manifestation of God, which is *miracle* in the proper sense of the word, and the special apprehension of it, which is *inspiration* in the more limited meaning, have happened, and have been recorded, and the apologist has therefore as much to do with the record of the revelation as with the revelation itself; and hence, after the preliminary investigations into the nature of revelation and its twin sides, manifestation and inspiration, comes an investigation of the sources from which we derive our knowledge of this revelation. The whole question of the Canon of Scripture must, therefore, be looked into and settled, the character, historical or other, the authenticity, and the credibility of the various books of the Old and New Testaments must be discussed, and whatever assistance in this task can be obtained from contemporary history must be taken advantage of. Connected with this inquiry, several difficult and delicate questions arise, about the relation between inspiration and perfect historical accuracy in every point, the questions of plenary and non-plenary inspiration, whether plenary inspiration requires perfect accuracy in minute details of history, whether it demands scientific accuracy of description, &c., none of which can be entered into here.

From the records of the revelation the apologist turns to the revelation itself. We have already distinguished the Christian from other pretended revelations, by saying that it is a revelation which has Christ, while other revelations have not Christ, and in our day the whole attack and defence have centred round the doctrine of our Lord Jesus Christ. The opponents of Christianity, feeling that the core of the system which they are attacking is the supernatural life of Christ, set themselves to attack that conception, and they do so by attempting to show, either that there was no such life as that of the Jesus Christ of the Gospels, or else that it was not supernatural—there was no such man as Jesus Christ, or if there was, He did not differ wholly from other men. The first mode of attack is that adopted by D. F. Strauss, and the second that of Ernest Renan and others. Strauss's position is somewhat of this kind: the historical and the supernatural are so inextricably mixed the one with the other that they cannot be separated, but the supernatural is on general grounds impossible, and therefore the historical is impossible also. He accordingly sets himself to show that the Gospels are not credible as history, and he resolves the Gospel life of Jesus of Nazareth into a poem, *the* poem of the Jewish nation and, indeed, of the human race. This is the basis of his celebrated mythical theory. Renan, on the other hand, cannot admit the thorough-going destructive criticism of Strauss. There must have been such a life as that of Jesus of Nazareth, although the account we have of it is a highly coloured picture. He admits the life, but denies the supernatural element in it, and explains it by saying that it was created round about the historical life by the enthusiasm of the early disciples; in short, he separates the historical from the supernatural, and while he admits the one he rejects the other. The apologist answers such attacks as these very much by pitting the one antagonist against the other. He asserts with Strauss that the historical and the supernatural are inseparably blended, and he takes from Renan the general idea, that, according to all laws of historical research, the Gospel narratives are truly historical. In this way he tries to show, epecially against Strauss, that there is no time, even if the Gospel narratives are brought down to the latest possible date, for the growth of the poem into which he resolves the life of Christ; and specially against Renan, he points out that if the historical be granted even only to the length to which Renan goes, it is so blended with the supernatural that the miraculous cannot be separated from it. This defence of the historical and supernatural character of the life of Christ, and of Christianity because it has the life of Christ as its centre and essence, widens into a general description of His position and character as these are shown in the Gospels. Apologetics tries to show that Jesus Christ is, as it were, the sum of all the previous revelation of God contained in the Old Testament. It traces the broadening down of revelation, in order to show how perfectly the life of Christ came as the conclusion and perfection of all that went before, and that it fulfilled both Jewish prophecy and pagan aspiration. It attempts to show that Jesus is not merely the actual and perfect fulfilment of every previous theophany, but that He is and must be the Perfect Revelation of God. It does this in various ways: by describing the character of Jesus, unique intellectually and unique morally; by describing the teaching of Jesus, and its marvellous similarity and yet dissimilarity with the doctrines of Jewish revelation and Gentile philosophy; by describing the actual work of Jesus, by showing that in Him miracle or manifestation and prophecy or inspiration came to their culmination; and by pointing to the mission of the Holy Ghost and the victorious spread of Christianity throughout the world. Such is a short outline of Apologetics and the field of investigation which it occupies: we shall now proceed to give a short summary of the history of the study.

The historical course of Apologetics may be divided into five great periods:—

The first period, extending from the beginning of the 2d century to the end of the 5th, may be subdivided into two: (1.) From the beginning of the 2d to the beginning of the 3d century; and, (2.) From the beginning of the 3d to the end of the 5th. The first of these is marked by the writings of Justin Martyr, Athenagoras, Tertullian, and Minucius Felix. The two Apologies of Justin were directed, the one against the Jews, and the other against the pagans. In both he follows the same method of justifying the Christian religion from the charges which were then commonly brought against it, and then attacking his opponents severely. All the apologists of this age follow the same course, and we see from their writings that the common attacks upon Christianity were charges of atheism, immorality practised at their Agapæ, the Thyestæan banquets, and the like. The second of these periods is marked by the writings of Origen, Arnobius, Lactantius, Eusebius, Cyril of Alexandria, Augustine. These names show the course that Apologetics was taking. It had raised itself far above the position of a mere defence against vulgar prejudice and polished sarcasm; and Origen, when he opposed Celsus, was giving a philosophical defence against a philosophical attack upon the principles which lay at the basis of Christianity (*cf.* Pressensé's *Hist. de l'Eglise*, 2^{me} série, ii. pp. 104–142). With Arnobius begins the study of Christian evidences; and he tries to show that Christianity is not merely probable, but certainly true; while Lactantius proceeds upon the idea that, if Christianity be only clearly understood, it must be accepted, that its best defence is a clear statement of the principles on which it rests. Eusebius, on the other hand, is the first of the learned apologists, and proves the truth of Christianity by an elaborate comparison between it and all that was best in the various systems which went before it, and so far prepared the way for it. Cyril opposes Julian as Origen had opposed Celsus. Julian had directed his attack against the claims of Christianity to universal dominion; he admitted that it was one form, but denied that it was the only form of truth, and Cyril's defence is interesting, inasmuch as it is the first answer of the Christian apologist to the objections of the pure Theist. Augustine's great work, the *De Civitate Dei*, is apologetic in so far as it endeavours to show that Christianity and the church are the only ark of safety in presence of the dissolution of the empire and human society which then seemed imminent. In this second division of the first period, Christianity has become triumphant, and the duty of Apologetics has not been to defend it from the coarse attacks of passion and prejudice, but to give a philosophical answer to philosophical objections, and then to show how Christianity adapts itself to the intellectual, moral, and political requirements of men and nations.

The second period dates from the 6th to the middle of the 15th century. It is that period in the history of theology in which the church attempted to rule thoroughly the intellectual life of mankind; when the *ecclesia salvans* had become an *ecclesia docens*, and the *ecclesiæ patres* had given place to the *ecclesiæ scholastici*. It embraces the growth, life, and decline of scholasticism. In this period there are no direct attacks upon Christianity, and so no direct defences of it; but still Apologetics, although for the most part absorbed into the sum of Christian doctrine, and recognisable only in the attempt to assimilate philosophy and theology, is to some extent visible in the jealous defence of particular doctrines against the attacks of Nominalism, and reveals itself more prominently in the attacks made by Christian theologians upon the Jewish and the Mahometan religions. Such works as Abelard's *Dialogus inter Philosophum Judæum et Christianum*, and Thomas of Aquin's *De Veritate Catholicæ Fidei contra Gentiles*, are the best examples of the Apologetics of this second period.

The third period extends from the middle of the 15th to the middle of the 17th century. This was the age of the Renaissance and of the Reformation, an age of inquiry, doubt, and change. Along with the Reformation, keeping with it as long as it was merely destructive, and abandoning it as soon as it became constructive, was a spirit or tendency, best described by the term Humanism. The Humanists were men who were thoroughly imbued with the spirit of the old classical poets of Greece and Rome, and had imbibed many of the old pagan ideas with reference to Christianity. Humanism, which was at first learning revived, contained within it two tendencies which afterwards showed themselves hostile to Christianity: the first was embodied in literary criticism, and mainly displayed the antagonism between literature and dogma, while the other took the form of a pantheist philosophy founded on the divinity of Nature. The most notable of the apologetical works of this period are those of Marcilius Ficinus (*De Religione Christiana*), Eugubinus Steuchus (*De Perenni Philosophia*, from which Bishop Berkeley has borrowed largely in his *Siris*), and Johannes Ludovicus Vives (*De Veritate Religionis Christianæ*).

The fourth period extends from the middle of the 17th to the end of the 18th century. During this period, antichristian speculation assumes distinct forms, and Apologetics undergoes corresponding changes. The period has three divisions, which are to some extent successive, but are best distinguished by the form of unbelief then prevalent—the English deism, the French scepticism, and the German rationalism. The English deism, which began with Lord Herbert of Cherbury and Hobbes, and ended with Hume, called forth an innumerable number of replies from Christian theologians, and the special nature of the attack then made upon Christianity still gives their special form to English works upon Apologetics. The general tone of English Deists was that there was no warrant for the mysteries in Christianity, for its superior morality, for its historical position and influence, and so English Apologetics has been mainly concerned with the doctrine of the *evidences* of Christianity; and the general line of argument commonly taken has been, that there is as much evidence for Christianity as for some ordinary set of opinions generally admitted. Thus Bishop Berkeley's *Alciphron, or the Minute Philosopher*, among other things, aims at establishing the existence of God by showing that the evidence is as strong as the evidence for the existence of our fellow-men; Locke's *Reasonableness of Christianity* shows that the Christian theology attacked is in all points able to be satisfactorily explained in accordance with human reason, if the same methods of investigation and adjustment be allowed, which are usually permitted when testing the reasonableness of any common statement or opinion; and in the *Analogy* of Bishop Butler the whole argument rests upon the basis:—the Deists make certain statements about religion; if these be true they contain as many difficulties as are to be found in Christianity, and difficulties of the same kind, therefore Christianity is as reasonable, at least, as deism or any system of mere natural theology. In the French scepticism, the principal charge made against Christianity was that it rested on imposture and was maintained by trickery. An attack of this kind is answered, not so much by special defence, as by a silent appeal to historical testimony and to the character of man, and it is not to be wondered at if the French Church has not produced any very valuable apologetic writings defending Christianity from the special attacks of this school. The German rationalism began with Lessing's publication of the *Wolfenbüttel Fragments*, (extracts from a work by Reimarus, a schoolmaster at Hamburg), and ended with Kant. In its earlier form it was little else than an importation of the ideas of the English Deists, but latterly it assumed a special form by upholding the authority of the *individual* reason. The replies to the ordinary arguments of the English Deists were very numerons (*cf.* Lechler's *Geschichte des Engl. Deismus*), but do not deserve further notice. The authority of the individual reason may be vindicated, either in the province of criticism or in that of dogma; the one effort gave rise to the critical rationalism of Eichhorn and Paulus, and the other to the dogmatic rationalism of Wegscheider. The critical rationalism of Eichhorn and his school has been gradually answered by the advance of criticism itself, which shows a progressive tendency towards higher and more spiritual ideas, if not to a recognition of the inspired authority of Scripture. The dogmatic rationalism of Wegscheider has fallen before the new impulse given to dogmatic theology by Schleiermacher and Neander.

At the present time Apologetics seems to be in a transition state. Since the time of Kant the historical method of investigation has become all powerful in almost every department of human knowledge, and at the present the chief attacks made upon the supernatural and unique character of the Christian religion and theology are based upon the comparative science of religions. It is held that the Christian religion is the highest and most perfect development to which the religious spirit of man has yet reached, but that it simply differs in degree of development from any other religion. It is said that the Christian theology contains, like all other theologies, a great many elements of truth, but that it is simply a natural religion like any other. This mode of attack has not yet been thoroughly faced by Christian apologists, but it must be the work of the Apologetics of the future to vindicate the supernatural character of Christianity by arguments which are based upon historical investigation and comparison of the different religions of mankind. For the general outline of Apologetics see *Hagenbach's Encyclopaedie*, and Heubner's article on "Apologetik" in Ersch and Gruber's *Allg. Encycl.* For natural theology *cf.* Paley's *Natural Theology*, Chalmers's *Natural Theology*, Bishop Butler's *Analogy*, and Hegel's *Philosophie der Religion.* The *Bampton Lectures* discuss many of the particular problems of Apologetics, and A. S. Farrar's *Critical History of Free Thought* (the *Bampton Lectures* for 1862) gives a very good history of Apologetics. (T. M. L.)

APOLOGUE. This word was originally, in Greek and Latin (ἀπόλογος, *apologus*), employed loosely for any kind of story, but has now become synonymous with *moral fable.* See FABLE.

APOPHTHEGM (ἀπόφθεγμα, from φθέγγομαι, to speak), a short, sententious, instructive utterance, as "Knowledge is power," "True greatness always wills." Of such sayings Plutarch made a famous collection in his *Apophthegmata Laconica*, and the biblical book of Proverbs abounds with examples. Every apophthegm is a possible proverb; to pass into a proverb it requires age and currency.

APOPLEXY (ἀπό, πλήσσω, to strike down, to stun), a term in medicine which, though now also employed with other significations, is commonly understood to apply to a fit of sudden insensibility occurring in connection with some diseased condition of the brain.

Apoplectic attacks vary both as regards their intensity and their attendant phenomena, but well-marked cases present the following symptoms: The person attacked becomes, more or less suddenly, deprived of consciousness and all power of voluntary motion. He lies as if in a deep sleep, with a flushed face, a slow pulse, stertorous breathing, accompanied with puffing of the cheeks during expiration, and with the pupils of the eyes insensible to light, and contracted or unequal. This state in many respects resembles the coma of narcotic poisoning, and is unfortunately too often mistaken by unskilled persons for alcoholic intoxication. The symptoms and history of the case, however, are usually sufficient to enable a medical man to form a correct diagnosis. In this condition of insensibility death may occur within a few hours, or there may be a gradual return to consciousness, in which case it is frequently observed that some trace of the attack remains in the form of paralysis of one side of the body, while occasionally there may also be noticed some impairment of the mental powers, pointing to damage done to the brain. (See PARALYSIS.)

Although thus generally sudden in its onset, it is seldom that an attack of apoplexy occurs without some previous warning. Persistent headache of a dull throbbing character, a sense of fulness in the head, vomiting, giddiness, noises in the ears, slight confusion of mind, and numbness of a limb or of one side of the body, are among the more important premonitory symptoms; and these may exist for a variable length of time before the fit comes on. . Such symptoms, more particularly the association of them, when occurring in a person at or beyond middle life are to be regarded with anxiety, as indicating danger of an apoplectic seizure. Various morbid conditions of the brain are capable of giving rise to fits of apoplexy. Hence different forms of apoplexy have been described by medical writers, such as the *congestive*, where the cause appeared to lie in an engorgement of the blood-vessels of the brain and its membranes; and the *serous*, where sudden effusion of fluid into the ventricles or substance of the brain seemed to have brought on a fit. But by far the most frequent and important occasion of apoplexy is hæmorrhage into the brain by the rupture of blood-vessels. Indeed, by many modern writers the term apoplexy is applied only to cases of cerebral hæmorrhage. The blood-vessels of the brain, like those in other parts of the body, are liable to undergo degenerative changes after middle life. These changes affect the minute capillaries, as well as the larger vessels, rendering their texture fragile, and at the same time impairing their function in carrying on the healthy nutrition of the brain. Hence, in the immediate vicinity of the diseased blood-vessels, the substance of the brain itself undergoes degeneration, and becomes softened. The capillary vessels having thus lost the natural support of the surrounding tissues, and being themselves weakened by disease affecting their walls, are liable to give way, and blood escapes into the brain. The hæmorrhage may be slight in amount and in parts of the brain where its presence gives rise to little disturbance; but where a large blood-vessel has ruptured, and more especially where the blood has been extravasated in or around the important structures at the base of the brain, the result is a fit of apoplexy as above described, and death not unfrequently follows within a short period. In favourable cases where a certain measure of recovery takes place, the effused blood undergoes gradual absorption, or becomes enveloped in a sort of capsule formed by the surrounding brain substance, and ceases to cause further disturbance. But even in such cases some degree of paralysis remains at least for a time. Moreover, the nutrition of the brain is so impaired as to render probable a recurrence of the hæmorrhage, and thus the danger to life, as is well known, increases with each successive attack.

From what has been above stated, it will be observed that apoplexy is to be regarded as a disease of advanced life. Hippocrates states that it is of most frequent occurrence between the ages of forty and sixty, and all medical experience confirms the truth of this observation. Nevertheless it may occur at any period of life, and cases are not wanting of true apoplexy in very young children. It is said to be more common in men than in women, but this is denied by many observers, and appears at least doubtful. What has from early times been described as the apoplectic habit of body, consisting in a stout build, a short neck, and florid complexion, is now generally discredited, it being admitted that apoplexy occurs about as frequently in thin and spare persons who present no such peculiarity of conformation. A hereditary tendency is acknowledged as one of the predisposing causes of apoplexy, as are also diseases of the heart and kidneys. With respect to the exciting causes of a fit of apoplexy, it may be stated generally, that whatever tends directly or indirectly to increase the tension within the cerebral blood-vessels may bring on an attack. Hence, such causes as immoderate eating or drinking, severe exertion of body or mind, violent emotions, much stooping, overheated rooms, exposure of the head to the sun, sudden shocks to the body, and the sudden suppression of evacuations, such as the menstrual discharge, may precipitate the fit.

A knowledge of these facts is of the utmost importance in the treatment of apoplexy, as obviously much can be done in the way of warding off fits where they appear to threaten, and of preventing a recurrence in cases where there have been previous attacks. With respect, further, to the treatment of apoplexy, it must be admitted that little can be done during the state of unconsciousness. The practice of blood-letting, once so common in this disease, is now almost entirely abandoned, although there are physicians who still recommend its employment, especially where the attack occurs in stout, plethoric persons. Where death appears to threaten from failure of the heart's action, warm applications to the surface of the body, and, should there exist any power of swallowing, the cautious administration of stimulants, are to be recommended. The case must be anxiously watched, and symptoms treated as they arise. When consciousness returns, the utmost care and quietness are to be observed to prevent the occurrence of inflammatory action, so apt to be developed, as a result of hæmorrhage into the brain.

The term *Apoplexy* is also applied in modern medical nomenclature to an extravasation of blood within the substance of any organ in the body, as for instance, *pulmonary apoplexy*, where blood has been effused into the tissues of the lung. This use of the word, however, is altogether objectionable. (J. O. A.)

APOSTASY (ἀπόστασις), denoting in classic Greek (Herodotus, Thucydides) a defection or revolt from a military commander, is generally employed to describe a complete renunciation of the Christian faith. In the first centuries of the Christian era, apostasy was most commonly induced by persecution, and was indicated by some outward act, such as offering incense to a heathen deity or blaspheming the name of Christ. The Emperor Julian, who is known in history as The Apostate, abandoned Christianity for paganism soon after assuming the purple, though it is questionable whether he had ever really embraced the Christian faith. In the Roman Catholic Church the word apostasy is also applied to the renunciation of monastic vows (*apostasis a monachatu*), and to the abandonment of the clerical profession for the life of the world (*apostasis a clericatu*). Of the latter class a celebrated instance was Talleyrand.

APOSTLE (Greek ἀπόστολος, one who is sent forth) is in the New Testament, and in Christian literature, a technical term—apostle of Jesus Christ. It appears from Mat. x., Mark vi., that the name was originally applied to the twelve disciples in reference to the special mission to preach and work miracles in Israel, on which our Lord sent them forth during His ministry on earth. Luke alone of the evangelists uses the word in a technical sense out of connection with this mission. After the resurrection the eleven, who again become twelve by the election of Matthias in the room of Judas, are regularly designated apostles. The precise prerogative of the apostolate is not defined. The apostles themselves feel that their distinguishing qualification is their personal fellowship with Jesus through all his ministry, their main office to witness to the resurrection (Acts i.) They do not act hierarchically (Acts xv.), and decline to be withdrawn by administrative cares from the ministry of the word and prayer (Acts vi.) Their central and unique position is, in truth, too universally allowed to call for precise definition. Nevertheless, the question, What is an apostle? soon became a burning one in the church. How far a lax use of the name extended it in a lower sense to others than the twelve is a question of little importance (Acts xiv. 4, 14; Rom. xvi. 7?); but when Paul claims to be an apostle, and especially the apostle of the Gentiles, his claim is to preach the gospel with the authority of one who is equal to the twelve, and responsible only to Christ. He is not an apostle (sent) from man or through man, he received his gospel not from man, but by revelation of Jesus Christ, whom he has seen as well as the twelve, and his apostleship is confirmed by miracles, and sealed by his success in founding churches (Gal. i.; 1 Cor. ix. 1, *ff.*, xv. 8, *ff.*; 2 Cor. xii. 12). The last mark is acknowledged by the twelve as decisive (Gal. ii.) Nevertheless, Paul's Judaising opponents continue to deny his apostolic authority (2 Cor.) The exact relation of parties which this controversy presupposes is a leading subject of debate in recent criticism. Here we have only to observe that the notion of apostleship now appears as that of evangelical authority derived direct from Christ and irresponsible to man. This authority is not properly administrative, though it is sometimes brought to bear on administrative questions. The apostleship is not a church office, but a *charisma*, similar to prophecy, but superior (1 Cor. xii. 28), and having its fit exercise in the founding of churches by direct testimony to Christ. Thus, the church is said to be built on the foundation of the apostles and prophets (Eph. ii. 20), not because they are the basis of the hierarchy, but because their activity lay at the root of the growth of the Christian society.

Very early, however, the notion that the apostleship is essentially an hierarchical office found entrance in the church. Irenæus and Tertullian regard the episcopate as a continuation of the apostolic functions, especially connecting this position with the idea of an authoritative tradition of apostolic doctrine. This view is further developed by Cyprian, and so becomes the foundation of the episcopal system of the Catholic Church, which regards all church power, especially disciplinary power, as entrusted by Christ to the apostles, from whom the bishops derive their authority by apostolic succession. This notion of the apostleship is based on an uncritical interpretation of Mat. xvi. 18, *f.*; John xx. 21, *ff.* The later Papal system goes still farther, so that Bellarmine and others teach that Peter alone was ordained bishop by our Lord, and all the other apostles by Peter.

Of the history of the apostles we have almost no authentic knowledge beyond what is stated in the New Testament. The names of the twelve are given in Mat. x., Mark iii., Luke vi., Acts i. With regard to these lists it is to be observed that the Lebbeus of Matthew is identical with the Thaddeus of Mark, and that both these titles must probably be viewed as surnames of the Judas whom Luke calls either son or brother of James (Ἰούδας Ἰακώβου). Bartholomew, too, is probably a patronymic of John's Nathanael. The history of the Acts tells little about any of the apostles except Peter and Paul; and precisely with regard to these names the statements of the book have been made subject of critical controversy. (See ACTS OF APOSTLES.) The later history of Peter has an artificial interest from the importance attached by the Roman Church to his episcopate at Rome, and the history of John is involved with the question of the genuineness of the Johannine writings. Pretty early tradition associates Philip with Phrygia, Thomas with Parthia, Andrew with Scythia, Bartholomew with India. Later traditions make the apostles divide the various countries between them by lot, and assert (against earlier tradition) that all except John were martyrs. The form ultimately assumed by the legendary history of the apostles may be seen in the Latin work which bears the name of Abdias, in Fabricii *Codex Apocryphus N. T.* (W. R. S.)

APOSTLES' CREED, one of the earliest and most generally accepted symbols of the Christian faith, so called from the fact that its authorship was attributed to the twelve apostles. See CREEDS.

APOSTOLIC or APOSTOLICAL, a name assumed at different times by various churches and sects on the ground of some special connection with the apostles. It was applied in the first centuries of the Christian era to certain churches that claimed to be founded by individual apostles and especially to Rome, Alexandria, Antioch, and Jerusalem. The title was also borne by the bishops of these churches as the successors of the apostles.

APOSTOLIC CANONS. These are rules to regulate Christian life and the discipline and government of the Christian church, which, it is supposed, have come down to us from the apostles. Several collections of rules claiming apostolic origin and authority have descended to us, and of these the two most important are the canons of the Apostolic Synod of Antioch and the collection now described, which bears the title *Canones qui dicuntur Apostolorum* (Κάνονες τῶν ἁγίων καὶ πανσέπτων Ἀποστόλων). The Apostolic Canons consist of a series of eighty-five rules, of which the first fifty are held to be the most important. These rules contain a tolerably complete directory for the guidance of the clergy in their daily life and usual round of duties. It is somewhat remarkable that the life of the ordinary layman is for the most part left unnoticed; four Canons only deal with the laity, the rest of them speak of the clerical life and that alone. The authority of these Canons varies in the Eastern and in the Western Church. The Eastern Church, following the guidance of John of Damascus, has received as authoritative the whole eighty-five, and makes them of equal authority with the Epistles of St Paul, *i.e.*, acknowledges that they possess plenary authority. The Western Church has always hesitated to receive more than the first fifty, and has received them more on the recommendations of such distinguished popes as John II., Stephen III., and Urban II., than because of their own intrinsic value; and it was only when they were incorporated in the decretals that they obtained a real authority.

According to some authors, they are first quoted in the Acts of the Synod of Constantinople, in 394 A.D., and in those of the Synods of Ephesus and Chalcedon, in 431 and 451 A.D. Some have said that they are mentioned in the *Decretum de libris recipiendis*, issued by Pope Gelasius (492–496 A.D.), while others have pointed out that the name occurs in those MSS. only which have the decree of Hormisdas (514–523). Perhaps the soundest decision is, that the collection is not mentioned in history until about the end of the 5th century; it is undoubted that it was in existence before the beginning of the 6th, for the Latin translation of the first fifty Canons dates from the year 500 A.D.

A great deal of criticism has been expended upon this collection of ecclesiastical rules. It was once commonly received that the Apostolic Canons were the authoritative decisions upon church life and discipline enacted by the first council of Jerusalem, whose proceedings are recorded in the Acts of the Apostles. Since the 16th century juster views have prevailed. The Canons themselves contain statements which are almost identical with many passages in Holy Scripture, and with many of the decisions of the earlier synods and councils, more especially those of Antioch, Nicæa, and Laodicea; it is also evident that much that they include is but the description of the tradition and practice of the church then existing. The following questions then arise:—(1.) Are the passages which resemble what we find in Scripture taken therefrom, or from contemporary independent oral tradition? and, (2.) Have the rules, which are almost literally identical with the decisions of the earlier councils suggested and formed the basis of these decisions, or are they themselves suggested by the decisions of the councils? When we bear in mind the fact that the historical existence of the Holy Scriptures and of the councils is well assured, and that we have no trustworthy evidence of the existence of this collection until the end of the 5th century, the conclusion forces itself upon us that the Apostolic Canons must be based upon the Acts of the earlier councils, not these upon the Canons. Critics have differed about the precise date of the compilation. The Magdeburg Centuriators think that it was some time in the 3d century; while Dalleus is of opinion that it was not until the middle of the 5th century; others place it between these dates. Perhaps the best conclusion we can come to is that the so-called Apostolic Canons are a compilation of practical rules for the guidance of the clergy made from holy Scripture, the decisions of the earlier councils, and existing ecclesiastical usage, by an unknown ecclesiastic belonging to the Syrian Church, who lived in the 4th or 5th century.

See Dalleus, *De Pseudepigraphis Apostolorum;* Franciscus Turrianus, *Pro Canonibus Apostolorum*, who asserts their apostolic origin; Bickrell, *Geschichte des Kirchenrechts.* (T. M. L.)

APOSTOLIC CONSTITUTIONS are a collection of eight books of directions and prescriptions on ecclesiastical and theological matters, for which apostolic origin and authority have frequently been claimed. It is probable that the first six books form the earliest part of the whole, and it is certain that they were known and quoted as a separate treatise, under the title *τὰ διδασκαλία τῶν Αποστόλων;* the seventh book was also separately known, and in many parts bears a curious resemblance to the Epistle of St Barnabas; the eighth is also an independent work, and is more legislative than the others. Historians have differed as to the first mention of the collection. Some, without much warrant, think that the work is mentioned by Eusebius and Athanasius, under the title *διδαχή* or *διδαχαὶ τῶν Ἀποστόλων;* while others, with more justice, think that it is not alluded to by any well-known writer until Epiphanius (d. 402), quotes it under the name *διάταξις τῶν Ἀποστόλων διδασκαλία.* It was well known in the 6th and 7th centuries. The book as a whole has never been received as an authority in the church, and its influence has been greater in the East than in the West. The principal defenders of its apostolic origin and authority have been such English Episcopalian writers as Stapleton, Whiston, and Pearson.

See Whiston, *Primitive Christianity Revived*, 1711; Baur, *Ueber der Ursprung des Episcopats in der Christlichen Kirche.* (T. M. L.)

APOSTOLIC FATHERS. The apostolic fathers is a name given to certain writers in the earliest period of Christianity, who were believed to have been the disciples of the apostles, and to have had intercourse with them. Those generally included under the title are Clemens Romanus, Ignatius, Polycarp, Barnabas, and Hermas. Sometimes the name is extended to Papias of Hierapolis and the writer of the Epistle to Diognetus. A critical examination of the writings attributed to these men, and a critical sifting of the traditions which we have in relation to their history, bring out the circumstance that the name is unsuitable. Clemens Romanus, Barnabas, and Hermas were supposed to be persons mentioned in the New Testament; but criticism proves conclusively that this is a mistake in regard to Barnabas and Hermas, and possibly also in regard to Clemens. Polycarp, in all probability, and according to the best testimony, had intercourse with apostles, but it was in his early youth; and his Letter belongs to a period considerably later than that of the apostles. The Epistles of Ignatius, as well as the personal history of that martyr, are involved in great obscurity, and critics differ widely in regard to both. At the same time, the writings assigned by most critics to these men with some degree of certainty belong to a very early age of Christianity. They are among the earliest utterances of the Christian faith which have come down to us. All of them are of the nature of occasional productions, with perhaps the exception of the Pastor of Hermas. All of them breathe a spirit of deep piety. There is no attempt to formulate the truths of Christianity. There are very few references to the books of the New Testament, and very few quotations from them. All of them are written in Greek.

Clemens Romanus.—According to the statement of Irenæus, Clemens was the third bishop of the Roman Church; this seems to have been the tradition among the Greek writers. Tertullian, on the other hand, seems to have believed that he was the first bishop, and that he had been ordained by St Peter. Origen regarded him as the Clemens mentioned in the Epistle to the Philippians, and Clemens Alexandrinus often calls him an apostle. Nothing is known of his death. Very late fictions represented him as a martyr. Eusebius gives as the date of his episcopate from 93 to 101 A.D. The only writing which can in any satisfactory manner be ascribed to Clemens Romanus is an epistle from the Roman Church to the Corinthian. Quarrels had arisen in the Corinthian Church, most probably in the reign of Domitian, as to some of the office-bearers of the church. And the Roman Church sent a letter to the Corinthian Church urging it to pursue a peaceful course, to shun envy and jealousy, and to do all things in order. The writing of this letter is ascribed to Clemens by Dionysius, bishop of the Corinthian Church, in a letter to Soter, bishop of the Roman Church (166–174 A.D.), and all subsequent testimony is in favour of this authorship. The letter was found at the end of the Codex Alexandrinus. Its position there is in harmony with the circumstance noted by several of the ancients, that it was read in the churches on the Sunday. Clemens Alexandrinus also frequently quotes it as the work of the "Apostle Clemens," and the mode of quotation is such as to lead one to believe that he regarded it as Scripture, though some have maintained that he did not regard it as canonical. The genuineness of the epistle has been generally acknowledged. There is strong external testimony for it, and the internal evidence is at least not against it. But as Dionysius of Corinth (166 A.D.) is the first to mention Clemens as the author, there is a considerable interval between the date usually assigned to the epistle and the time of Dionysius, during which no one testifies to the epistle. Accordingly some critics have refused to recognise Clemens as the author, and they put the letter well on into the 2d century. The date usually assigned to the letter is 96 or 97 A.D. Some critics have assigned it to the year 68 A.D., but the arguments are not satisfactory. Some writers have taken exception to a few chapters in the letter which they regard as interpolations, but their opinions have not been generally adopted. The letter is defective. A whole leaf of the MS. is supposed to be wanting. The best edition of the epistle is by Professor Lightfoot (London and Cambridge, 1869). A whole literature arose around the name of Clemens in subsequent times. Of this literature the following portions have come down to us. 1. A second Epistle to the Corinthians, found along with the first in the Codex Alexandrinus. As far as one can judge from the writing itself, this work is rather a homily than a letter. In all probability its author belonged to Egypt. Various suppositions have been made as to its authorship, but none that commands the assent of a considerable number of critics. It seems to have been written towards the middle or end of the 2d century. 2. Two letters on Virginity, found in Syriac. There is no external testimony that Clemens was the author of these letters, and they breathe a spirit of asceticism and dislike of marriage different from that prevalent in the early times of Christianity. They also refer to customs of a later date. Notwithstanding this, some critics, especially some Roman Catholics, have keenly defended their genuineness. 3. The *Clementines*. These appear in two forms: the *Recognitions* in Latin, and the *Homilies* in Greek. They are a fiction. The writer attempts to represent the state of the church as it was during the period between the ascension of Christ and the entrance of St Paul on his work as an apostle. St Peter is accordingly the hero of the work, and his great enemy is Simon the magician. The doctrines of the book are peculiar, and are most nearly allied to those that are reckoned to be the doctrines of the Ebionites. The question arises, Did the writer wish to represent the doctrines as the merely temporary doctrines of that period of transition? Or did he regard the doctrines which he has put forth in the work as the only true doctrines, and the subsequent doctrines of the Catholic Church as perversions of the true and aberrations from them? Baur and the Tubingen school have regarded the book as giving a genuine picture of the state of the early church and of Ebionitic doctrine, and a great part of their theory of the origin and rise of Christianity is based upon it. They suppose that in Simon the magician the writer has attacked the apostle Paul. Many critics suppose that the work was written at a very early period, but that it received numerous additions. As the work now exists, it seems to belong to the end of the 2d or beginning of the 3d century. 4. The *Apostolical Constitutions*. This work is a series of regulations in regard to the management of the church, such as the functions and character of bishops, presbyters, and deacons (see last article). In all probability the work was the result of one addition after another made to an originally small nucleus. Some assign portions of it to the apostolic age. Whiston thought that it was inspired. Most probably the main portion of it belongs to the 3d century. There is no reason for connecting with it the name of Clemens, though this was done by ancient writers. We should add to this list that some ascribed the canonical Epistle of the Hebrews to Clemens Romanus.

Ignatius.—The information we get in regard to Ignatius up till the time of Eusebius is exceedingly scanty. He is mentioned in the epistle of Polycarp. Origen speaks of him in two passages, which, however, may possibly be interpolations. Eusebius in his *Chronicon*, at the year 70 or 71 A.D., states that he was appointed bishop of Antioch, and at the year 109 A.D., that he suffered martyrdom. He repeats the same statements in his *Ecclesiastical History*, introducing his account of the martyrdom with the words, "The story goes." After the time of Eusebius our information becomes much more precise and minute. The birthday of the martyr (*i.e.*, the day of his martyrdom) was celebrated in the church of Antioch. Speeches were delivered in his praise. Wonderful stories were told of him. He was one of the children whom Christ took up in his arms and blessed. He introduced antiphonal chants into the service of the church, because he had seen a vision of angels praising God in antiphonal hymns. The details of his martyrdom are given in a document devoted to the purpose. Of this document there are eight forms; but one is generally believed to be better than the rest. This one states that Trajan, in the ninth year of his reign, was in Antioch, that Ignatius was brought before him, and that the emperor condemned the bishop to be sent to Rome, and to be exposed to the wild beasts. The writers then describe the journey of Ignatius to Rome, mention various letters which he wrote on the way, and then narrate his exposure to the wild beasts, and how they saw him afterwards in a vision. The letters of Ignatius cause great difficulty to the critic. Eight of the letters ascribed to him are now universally rejected. There remain seven others. These seven appear in two Greek forms, a longer and a shorter. Latin translations of these forms are found, and they differ somewhat from the Greek. And of the seven letters three are found in Syriac, and the Syriac form is much shorter than the shortest of the Greek. Which are the original letters? Or have we the original letters at all? Unfortunately before the time of Eusebius there is no external testimony to these letters that can give us any clue to the true nature of the text. And the testimony of Eusebius is of little value. He states distinctly that there were seven letters. But the critics who maintain that the seven shorter Greek letters are largely interpolated, have no hesitation in agreeing to the opinion that these interpolations were made before the time of Eusebius. The shorter form unquestionably belongs to the 2d or 3d century, most probably to the 2d. A few critics have maintained that the longer form is the genuine. A very large number of critics regard the shorter Greek form as the original form, though almost all allow that there are some traces of interpolation even in the shorter epistles. Other critics maintain that the shorter Syriac forms are alone genuine, that they are not epitomes, but the original letters, and they appeal to the circumstance that all the references to the epistles up to the time of Eusebius belong exclusively to the three Syriac epistles. The question is embittered by a keen controversy in regard to Episcopacy, the Ignatian letters being supposed to afford strong evidence of the early institution of that form of church government. The longer text was first known to scholars. Usher discovered a Latin version of the shorter form, and Vossius the Greek original of this version. Tattam found the Syriac translation in an Egyptian monastery, and Cureton edited it in 1845. Cureton's services in connection with Ignatius deserve the highest praise; and his *Corpus Ignatianum* contains almost all the evidence that can be brought to bear on the subject. The contest in regard to Ignatius's writings has been keen in various periods of the church's history; and since the Syriac version appeared, the subject has been discussed by a host of writers, among whom may be mentioned Bunsen, Baur, Dusterdieck, Denziger, Hilgenfeld, Lipsius, Ritschl, Merx, Nirschl, Zahn, and Newman.

Polycarp was bishop of Smyrna. The principal part of the information we have in regard to him is derived from Irenæus, and may be accepted with confidence. Irenæus knew Polycarp personally, and remembered how Polycarp "related his intercourse with John and the rest who had seen the Lord." The apostles appointed Polycarp a bishop of the church in Smyrna, and he remained there a long time teaching the truth. In the time of Anicetus, Polycarp came to Rome, and showed a strong spirit of love and charity, which was fully reciprocated by the Roman bishop. They differed in regard to the celebration of the day of the passover, but their differences did not interfere with their love for each other. A special document describes the martyrdom of Polycarp. There are good reasons for doubting the minute accuracy of this work, but the main circumstances have the appearance of being true. A persecution had arisen in Smyrna against the Christians, and naturally a demand was made for Polycarp, the chief of the Christians. At first he fled, but finding that this was of no use, he allowed himself to be apprehended and brought back. He was led before the proconsul, and urged to swear by Cæsar and revile Christ. "Eighty and six years," said Polycarp, "have I served Him, and He has done me no ill, and how can I blaspheme my King who has saved me?" The multitude wished the Asiarch to expose the bishop to the lions, but the Asiarch refused, as the time for lions was over. So the people gathered wood and lighted a fire. And Polycarp was placed in the fire, and ultimately also stabbed. The date of his martyrdom has been matter of keen discussion. Eusebius fixed it at 166 A.D. The *Martyrium* mentions that it took place in the proconsulate of Statius Quadratus. Recently Waddington has tried to show that Quadratus was proconsul in 154–5, and Lipsius has based on this result the conclusion that Polycarp suffered martyrdom in 155. This date, however, is open to serious objections; and even Waddington's reasons for placing the proconsulate of Quadratus in 154–5, are not of a satisfactory nature. The only writing that can be now attributed to Polycarp is a letter to the Philippians. This letter is mentioned by Irenæus and by subsequent writers. Jerome mentions that it was read in the churches. It is a simple outpouring of ordinary Christian thought and feeling. The Tübingen School deny the genuineness of the epistle on internal evidence. Ritschl has tried to show that it is largely interpolated, and there are strong reasons for believing the thirteenth chapter an interpolation.

Barnabas.—There has come down to us a work called the *Epistle of Barnabas.* This work is unanimously ascribed to Barnabas, the companion of St Paul, by early Christian writers. Clemens Alexandrinus quotes the letter seven times, and speaks of it as the work of the apostle Barnabas. Origen, Eusebius, and Jerome mention it. The internal evidence is conclusive against its genuineness. The writer regards the Jews as entirely wrong in having practised the ceremonial law. He thinks that Moses never intended that the precepts of the law should be carried out literally. They were to be understood from the first spiritually. By this literal interpretation the Jews had forfeited all claim to the covenant The covenant belongs only to Christians who obey the law in spirit. The writer applies this principle to sacrifices, circumcision, and the Sabbath. It is difficult to imagine that Barnabas could have adopted such a mode of viewing the law. In all probability he adhered to some of the Jewish practices to the end of his days. Moreover, the writer commits such mistakes in relation to the Jewish ritual as no Jew would commit who had had practical experience of it. Some of the opinions in the letter, and the whole tone of thought indicate that the writer had strongly felt the influence of Alexandrian Judaistic speculation. Accordingly, some critics have maintained that it was written in Alexandria. There is no clue to a date; but there are various indications which have been differently interpreted by different critics. Some, as Weizsäcker, have assigned it to the reign of Vespasian; others, as Wieseler, to the reign of Domitian; but the great majority of critics assign it to the reign of Hadrian, some time between 119 and 126 A.D. The letter consists of two parts. The latter part is somewhat different in style and purport from the former, and, accordingly, doubts have been entertained as to its genuineness. But there is no good reason for doubt, and external testimony is in favour of it. The first five chapters were extant only in the Latin translation until Tischendorf discovered the entire Greek of the first part in the *Codex Sinaticus.* The letter is interesting, as throwing light upon a peculiar phase of theological speculation in the early church.

Hermas.—The *Pastor of Hermas* is one of the most interesting books of Christian antiquity. The name Hermas occurs several times in the work, and it was therefore natural for the ancients to suppose that this was the name of the author. The book at a very early period became widely known in the East, and was regarded as inspired. Irenæus, Clemens Alexandrinus, and Origen speak of it and quote it as Scripture, and Eusebius uses somewhat similar language in regard to it. Origen asserts his belief that the author was the Hermas mentioned in the Epistle to the Romans. The African Church held a different opinion in regard to it. Tertullian speaks slightingly of it; and the story became current that it was written by a Hermas, who was brother to Pius, bishop of Rome from 140 to 155 A.D It may be doubted whether the author has really given his name. The work is fictitious in form, and there is no good reason for supposing that he has introduced any real characters into it. There is no clear indication of a date; but various circumstances lead to the inference that it was written towards the end of the reign of Hadrian, or the beginning of the reign of Antoninus Pius. Internal evidence points strongly to Italy as the place in which it was written. The book is divided into three parts: visions, commandments, and similitudes. It was very popular with the ancient church, and deservedly so. It presents Christian truth in an attractive manner. Its tone is high and noble, and it breathes the spirit of the gospel of love. The name of Christ does not occur in it, and as the references to the Son of God are few, some have characterised the book as strongly Judaistic. Indeed, various heresies and heretical tendencies have been discovered in it by keen-eyed critics; but as Clemens Alexandrinus and Origen failed to see them, and as the great mass of the early church accepted it as eminently fitted to edify, we cannot but think that the critics are wrong. The *Pastor of Hermas* has come down to us in several Latin translations. Simonides was the first to give us any portion of it in Greek. He brought three leaves of a codex of it from Mount Athos, with a copy of a considerable portion of the rest. The remainder of the Athos MS. has not been discovered. Tischendorf found a large portion of the *Pastor of Hermas* in Greek at the end of the *Codex Sinaiticus.* The Greek is very nearly the same as the Greek of Simonides.

There are numerous editions of the works of the apostolic fathers, but special mention may be made of those of Cotelerius, Hefele, Dressel, Hilgenfeld, and Jacobson. Professor Lightfoot's *Clemens Romanus* is the first part of what promises to be the most satisfactory edition of the apostolic fathers. Translations of all the works mentioned in this article, including the writings attributed to Clemens, are given in Clark's Ante-Nicene Christian Library; and the works are discussed in Hilgenfeld's *Apostolische Väter*, 1853, and Donaldson's *Apostolical Fathers*, 1874. (J. D.)

APOSTOLICI, or APOSTOLIC BRETHREN, a name assumed by three different sects, which professed a close adherence to the doctrines and practice of the apostles. The earliest, known also as the *Apotactici*, were a branch of the Encratites, and came into existence in the 3d century. According to Epiphanius, their principles were communistic. The second sect of the name was formed in the district surrounding Cologne about the middle of the 12th century. Its members were zealous reformers, rejecting the authority of the Pope and the rites and ceremonies of the church. It is not certain that they absolutely rejected marriage, though they preferred celibacy. Founding on the authority of St Paul, the celibates took spiritual sisters, with whom they lived in concubinage. Bernard of Clairvaux wrote against the sect, and some of its most prominent members being brought before the archbishop of Cologne were condemned to the flames. The third sect of Apostolici in chronological order was founded by Gerhard Segarelli, a mechanic of Parma, towards the close of the 13th century. Segarelli, who had sought admission unsuccessfully to the Franciscan order, was much impressed, it is said, by a picture of the apostles which hung in the Franciscan chapel at Parma. Becoming convinced that the much-needed reform of the church could only be effected by a return to the apostolic practice, he sought to establish a community in which the life of the apostles should be imitated as closely as possible. By slow degrees he gathered a considerable number of followers, chiefly from the lower orders, who went about from place to place clad in white robes, with long beards, dishevelled hair, and bare heads, accompanied by women whom they called their spiritual sisters. Like the other two sects of the same name, they established a community of goods. Though their practice was thus peculiar, their doctrinal teaching did not for a considerable period seriously diverge from the orthodox standard. The arrest of their leader by the bishop of Parma (1280), and condemnatory decrees issued by Honorius IV. (1286) and Nicolas IV. (1290), changed their position into one of open hostility to the Church of Rome. Accepting the predictions of the Abbot Joachim of Flora, they looked for the downfall of the papacy, which they described as the Babylon of Scripture, and the establishment of a new and purer church upon its ruins. Segarelli was accused of heresy in 1294, but escaped for the time by recantation. In 1300, however, he was condemned as a relapsed heretic to the flames. His place was immediately taken by Dolcino of Novara, the natural son of a priest, under whom the sect became still larger and more formidable. He seems to have been a man of superior power to Segarelli in all respects, and especially to have had considerable talent as a military leader, having succeeded in carrying on a war for two years against Raynerius, bishop of Vercelli. In 1307 he was defeated, taken prisoner, and put to a cruel death at Vercelli. The name "Dolcinists," frequently applied to the sect, marks the extent of Dolcino's influence, as does also an allusion to him in Dante's *Inferno.* The sect of the Apostolici maintained its existence in spite of continual persecution until the beginning of the 15th century, when it became extinct or was merged in other sects. (See Muratori's "Historia Dulcini," in his *Rerum Italicarum Scriptores*, ix. § 425; Mosheim's *Geschichte des Apostelordens*, 1748; Neander's *Church History*, vol. viii.; Mariotti's *Fra Dolcino and his Times*, 1853; Milman's *Latin Christianity*, vol. vii.)

APOSTOLIUS, MICHAEL, a Greek theologian and rhetorician of the 15th century. When, in 1453, the Turks made themselves masters of his native city, Constantinople, he fled to Italy, and there obtained the protection of Cardinal Bessarion. But engaging in the great dispute that then raged between the upholders of Aristotle and Plato, his zeal for the latter led him to speak so disrespectfully and contemptuously of the more popular philosopher and his defender, Theodorus of Gaza, that he fell under the severe reprehension of his patron, who was too thoroughly a follower of Plato to wish his cause to be maintained by weapons so unworthy. He afterwards retired to Crete, where, with a "proud humility," he earned a scanty living by the teaching of children and the copying of manuscripts. Many of the productions of his pen are still to be found in the libraries of Europe. One of them, a copy of the *Icones* of Philostratus at Bologna, bears the inscription: "The king of the poor of this world has written this book for his living." Of his numerous works a few have been printed:—*Παροιμίαι*, Basle, 1538, now exceedingly rare; a collection of proverbs in Greek, of which a fuller edition appeared at Leyden, "Curante Heinsio," in 1619; *Oratio Panegyrica ad Fredericum III.* in Freher's *Scriptores Rerum Germanicarum*, vol. ii., Frankfort, 1624; Georgii Gemisthi Plethonis et Mich. Apostolii *Orationes funebres duæ in quibus de Immortalitate Animæ exponitur*, Leipsic, 1793; and a work against the Latin Church and the Council of Florence in Le Moine's *Varia Sacra.* Apostolius died about 1480, leaving two sons, Aristobulus Apostolius and Arsenius. The latter became bishop of Malvasia (Momembasia) in the Morea.

APOTHECARY. This name is derived from the Greek Ἀποθήκη, a word used by Galen to denote the repository where his medicines were kept. In Scotland the term is often applied to one who compounds and sells drugs, but this class is now defined in the language of some recent Acts of Parliament as pharmaceutical chemists, and chemists and druggists, both in England and Scotland. In England the name indicates a general practitioner in medicine who supplies drugs to his patients. The Apothecaries' Society of London is one of the corporations of that city, and both by Royal Charters and Acts of Parliament exercises the power of granting licences to practise medicine. The members of this society do not possess and never have possessed any exclusive power to deal in or sell drugs; and until very lately (1868) any person whatever might open what is called a chemist's shop, and deal in drugs and poisons. In that year, however, the Pharmacy Act was passed, which prohibits any person from engaging in this business without being registered.

From early records we learn that the different branches of the medical profession were not regularly distinguished till the reign of Henry VIII., when separate duties were assigned to them, and peculiar privileges were granted to each. In 1518 the physicians of London were incorporated, and the barber-surgeons in 1540. But, independently of the physicians and the surgeons, there were a great number of irregular practitioners, who were more or less molested by their legitimate rivals, and it became necessary to pass an Act in 1543 for their protection and toleration. As many of these practitioners kept shops for the sale of medicines, the term "apothecary" was used to designate their calling.

In April 1606 James I. incorporated the apothecaries as one of the city companies, uniting them with the grocers. On their charter being renewed in 1617 they were formed into a separate corporation, under the title of the "Apothecaries of the City of London." These apothecaries appear to have prescribed medicines in addition to dispensing them, and to have claimed an ancient right of acting in this double capacity; and it may be mentioned that Henry VIII., after the grant of the charter to the College of Physicians, appointed an apothecary to the Princess Mary, who was delicate and unhealthy, at a salary of 40 marks a year, "*pro meliore curâ et consideratione sanitatis suæ.*" During the 17th century, however, there arose a warm contest between the physicians and the apothecaries,—the former accusing the latter of usurping their province, and the latter continuing and justifying the usurpation until the dispute was finally set at rest by a judgment of the House of Lords in 1703, when it was decided that the duty of the apothecary consisted not only in compounding and dispensing, but also in directing and ordering the remedies employed in the treatment of disease. In 1722 an Act was obtained empowering the Apothecaries' Company to visit the shops of all apothecaries practising in London, and to destroy such drugs as they found unfit for use. In 1748 great additional powers were given to the company by an Act authorising them to appoint a board of ten examiners, without whose license no persons should be allowed to dispense medicines in London, or within a circuit of 7 miles round it. In 1815, however, an Act of Parliament was passed which gave the Apothecaries' Society a new position, empowering a board, consisting of twelve of their members, to examine and license all apothecaries throughout England and Wales. It also enacted that, from the 1st of August of that year, no persons except those who were so licensed should have the right to act as apothecaries, and it gave the Society the power of prosecuting those who practised without such license. But the Act expressly exempted from prosecution all persons who were then in actual practice, and it distinctly excluded from its operation all persons pursuing the calling of chemists and druggists. It was also provided that the Act should in no way interfere with the rights or privileges of the English Universities, or of the English College of Surgeons or the College of Physicians; and indeed a clause imposed severe penalties on any apothecaries who should refuse to compound and dispense medicines on the order of a physician, legally qualified to act as such. It is therefore clear that the Act contemplated the creation of a class of practitioners who, while having the right to practise medicine, should assist and co-operate with the physicians and surgeons.

Before this Act came into operation the education of the medical practitioners of England and Wales was entirely optional on their own part, and although many of them possessed degrees or licences from the universities or colleges, the greater number possessed no such qualification, and many of them were wholly illiterate and uneducated. The Court of Examiners of the Apothecaries' Society being empowered to enforce the acquisition of a sufficient medical education upon its future licentiates, specified from time to time the courses of lectures or terms of hospital practice to be attended by medical students before their examination, and, in the progress of years, regular schools of medicine were organised throughout England.

As it was found that, notwithstanding the stringent regulations as to medical acquirements, the candidates were in many instances deficient in preliminary education, the Court of Examiners instituted, about the year 1850, a preliminary examination in Arts as a necessary and indispensable prerequisite to the medical curriculum, and this provision has been so expanded that, at the present day all medical students in the United Kingdom are compelled to pass a preliminary examination in Arts, unless they hold a university degree. An Act of Parliament, passed in 1858, and known as the Medical Act, made very little alteration in the powers exercised by the Apothecaries' Society, and indeed it confirmed and in some degree amplified them, for whereas by the Act of 1815, the licentiates of the Society were authorised to practise as such only in England and Wales, the new measure gave them the same right in Scotland and Ireland.

A still more recent Act, passed in 1874, relates exclusively to the Apothecaries' Society, and is termed the Apothecaries' Act Amendment Act. By this measure some provisions of the Act of 1815, which had become obsolete or unsuited to the present times, were repealed, and powers were given to the Society to unite or co-operate with other medical licensing bodies in granting licences to practise. The Act of 1815 had made it compulsory on all candidates for a licence to have served an apprenticeship of five years to an apothecary, and although by the interpretation of the Court of Examiners of the Society this term really included the whole period of medical study, yet the regulation was felt as a grievance by many members of the medical profession. It is accordingly repealed, and no apprenticeship is now necessary. The restriction of the choice of examiners to the members of the Society is also repealed, and the Society has moreover the power (which it did not before possess) to strike off from the list of its licentiates the names of disreputable persons. As a question was raised, under the Act of 1815, whether women were admissible as candidates for the medical licence (owing to the ambiguous wording of the measure), and as the society, acting under legal advice, had admitted a woman to the licence, the Act of 1874 refers to the point, but leaves it still undecided, merely specifying that the new Act does not deprive the Society of any right or obligation they may have to admit women to examination, and to enter their names on the list of licentiates if they acquit themselves satisfactorily.

APOTHEOSIS, deification, the enrolment of a mortal among the gods. In its most rudimentary form, this practice may be regarded as an offshoot of the universal belief of primitive mankind in the existence of disembodied spirits, and their continued agency in human affairs. (Tylor, *Primitive Culture*, ch. xi.–xvii.) An invisible being thus invested with beneficent or malefic attributes, and capable of being offended or propitiated, virtually becomes a local or tutelary divinity. The cultus of such genii constitutes a large part of the religion of most negro nations. In China it takes the shape of a respectful veneration of ancestors, accompanied by a species of liturgical service. In India it is apparently excluded by the tenet of incarnation, according to which the individual either resumes a rank previously held by him, or enters upon a cycle of transmigrations admitting of no fixity of condition and, consequently, of no absolute deification. The Egyptian, Persian and Phœnician theologies seem to offer no trace of the idea; but there is reason to expect that it will be shown to have been a leading feature of the religions of Assyria and Babylon. For perfectly unequivocal examples of its prevalence among a highly cultivated people, we must resort to Greece and Rome. In Greece the worship of deified heroes was universal. A distinction, however, must be observed between the imaginary patriarchs of the golden age, who, after their decease, according to Hesiod (*Op. et Dies*, 121), became by the counsel of Zeus beneficent dæmons, guardians of mortal men, but who seem to have enjoyed only a vague and general veneration, and the mythical heroes, definite objects of worship, who may have been equally apocryphal, but whose legends were none the less regarded as authentic history. The reputed founders of cities were especially honoured with sacrifices by their descendants, and the practice extended to such indubitably historical personages as Lycurgus, Brasidas, Harmodius, Aristogiton, and Ptolemy Lagus. Instances of the origination of such worship in the historical period are nevertheless rare, and the veneration paid to the hero was in all cases merely local. The religious honours subsequently bestowed in their lifetime on Lysander, Alexander the Great, and other illustrious persons, were merely the extravagance of flattery, devoid of any influence on the national theology. The same cannot be said of the apotheosis of the Cæsars, the germ of which already existed in the veneration paid to the legendary founder of Rome. To the Roman the emperor appeared as the visible manifestation of the genius of the state, long the object of his reverence. (Friedländer, *Sittengeschichte Roms*, vol. iii. p. 455.) The people, says Suetonius, fully believed in the divinity of Julius Cæsar, hinting at the same time that this was by no means the case with the majority of the apotheoses subsequently decreed by the senate. (*Jul. Cæs.* c. 88.) The honour was indeed not only conferred upon almost every emperor who transmitted the sceptre to his descendants, but frequently upon deceased members of his family, or even his personal favourites, as in the case of Antinous. Sixty persons altogether are recorded as having been thus raised to divine honours from the time of Cæsar to that of Constantine. The majority of such apotheoses would be regarded as mere matters of official form; in some instances, however, it was otherwise. We learn from Capitolinus that Marcus Aurelius was still worshipped as a household divinity in the time of Diocletian, and was believed to impart revelations in dreams. (*Vit. M. Ant.* c. 18.) Antinous was adored in Egypt a century after his death (Origen, *Contra Celsum*, iii. 36). The ceremonies attendant on an imperial apotheosis are very fully described by Herodian (lib. iv. c. 2) on occasion of the obsequies of Severus, which he appears to have witnessed. The most significant was the dismission, at the moment of kindling the funeral pyre, of an eagle which was supposed to bear the emperor's soul to heaven. Sharp-sighted persons had actually beheld the ascension of Augustus (Suet., *August.* c. 100), and of Drusilla, sister of Caligula; the latter eyewitness took the public incredulity exceedingly amiss (Seneca, *Apocolocyntosis.*) The ludicrous side of the deification of a bad or indifferent emperor could escape no one, and is pungently illustrated by Seneca in the witty lampoon just quoted: even here, however, it is laid down that *principes pietate et justitia dei fiunt*. Representations of apotheoses occur on several works of art; the most important are the apotheosis of Homer on a relief in the Townley collection, and that of Augustus on a magnificent cameo in the Louvre. The establishment of Christianity put an end to apotheosis as an avowed belief and a public ceremony, although the principle on which it rested is still conspicuous in the adoration and invocation of saints by the Latin, Greek, and African Churches. The commemoration of Auguste Comte by his followers may be cited as another instance in point. The worship of Ali and his sons by some Persian sects, and that of the Caliph Hakem by the Druses, are not properly examples of apotheosis, being rendered to them not as deified mortals, but as incarnations of the Deity. (R. G.)

APPALACHIAN MOUNTAINS, the general name given to a vast system of elevations in North America, partly in Canada, but mostly in the United States, extending for 1300 miles, from Cape Gaspé, on the Gulf of St Lawrence, south-west to Alabama. The whole system may be conveniently divided into three great sections: the *Northern*, from Cape Gaspé to New York; the *Central*, from New York to the valley of the New River; and the *Southern*, from the New River onwards. The first of these includes the Adirondacks, the Green Mountains, and the White Mountains, and the irregular elevations towards the north: the central contains a large portion of the Blue Ridge, the Alleghanies proper, and a great number of lesser ranges: and the southern consists of the prolongation of the Blue Ridge, the Black Mountains, the Smoky Mountains, and the Unaka Mountains. The whole range, and especially the central portion, is remarkable for the parallelism of the various ridges, the uniform height of the summits in the same part of the chain, the absence of a central axis of elevation, and the presence, instead, of a central valley or axis of depression. The typical arrangement of the system—most distinctly visible in the central division—might be represented in diagram thus. first, a stretch of country, gradually sloping, with slight undulations and irregularities, upwards from the Atlantic, and attaining a height of 300, 500, or 1000 feet; then, a lofty ridge rising like a rampart, and succeeded by other ridges separated from each other by longitudinal valleys; next, the great central valley or axis of depression; and lastly, a new succession of ridges breaking off into table-land with transverse valleys and a gradual decrease of elevation. The Atlantic slope varies in breadth from 50 miles, as in New England, to 200 miles, in the south, and in the neighbourhood of New York has almost altogether subsided. The central valley may be traced from Lake Champlain in the north, along the course of the Hudson, down through the Cumberland Valley, in Pennsylvania, and the Great Valley of Virginia and Tennessee; it varies in breadth from 15 miles in the north to 50 or 60 miles in the south. The elevation of the valley rises towards the south in keeping with the elevation of the neighbouring ranges. None of the summits of the system reach the region of perpetual snow, but a large number of them attain a considerable altitude. In the Adirondacks the highest point, Mt. Tahawus or Mt. Marcy, reaches 5379 feet. In the White Mountains, Mt. Washington, in the main chain, has a height of 6288 feet; Mt. Adams, 5794; Mt. Madison, 5365; Mt. Jefferson, 5714; Mt. Clay, 5553; Mt. Monroe, 5384; Lafayette, 5290; and a great number of summits attain a height of more than 4000 feet. In the Green Mountains the highest point, Mt. Mansfield, is 4430 feet; Lincoln Mount, 4078; Killington Peak, 4221; Camel Hump, 4088, and a number of other heights upwards of 3000 feet. In the central division the hypsometric surveys are imperfect; but the general elevation of the higher chains is from 1000 to 2500 feet. As we approach the south, the complexity of the system and the altitude of the individual mountains increase together, and the chains which have run parallel and distinct begin, as it were, to gather and fold themselves into an irregular coil. The peaks of Otter in Virginia are about 4000 feet high; and in the Black Mountains, the Black Dome (Clingmann), which is the culminating point of the whole system, attains the height of 6707 feet; Balsam Cone (also known as

Guyot, from the hypsometrical explorer of the region) has 6671; Black Brother, 6619; and Mt. Hallback (Sugarloaf), 6403; besides a large number of summits varying from 3000 up to 6000 feet. In the Smoky Mountains we have Clingmann's Dome, 6660 feet high; Guyot (in Tennessee), 6636; Mt. Alexander, 6447; Mt Leconte, 6612; Mt Curtis, 6568; several others upwards of 6000, and a great many of more than 5000. In the whole Appalachian system, Lake Champlain is almost the only lake of any importance; but a multitude of rivers, and some of them of considerable size, find their sources in its recesses. The watershed does not lie along any one continuous axis, but shifts its position several times along the line. In the north it is found in a stretch of country, called the Height of Land, that lies between the White and the Green Mountains, and gives birth to the Connecticut and a number of smaller streams; next, it is formed by the Adirondack Mountains, which supply the sources of the Hudson River; and, further south, by the high plateaus of Pennsylvania and New York, which give origin to the Delaware and the Susquehanna, with their numerous tributaries. These rivers, flowing south and east, have thus to cut their way through the successive ridges of the whole Appalachian range. The watershed is next situated in the Alleghanies proper, which send a number of affluents to the Ohio on the west, and give rise to the James River on the east; and lastly, it runs along the terminal cluster or coil composed of the Black, the Smoky, and the Unaka Mountains. Here a tributary of the Ohio, called the Red River, a number of the affluents of the Tennessee, and various less important streams, have their sources. The Appalachian Mountains are a vast storehouse of mineral wealth. Magnetite, hematite, limonite, and other iron ores, are found in great abundance. The first is best exhibited in what is frequently called the Champlain Iron District, where it is now largely manufactured; and it also attains remarkable development in various parts of New York and New Jersey. The extensive deposits of this ore in Virginia, North Carolina, and Georgia, have hitherto been turned to comparatively little account. It is frequently contaminated by phosphate of lime, sulphur, and titanium. Red hematite is found in New York, Pennsylvania, Tennessee, and Georgia, and is usually known as Clinton ore, from a place of that name in Madison County, New York, while in Tennessee it is called Dyestone ore. It is of great commercial importance, though, on account of the amount of phosphorus which it contains, it is worthless for the manufacture of steel. Limonite, or brown hematite, which, from its fusible character, is usually worked along with the more crystalline ores, occurs in a series of beds all along the flanks of the Appalachians, from Maine in the north to Georgia in the south. The earthy carbonate of iron—"clay ironstone ore," "shell ore," "kidney ore," —is found in most parts of the system in connection with the Carboniferous strata, and has been very largely manufactured. In the northern district alone—that is, in the eastern part of New York, in New Jersey, and Eastern Pennsylvania—the number of furnaces is about 200, and the gross production of iron 900,000 tons per annum, or one-third of the entire production of the United States. This abundance of ore would have been almost useless had it not been for the equally abundant supplies of fuel; and the coal measures are among the most extensive in the world, the bituminous coal alone covering an area of 56,000 square miles, without counting the unrivalled beds of anthracite in Pennsylvania and New York, which cover an area of between 400 and 500 miles. While the supply of gold, silver, copper, and lead is of comparatively no importance, marble, limestone, fire-clay, gypsum, and salt are extremely abundant. Many of the ranges are richly covered with forest, and yield large quantities of valuable timber, consisting chiefly of sugar maple, white birch, beech, and ash, in the north, and oak, cherry-tree, white poplar, white and yellow pine, towards the south. The dark foliage of the pines, balsam-firs, hemlock-trees, and cedars, gives colour and name to many of the districts. Rhododendrons, kalmias, azaleas, and other flowering shrubs, often grow in almost impenetrable thickets; and in some parts the botanist is at once delighted and bewildered by the profusion and variety of the smaller plants. Bears, "panthers," wild cats, and wolves haunt the forests in large numbers.

The Appalachian system has a history which is of great interest, as it affords the clue to the causes of its formation; but a few points only can be touched on here. The earliest strata in the range are of Upper Cambrian age, and during the later portion of this period the Potsdam sandstone was deposited, the nature of which demonstrates that a large portion of the United States was then a shallow sea. Upon this were superimposed strata of Silurian, Devonian, and Carboniferous age, but these deposits were by far the thickest along the broad band now occupied by the Appalachians, and where thickest they have the general character of shallow water-beds. Beds of the same age occupy the valley of the Mississippi; there they are largely composed of limestones and deep water-beds, and have an aggregate thickness of about 8000 feet, usually horizontal or only slightly inclined. In the Appalachian Mountains their aggregate thickness is 40,000 feet, and the beds are thrown into complicated folds and contortions. At the close of the Carboniferous Period the beds were deposited in shallow water, and hence there must have been a subsidence along the band whereby the Potsdam sandstone and its associated rocks were depressed from 30,000 to 40,000 feet below the sea-level. This depression threw the strata into one gigantic synclinal basin, to conform to which the beds were necessarily crumpled up, and at the same time more or less metamorphosed. Then the beds began to rise above the sea-level, and the valleys and ridges to be formed, a process which may have been one of slow development, but which had made considerable advance prior to the Triassic age, when sandstones were deposited in the Appalachian valleys. The elevation has continued until the Potsdam sandstone is now a few hundred feet above the sea. If the strata had retained their original character and planes of deposition relatively to the horizon, the highest mountains would have reached 40,000 feet; but, as we have seen, they actually attain but 6707 feet. The elevation was not confined to the line of the Appalachians, but was continental in extent. During the process of elevation denudation was in operation, and by this agency the surface features of the range generally have been moulded. From this brief summary some idea may be conceived of the numerous operations and circumstances involved in the formation of a mountain chain like the Appalachians, which are intermediate in nature and in age between the older Laurentides, which are now worn down almost to a stump, and the Rocky Mountains, which have an air of comparative freshness. (For fuller details on this subject, consult the references given below and the separate articles on the States in this work:—Petermann's *Mittheilungen*, 1860, p. 263; *The American Journal of Science*, vol. xxxi. p. 157, and p. 392, 1861; Roger's *Report on the Geology of Pennsylvania*, 1858; a paper by Dana in the *American Journal of Science*, vol. xxxvi. p. 227, 1863; Hall, *Palæontology of New York*, vol. iii.; Sterry Hunt's "Geognosy of the Appalachian System," in his presidential address, *Proceedings of American Association for the Advancement of Science*, for 1872, p. 3.)

APPARITIONS

APPARITIONS, in the ordinary acceptation of the word, can scarcely be better defined than in the terms used by Defoe: "They are the invisible inhabitants of the unknown world, affecting human shapes or other shapes, and showing themselves visibly to us." In this definition no account is taken of "spectral illusions, involuntarily generated, by means of which figures or forms, not present to the actual sense, are nevertheless depicted with a vividness and intensity sufficient to create a temporary belief of their reality." Theories of apparitions generally deal with these hallucinations, and no doubt they are the foundation of many of the stories of superstition, but they scarcely suffice to account for the universality of the belief in the possible appearance of disembodied spirits. These figures, kind or threatening, are probably the first objects that meet the vision of primitive men, when they begin to reflect on the unseen powers around them, and "to explore these coasts which our geographers cannot describe." Ghosts are almost the first guess of the savage, almost the last infirmity of the civilised imagination; on these forms, shadowy and unsubstantial as they are, solid superstructures of ritual and morality have been based, and apparitions, with the consequences of the belief in them, have a literature and a history of their own.

In the first place, the belief has had an immense effect on the religious and moral development of our race. Though it is as yet impossible to analyse to its first elements the confused mass of fear and custom which makes up the faith of savages, there can be little doubt that their religion, with the later and refined heathenism of Greece and Rome, sprang in part from the propitiation of the spirits of ancestors. Again, it would no longer be true to say, as Scott did forty years ago, that "the increasing civilisation of all well-constituted countries has blotted out the belief in apparitions." The visionaries who found their religion on a pretended intercourse with the dead, and who consider the highest function of their clergy to be "the serving of tables"—tables that rap and move—may be counted in America by millions. Many causes have combined to bring about this return to what a short time ago seemed a forlorn superstition. First, there was that reaction against the somewhat commonplace scepticism of the last century which took in literature the form of Romanticism and of the Gothic revival, and brought back in a poetical shape the fairies and spectres of mediæval fancy. Again, the lofty morality and pure life of Swedenborg (1688–1771) won a hearing for his extraordinary visions, and minds influenced by him were ready to welcome further additions to the marvellous. He declared that "the spirit of man is a form," and added that it had been "given to him to converse with almost all the dead whom he had known in the life of the body." Last of all came what is called spiritualism, inspired by an impatient revolt against the supposed tendencies and conclusions of modern science. Inquirers who live in constant fear that science is trying to demonstrate the truth of materialism, and to rob them of their dearest hope, that of a future life in the society of their departed friends, turn eagerly to what they think ocular evidence of another existence. There is scarcely any literature, not even the records of trials for witchcraft, that is more sad and ludicrous than the accounts of "spiritual séances," with the persistence of the bereaved in seeking a sign. The attempt of the Alexandrian Platonists to substitute the visions of trances for the conclusions of intellect has been called the despair of reason; and modern spiritualism, when it is not a drawing-room amusement, is too often a moment in the despair of faith.

The belief in apparitions, we have said, has its history, a history contained in ancient laws and literature, in the customs and superstitions of savages, and in the fireside ghost-stories of our own homes. By a comparison of all these we shall try, first, to show how the notion of the existence of spirits and of the possibility of their appearance arose; next, to trace several of the shapes in which it is most powerful and general; lastly, to point out how modern theories and marvels are connected with primitive and savage ideas, and we shall probably arrive at the conclusion that there is either some substratum of unexplained facts, or that the human imagination is subject to laws which have not been sufficiently investigated.

Primitive beliefs.

It would be rash to say, with Mr Herbert Spencer, that the propitiation of the spirits of ancestors is the first germ of all religion, and it would be premature to deny that there may be races which have no conception of the existence of the spirit after death. But it is safe to assert that there are very few savage peoples who do not believe that their dead ancestors appear to them in dreams, and in what they think the clearer vision of trances, and who do not prove their belief by sacrifice of food, by prayers for help, by hymns, and by offerings made to show love or deprecate anger. The wide-spread graves of extinct races, with the weapons and vessels buried along with the dead, demonstrate that these nameless and vanished hordes also held that the life of the dead persists, with its old needs and desires. The literature of cultivated peoples shows clearly that the Greeks and Romans held the same opinion, and practised no very different rites. It would be tedious and superfluous to state all the facts so carefully collected by Mr Tylor in his *Primitive Culture.* Enough to say that when the Athenians condemned the generals who neglected to bury the men who fell at Arginusæ, when Odysseus built a tomb in deference to the threat of the dead Elpenor—"lest I become a curse to thee, sent by the gods"—they acted from the same motive as the Australian "black fellow" who holds that his deceased tribesman, if left uninterred, will haunt him as an *ingna*, or mischievous spirit. If we wanted to state the savage theory of apparitions, we could scarcely do it better than in the words of Apuleius—"The human soul, after it has quitted the body, is called Lemur; that which undertakes the guardianship of the family is called Lar; those which wander without fixed homes are named Larvæ." The Lemurs then, we may say, are with us still as churchyard ghosts; the Lar, after becoming the venerated *hero* of Grecian religion, has departed with the advance of Christianity. An able account of the Greek worship of the dead will be found in *La Cité Antique*, by M. Fustel de Coulanges.

Taking it for proved that the credence in the apparitions and the power of the dead is a fact as good as universal in the beginning of thought, we must ask, How was the notion arrived at? Discarding for the moment the possibility that it was founded on actual apparitions, we observe several causes which might, indeed which *must*, have given rise to it. The savage, like the child, is full of questionings, and his reasonings are, so to say, perfectly rational. His hypotheses colligate and explain the facts, as far as he knows them. One of the earliest mysteries to him is the mystery of death—how is he to explain the sudden and eternal stillness of the warriors slain in battle? Now the savage philosopher knows of another state, namely, sleep, in which he *seems* as quiet as the dead, but is really active in dreams. Has he then two selves? The problem is that which Hartley Coleridge resolved when a child—"There is a dream Hartley, a shadow Hartley, a picture Hartley, a hold-me-fast Hartley." "When I sleep," then the savage may conclude, "one of my selves leaves the other to rest, and goes about its business. And in death, also, one self flies away, but it will not return—it is homeless, hungry, wandering. Above all, it is a very strange thing, and, as strange, to be feared." *A priori* reasoning goes as far as this, and then confirmatory facts support the hypothesis. In dreams he meets the dead warrior, and some of his friends have the same experience. And there is one of the tribe, the diviner or *shaman*, whose opinion they revere in these matters. He is thus described by a Zulu convert—"When he is awake he sees things which he would not see if he were not in a trance." He knows how to produce trances by fasting, by inhaling the smoke of herbs, and by the use of strange oils. He sees things before they happen, and tells how, when awake, he beheld the slain warrior, and promised to appease his hunger with sacrifice of cattle. There can scarcely be any other conclusion from these facts, as far as they are known to the savage, except that the dead yet live, and appear to the living, and keep their old passions and their old wants.

Now this belief in apparitions, thus stated, is capable of much development. The favourite ancestral spirit of the strongest tribe will tend to absorb the lion's share of sacrifice and hymns, and to become such a hero as Theseus was to the Athenians. Many other influences produce a still higher religion, a circle of Olympian gods, a philosophic and intellectual monotheism. The family of the seer will perhaps become a sacred caste, like the Eumolpidæ at Athens. An early civilisation is formed, with its philosophers, holding in secret a monotheism of their own, with its city population pleased by stately temples and hieratic splendours, but we must remember that all this time the *pagani*, the rural people of the hills and the coast, come very little under the influence of philosophy or of ritual. *They* still retain the old dread of the ghosts of the departed, and still people the woods and wells with wandering spirits. As slaves and nurses they enter the cultivated families, their old wives' fables impress the awakening imagination of childhood, and the earliest of all forms of belief in the supernatural finds its way back into the circle of culture. At last there comes a time of decadence, when the abstract notion of Deity seems too vague and distant, when the Olympian gods are no longer credible, and philosophy falls back in despair on the traditional ghosts of the nursery and of the Oriental slaves. Thus Neo-Platonism reinstated apparitions as demons, angels, powers; and thus Henry More and Joseph Glanvil combated the scepticism of the seventeenth century with stories of haunted houses, and of the mysterious drummer of Tedworth.

If this theory of the origin of the belief in apparitions be correct, it tends to explain what certainly is a difficulty—the *identity* of ghost stories in all lands and times, the conservatism of that great majority, the dead. For the further we go back in the history of civilisation, as in the works of nature, the simpler, the more identical, the more widely diffused are all its productions. The earliest implements for lighting fires, the earliest weapons, are not more alike than the earliest guesses of speculation and the earliest efforts of fancy. These oldest fancies dream of apparitions of the dead, and are preserved below the level of advancing culture, and insinuated into the ideas of the cultivated classes by the classes which are unprogressive, unaffected on the whole by religious or social changes It is for this reason that magical rites are everywhere the same, as M. Maury has observed—that the Scotch witch had the same spells as the Kaffir witch, that Balzac's description of a Parisian sorceress in *Le Cousin Pons* might serve as an account of a Finnish wise-woman. It is not strange that superstition and ignorance should always tell the same baseless tale if they have always treasured and still repeat the earliest and crudest fancies of the race. Nothing shows more clearly the purity of ancient culture than the absence of superstition in the Greek as compared with our Teutonic classics.

Supposing the origin of the belief in apparitions, and its identity in different peoples, to be thus accounted for, it remains to ask if the surviving forms of the creed can be traced back to a primitive source. In entering the cloud-land of folk-lore it is impossible to advance too cautiously. This is a realm where nothing is fixed and definite; where all is vague, floating, confused. He who would call up and try the spirits here must not place himself within too narrow a magic circle, but extend his view as far as possible to the beliefs of the most alien and distant races. The apparitions of popular superstition fall into classes which always tend to be merged in each other, but which are not so indistinct that they cannot be considered apart. No form is better known than the belief in fairies. All Fairies. over Europe fireside tradition tells of women who haunt lonely places, where they are seen to dance, to spin, to comb their long hair. They cause inexplicable nervous diseases—epilepsy and St Vitus's dance; they have a kingdom underground, whither they allure their lovers; they appear with fatal gifts at children's birth; they steal the children of mortals away, and leave changelings of their own. Our fathers dreaded them as *the good folk*, in Tweeddale and Ettrickdale; the Highlanders call them *the folk of peace;* in Greece they are *nereids;* in Servia, *vilis;* in Bretagne, *korrigans;* in Russia, *rusalkas.* They ought, if our hypothesis is correct, to be traceable to the lower spirits who in pagan times informed woods and wastes, and dwelt by the hearth; who had no temples to be overthrown or changed into Christian churches. The forests sheltered them when the fane of Jupiter fell, and the house of Theseus became the church of St George. The women concealed the hearth-spirit, as Rachel did Laban's gods, in the furniture of their houses. Rude and rustic people kept up the traditional belief, and the scant offering by the haunted well that the Highlanders of Perthshire still do not care to withhold. The capitularies of Liutbrand forbade such sacrifices; a series of councils repeated the prohibition. The result of these ecclesiastical allusions to "the lesser people of the skies" is that we can trace the French *fées* back to the *fata* of classical mythology. *Fées* in old French is *faés; faés* is the *fadæ* of Gervase of Tilbury in his *Otia Imperialia* (1220); *fadæ* is a corruption of *fata*, who are named with *bonæ, les bonnes dames* (the good ladies) among the superstitions of the Gauls. Such is the pedigree of the fées, as traced by M. Maury in his interesting tract, *Les Fées du Moyen Age.* Further information, to show the identity of the superstition, will be found in Scott's essay in the *Border Minstrelsy*, in Bernhard von Schmidt's *Peasant Life in Modern Greece*, in Pashley's *Travels in Greece*, in Ralston's *Folk-Songs of Russia*, and in the *Barzaz Breiz* of the Marquis de la Villemarqué. Now turn to Kaffir superstition. Dr Callaway, in the *Religious System of the Amazulu*, p. 226, writes thus:—"It may be worth while to note the curious coincidence of thought among the Amazulu regarding the *amatongo* or *abapansi* (ancestral spirits), and that of the Scotch or Irish regarding the fairies or 'good people. For instance, the 'good people' of the Irish have ascribed to them, in many respects, the same motives and actions as the *amatongo.* They call the living to join them, that is, by death; they cause diseases which common doctors cannot understand nor cure. The common people call them their friends or people, which is equivalent to the term, *abakubo*, given to the ancestral spirits. In the funeral procession of 'the good people' are recognised the forms of those who have just died, as Umkatshana, in the Zulu tale, saw his relations among the ancestral spirits. So also in the Highland tales. A boy who had been carried away by the fairies, on his return home speaks of them as 'our folks,' which is equivalent to *abakwetu*, applied to the ancestral spirits. The fairies are also called *ancestors*. 'The Red Book of Clanranald is said not to have been dug up, but found *on* the moss,' says Mr Campbell in the Tales of the West Highlands; 'it seemed as if the ancestors sent it.'" All these coincidences cease to be strange if we suppose that the Celtic people retain as subordinate and childish traditions the primitive beliefs which make the religion of the Kaffir.

Brownies. It would be easy to trace the belief in brownies (lubber spirits, who tend the house) to the lar, or hearth spirit of the ancients. The *domovoy*, or Russian brownie, "lives behind the stove; but he, or the spirits of the dead ancestors whom he represents, were held to be in even more direct relations with the fire on the hearth. In some districts tradition expressly refers to the spirits of the dead the functions which are generally attributed to the domovoy; and they are supposed to keep careful watch over the house of a descendant who honours them and provides them with due offerings. In some families a portion of the supper is always set aside for the domovoy; *for if he is neglected he waxes wroth, and knocks the tables and benches about at night.*" This is the account of Mr Ralston, which tallies with the Scotch stories of brownies, as with those of the Lithuanian *kanka*, the Finnish *paara*, the French *lutin*, and the humble Northumbrian *bogie*, who "flitted" with the farmer when he removed his furniture. All these are *lares*; and the ghastly superstition of the vampire, still prevalent in Greece as once in Scotland, may be traced to the unsatisfied *ingna*, or malevolent spectre of the Australian savage, the *tii* of Polynesia, the *upir* of Russian folk-lore.

Second sight. We now come to almost the most universally credited class of apparitions—namely, the subjective visions, coinciding with real facts and events occurring at a distance, beheld by persons possessing the Celtic *taishitaraugh*, or gift of second-sight. The second-sight is described by a believer as "a singular faculty of seeing an otherwise invisible object, without any previous means used by the person that beholds it for that end." The name of second-sight is the Scotch one under which the reputed phenomena excited the curiosity of Dr Johnson, and "made him wish to have some instances of that faculty well authenticated." In Scott's opinion, "if force of evidence could authorise us to believe facts inconsistent with the general laws of nature, enough might be produced in favour of the existence of the second-sight." All history, all tradition, abounds in instances. A well-known anecdote tells how St Ambrose fell into a comatose state while celebrating the mass at Milan, and on his recovery declared that he had been present at St Martin's funeral at Tours, where, indeed, reports from Tours afterwards declared that he had been seen. A similar experience of Swedenborg's (who described at Gottenburg a fire which was actually raging at Stockholm) is reported by Kant. The wide distribution of the belief is shown by the fact that Mr Mason Browne's exploring party on the Coppermine River was met by Indians, sent by their medicine man, who predicted the coming of the party, just as a seer in the Hebrides described even the livery of Dr Johnson's servant before his arrival. In a remote age and country we find Njal, the hero of the Njal's saga, credited with *forspan*, or the gift of beholding such shadowy apparitions of future events—a power carefully distinguished from ordinary clear-sighted wisdom. Returning to savage life, a complete account of the morbid nature and of the initiation of a diviner is given from the mouths of Kaffir converts in Dr Callaway's *Religion of the Amazulu*. A peculiar organisation, a habit of haunting the desert, and of fasting, combine to produce the *inyanga*, or second-sighted man; what Reichenbach calls *der sensitiv Mensch*, and franker Zulus "a soft-headed one." This part of the subject may be concluded with a quotation from the *Odyssey*, showing the similarity of these prophetic and warning apparitions in the islands of western Greece and of western Scotland. Theoclymenus speaks to the doomed wooers at their latest feast—"Ah, wretched men, what ails you? Your knees, and faces, and heads are swathed in night, and a wailing sound has arisen, and all cheeks are wet with tears, and the walls and the fair spaces of the ceiling do drip with blood, and the porch is full of ghosts, and the court is filled with shadows—the shadows of men bound hellwards—and the sun has perished out of heaven, and an evil mist has overspread the world." Compare Martin in his *Description of the Western Isles*—"When a shroud is perceived about one, it is a prognostick of death. The time is judged according to the height of it about the person; for if it is seen about the middle, death is not to be expected for the space of a year; and as it is frequently seen to ascend higher towards the head, death is concluded to be at hand within a few days or hours, as daily experience confirms." These modern and ancient instances scarcely serve to increase "the force of evidence" that Scott speaks of, but rather to prove that the superstition is a fragment of the most primitive speculations on the facts of trance and coma.

Apparitions in witchcraft. The apparitions which play a part in all the records of trials for witchcraft admit of some explanation, though scarcely an adequate one, in known laws of human nature. It is easy enough to understand how in primitive times the diviner who beheld spirits was also believed to be able to command them to do his bidding and to injure his enemies. The belief persisted under the civilisation of ancient Rome, and Apuleius tells a very impressive story of how the apparition of "a woman of hideous aspect, marked by guilt and extreme sorrow, whose haggard face was sallow as boxwood," was evoked by a witch to slay her foe. No instance of the survival of savage superstitions is stranger than the fact that men like Henry More and Glanvil, Bodin, the great French publicist, Sir Thomas Browne, and Wesley, could still maintain that disease and death might be caused by such malevolent apparitions. We can only say in their defence that the amount of concurrent evidence and confession, corresponding as it did with the prohibition of witchcraft in the Bible, constrained them to share the cruel superstition of their age. Nor is it impossible to assign causes, besides the inadequate one of conscious imposture, for the confessions of the unhappy creatures accused of witchcraft. First we must try to conceive how entirely and implicitly the faith of the middle ages accepted the existence of an omnipresent army of evil spirits. The world was the battlefield of devils and angels, and there was a constant tendency in men's minds to Manichæanism, to crediting the devil with frequent victories. Perhaps no single work enables the modern reader so vividly to imagine this state of terror, this agony of patients who believed that they were in conflict with visible powers of evil, as the autobiography of Guibert de Nogent, the contemporary historian of the first crusade. He has left, in the character of his mother, a most gracious picture of womanly piety, and yet this excellent lady supposed herself to be the nightly prey of Satan, whom she saw in tangible form! Then we must remember that the church everywhere declared that mortals could enter into compact with the fiends; and recalling how subject the middle ages were to imaginary epidemics, fevers of terror and fanaticism, it is not so hard to see how both accusers and accused believed the truth of their charges and confessions. In such an epidemic every one's fancy is inflamed, and people are found to accuse themselves, as they still do when a mysterious murder has excited the morbid brains of foolish persons. At these times we may almost reverse the French proverb, and say *qui s'accuse s'excuse*. Dreadful tortures, too, such as "the most severe and cruel pain of the boots," and "that most strange torment called in Scottish a turkas" (*i.e.*, pincers), want of sleep, and hunger, often made confession and death preferable to life in such misery. But these considerations do not explain away the obvious belief and remorse of many victims, nor account for the similarity in detail of all the confessions.

For the better understanding of these points we may briefly trace the ordinary course of a witch epidemic, as we gather it from the reports in Pitcairn's *Criminal Trials in Scotland*, from the Salem witchcraft trials recorded by Cotton Mather (1692), and from such *procès* as that against Urbain Grandier at Loudun (1632–34), as well as the stories collected by Glanvil in his *Sadducismus Triumphatus*. Generally it happened that some nervous patient, like the girls who used to meet and make what spiritualists now call a circle, in Parris's house at Salem, or the novices who accused Urbain Grandier, or the daughter of Richard Hill of Stoke-Trister in 1664, or Adam Clark of Prestonpans (1607), suffered from some hysterical complaint. In the case of Mistress Hill this malady took the form of stigmata or sudden prickings and swellings of the hands, like those of Louise Lateau, the Belgian ecstatic, whose name has recently become notorious. Living in a Protestant land, Mistress Hill, like all the other patients, referred her sufferings to the machinations of a witch, just as the Australian savage now supposes his ailment to be caused by magic. In the cases we have named, as in most others, the witch was said to appear in visible form, or to send "the devill in likeness of ane blak man efter ane feirfull manner," and so to torment the sufferer. The witch was then charged, examined, tortured, if necessary, in the *witch's bridle* or otherwise, and as a rule confessed, implicating many of her neighbours. The confessions were frequently recanted, like those made under torture by the Templars. They generally ran to the effect that the accused, in a despairing moment, "making heavy fair dule with herself," like poor Bessie Dunlop, who was "convict and brynnt" in 1576, met an apparition. It might be the ghost of Thom Reid who fell at Pinkie fight, or it might be the devil, as in most confessions, or the king of elf-land, but he always offered wealth and happiness in return for the soul of his victim. The bargain was closed, and the witch was taken at night to some spot, often a church, where she met a great number of her neighbours. Here she was made to swear fealty to Satan, who sometimes took the form of a buck in France, or of "a deer or roe" in Scotland. The same revolting ceremonies and travesties of the church service followed as were attributed to the Templars, and the worshippers received power to do evil, raise storms, bewitch cattle, and so on, after which there ensued a licentious revel. Sometimes the witches would fall into trances when under examination, and declare on waking that they had been spiritually present at the joys of the *Sabbat*. Their victims, when confronted with them, frequently became subject to convulsions, and were aware of their presence though walls and doors were between them. Both these facts point to the presence of the phenomena of hypnotism or mesmerism, and the abnormal state produced by concentrated attention and abeyance of the will. The ceremonies of this pretended *Sabbat* can be accounted for if we suppose that the Scotch peasants, like those of France, retained the traditions of those vast nocturnal gatherings, with their revival of pagan rights, their mockery of the church, their unnatural licentiousness, in which the popular misery of the 14th century found relief and expression. An account of these orgies is given in M. Michelet's book *La Sorcière*. He does not appear to have consulted the records of the Scottish trials for witchcraft, which makes the very close resemblance between the Scottish and French confessions even more striking.

In attempting to explain this resemblance, as well as the multitude of well-attested apparitions which the annals of witchcraft report, we have to remember the following facts. The manner of producing these abnormal nervous states, in which the patient is impressed exactly as if he heard and saw what he is commanded to hear and see, has always been familiar to peoples in a low state of civilisation. The witchcraft trials attribute to diabolical influence phenomena which we may now see performed on willing patients by strolling professors of mesmerism and magnetism. The constantly reviving interest in these phenomena, which to-day takes the shape of matter for gossip, in the middle ages swelled into a frenzy of fear and of excited imagination. The church encouraged this fear by its doctrines, and did little to check it by its exorcisms. All classes believed that the power which produces *hypnotism* could be hurtfully exercised, and all classes attempted the impossible crime of slaying by magic. The rural population retained the memory of pagan orgies, of the worship of heathen gods, now declared to be devils; they also retained the harmless tradition of the fairy world, and when tortured into confession they reproduced, with convincing identity, fragments of folk-lore. Isobel Gowdie was burned in Nairn in 1662 for telling tales which would nowadays make her invaluable to the collector of *Märchen* or nursery stories (Pitcairn, iii. 603). Survivals of belief out of an uncivilised stage of progress, attested by the facts of nervous disease, heightened by fear and imagination, interpreted by unscientific theology, go far to constitute the familiar apparitions of witchcraft. It ought to be added that modern believers in spiritualism claim the witches as martyrs of their own faith, and recognise in their reported performances, especially in their power of floating in the air, anticipations of their own puerile miracles.

Ghosts.

The species of apparitions we have discussed may all be traced to the traditions of the non-progressive classes, and connected with the earliest ideas about the supernatural. But the spirits which are most familiar to us, the spectres of ghost stories and fireside tales, rest their claims to existence on the evidence of the eyes and ears of people we meet every day. True, the evidence is of the hearsay class; it is almost as rare to find a witness who has seen a ghost as to encounter a person who does not know some one who has had this experience. As a rule, the deceased friend is said to have appeared at the moment or about the time of his death to an acquaintance at a distance. The belief is now more widely spread and more firmly held among the educated classes than it has been for centuries, and the arguments on both sides are worth consideration. The sceptics do not deny that people have been subjectively affected, in the same way as they would have been if the dead friend had been objectively present. But they bring forward several well-authenticated instances to prove that some people have been subject to *illusory* appearances, of which they could only test the reality by the attempt to handle them. Perhaps the best known case is that of Nicolai, a Berlin bookseller (1790), who repeated his own hallucinations to the academy of Berlin. "They were generally phantasms of his friends and acquaintances; or, in other words, copies of his past impressions and perceptions, so renovated and verified as to create an illusion of reality." Another example is the case of a Mrs A., attested by Sir David Brewster in his *Natural Magic*, and repeated by Professor Huxley in his *Elementary Physiology*. Mrs A.'s illusions were often grotesque and terrible, and she could not always connect them with any past impression. Different philosophical explanations are given of these cases of disordered vision. Dr Hibbert, in his *Philosophy of Apparitions*, conceives that the organs of sense are the actual medium through which past feelings are renovated; or, in other words, that when, from strong mental excitement, ideas have become as vivid as past impressions, or even more so, this intensity is induced by, or rather productive of, an absolute affection of those particular parts of the organic structure on which sensations depend, in the same way precisely as the salivary glands are known to be occasionally as much excited by the idea of some favourite food as if the said body itself were actually present, stimulating the *papillæ* of the *fauces*. It would have been more simple if Dr Hibbert had said that imagination, in some states, reacts upon the organ of sense and renovates past feelings or sensations, the natural antecedents or necessary concomitants of certain perceptions, with an intensity sufficient to create an illusion of reality.

A further explanation is given by Sir David Brewster, who has remarked as a physical fact that, "when the eye is not exposed to the impressions of external objects, or when it is insensible to these objects in consequence of being engrossed with its own operations, any object of mental contemplation, which has either been called up by the memory or created by the imagination, *will be seen as distinctly as if it had been formed from the vision of a real object*. In examining these mental impressions," he adds, "I have found that they follow the motions of the eye-ball exactly like the spectral impressions of luminous objects, and that they resemble them also in their apparent immobility when the eye-ball is displaced by an external force. If this result shall be found generally true by others, it will follow that the objects of mental contemplation *may be seen as distinctly as external objects*, and will occupy *the same local position in the axis of vision* as if they had been formed by the agency of light." This goes to the very root of the theory of apparitions, all the phenomena of which seem to depend upon the relative intensities of the two classes of impressions, and upon the manner of their accidental combination. In perfect health the mind not only possesses a control over its powers, but the impressions of external objects alone occupy its attention, and the play of imagination is consequently checked, except in sleep, when its operations are relatively more feeble and faint. But in the unhealthy state of the mind, when its attention is partly withdrawn from the contemplation of external objects, the impressions of its own creation, or rather reproduction, will either overpower external objects, or combine themselves with the impressions of them, and thus generate illusions which in the one case appear alone, while in the other they are seen projected among those external objects to which the eye-ball is directed, in the manner explained by Dr Brewster. To these physical causes of subjective apparitions, the forces of the imagination, of long desire, of strained attention, are supposed to contribute their influence.

"Enthusiastic feelings of an impressive and solemn nature," says Sir Walter Scott, "occur both in private and public life, which seem to add ocular testimony to an intercourse betwixt earth and the world beyond it. For example, the son who has been lately deprived of his father feels a sudden crisis approach, in which he is anxious to have recourse to his sagacious advice—or a bereaved husband earnestly desires again to behold the form of which the grave has deprived him for ever—or, to use a darker yet very common instance, the wretched man who has dipped his hand in his fellow-creature's blood, is haunted by the apprehension that the phantom of the slain stands by the bedside of his murderer. In all or any of these cases who shall doubt that *imagination*, favoured by circumstances, *has power to summon up to the organ of sight spectres which only exist in the mind of those by whom their apparition seems to be witnessed?* If we add that such a vision may take place in the course of one of those lively dreams in which the patient, except in respect to the single subject of *one* strong impression, is or seems sensible of the real particulars of the scene around him, a state of slumber which often occurs—if he is so far conscious, for example, as to know that he is lying on his own bed, and surrounded by his own familiar furniture, at the time when the supposed apparition is manifested, it becomes almost in vain to argue with the visionary against the reality of his dream, since the spectre, though itself purely fanciful, *is inserted* amidst so many circumstances which he feels must be true beyond the reach of doubt or question. That which is undeniably certain becomes in a manner a warrant for the reality of the appearance to which doubt would have been otherwise attached. And if any event, such as the death of the person dreamt of, *chances to take place*, so as to correspond with the nature and the time of the apparition, *the coincidence*, though one which must be frequent, since our dreams usually refer to the accomplishment of that which haunts our minds when awake, and often presage the most probable events, seems perfect, and the chain of circumstances touching the evidence may not unreasonably be considered as complete."

Now this is the point—namely, the possibility of frequent coincidence—where the advocates of the reality of apparitions join issue with the sceptics. They do not deny that some people have been subject to hallucinations. They say with De Foe, "we have, we believe, as true a notion of the power of imagination as we ought to have. We believe that we form as many apparitions in our fancies as we behold with our eyes, and a great many more. But it does not follow from thence that there are no such things in nature." It is when apparitions of men dying are seen at a distance from the place of their death, or when different witnesses, at different times, behold the same apparition in a certain place, that the explanation of mere fancy or subjective illusion becomes hard to accept. It is unfair of Scott to say that the coincidence between death and distant apparition in dream or waking vision is one which "must frequently happen." Mankind has agreed with Dr Johnson to consider the event *not* fortuitous. Nothing is explained, *if the multitude of such stories are supported by evidence*, by speaking of a coincidence. As Joab says in Voltaire's play, *c'est là le miracle*. Again, to convert Nicolai's visions into genuine apparitions, or to make Mrs A. what Professor Huxley calls a mine of ghost stories, what they saw should have been also seen by others, or should have been followed by some significant event. To give an example of a genuine ghost story as contrasted with a hallucination:—It happened to a lady, a distant relative of the writer, to waken one morning in Edinburgh, and see, as she thought, her father standing by her side. He was dressed in his full uniform as a general in the East India Company's army, and seemed to her to press his hand on his side with a look of pain, and then to disappear. The lady mentioned what she supposed she had seen to the clergyman with whom she was residing. He took a note of the date of the occurrence, which happened in a time, as was supposed, of profound peace. The next news from India brought tidings of the mutiny, and that the lady's father had gone out in full uniform to address his native troops, and had been shot down by them. Now granting, for the sake of argument, that the evidence for this story is sufficient, believers in apparitions would be justified in saying that a coincidence so odd must have some unexplained cause. Two explanations of appearances of this kind suggest themselves to the savage and the scientific spiritualist respectively. The former believes that all real objects have their shadowy doubles in the next world; the weapons buried with the dead chief send their doubles to join him in the happy hunting-grounds. The latter holds that the seer is subjectively affected in the manner desired by the person whose apparition he beholds, who naturally assumes some familiar raiment, "his habit as he lived." To take another example. The writer once met, as he believed, a well-known and learned member of an English university who was really dying at a place more than a hundred miles distant from that in which he was seen. Supposing, for the sake of argument, that the writer did not mistake some other individual for the extremely noticeable person whom he seemed to see, the coincidence between the subjective impression and the death of the learned professor is, to say the least, curious. Pursuing this line of thought, the whole question becomes one of evidence. Does the number of well-attested coincidences between the time of death and the moment of apparition exceed the limits that the laws of chance allow? Till people who have seen such spectres can give up the habit of adorning their stories with fanciful additions, and can make up their minds to attest them with their names, the balance of argument is on the side of the sceptics. These reasoners seem, however, to lay too much stress on the effect of "expectant attention." It is *not* as a rule the anxious mourner who beholds the spectre of the beloved dead. No sorrow is more common than the affliction of Margaret as described by Wordsworth:—

> "'Tis falsely said
> That there was ever intercourse
> Betwixt the living and the dead,
> For surely then I should have sight
> Of him I wait for day and night
> With love and longings infinite."

It may be added that hallucinations, or whatever we are to call the impression of beholding objects of supernatural horror, are not confined to the human race. A remarkable example of superstitious horror shown by a dog, at the moment of a supposed apparition to his owner, is given in the *Edinburgh Medical and Surgical Journal*, vol. lxiv., pp. 186–187. In the same way, during the mysterious disturbances at the house of the Wesleys, "the mastiff was more afraid than any of the children." Popular superstition has used this belief. When the dogs howl, in the Danish ballad, or in its Provençal counterpart, the cruel stepmother is afraid of the apparition of the dead mother, and treats the children kindly. In the same way, when Athene, in the *Odyssey*, appears to Odysseus, Telemachus cannot see her, but the dogs crouch and whine in fear. The case of Balaam's ass is sufficiently well known.

Spiritualism. The latest and the most important development of the belief in apparitions is that known as spiritualism. The believers in a religion based on pretended communications from the dead are numbered in America by millions. Their opponents say that their faith and practice help to fill the lunatic asylums, to which they easily reply that theirs is not the only creed that gives occasion to religious madness. Men of sense and experience are numbered in their ranks, and even in England it would be easy to name persons of eminence in art and literature, and some branches of science, who are puzzled by the phenomena they suppose themselves to have witnessed. Thus the late Augustus de Morgan writes in the preface of *From Matter to Spirit* —"I am perfectly convinced, in a manner which should make unbelief impossible, that I have seen things called spiritual which cannot be taken by a rational being to be capable of explanation by imposture, coincidence, or mistake."

Modern spiritualism arose from one of the commonest superstitions in the world—the belief in haunted houses. What the Germans call the *Poltergeist* (the noisy spirit that raps and throws about furniture) is not peculiar to any country. We find it in Japan (see *Tales of Old Japan*), in Russia, in Egypt. Pliny tells of the haunted house of Athenodorus, the philosopher, in Athens. In Iceland the ghost of the dead thrall Glam raps on the roofs in the Gretti's saga; and "the Dyaks, Singhalese, and Siamese agree with the Esths as to such routing and rapping being caused by spirits." Such disturbances, accompanied with apparitions, haunted the house inhabited by Mrs Ricketts, a sister of Earl St Vincent. Scott says in reference to this case that "no one has seen an authentic account from the earl;" but his sister's report has recently been published (see the *Gentleman's Magazine* for May 1872). Every one has heard of the rappings in the house of the elder Wesley. Glanvil, in his *Sadducismus Triumphatus*, has left well-authenticated reports of many cases, notably that of the drummer of Tedworth. The house of Mr Mompesson of Tedworth, in 1651, was disturbed by continual noises—furniture moving of its own accord, *raps that could be guided by raps given by the spectators*. Precisely the same phenomena occurred in the house of a Mr Fox, in West New York, in 1847–48. It was discovered by his daughter, Miss Kate Fox, a child of nine years old, that the raps replied to hers. An alphabet was then brought, the raps spelled out words by knocking when certain letters were pointed to, and modern spiritualism was born. It has again and again attracted notice in England; medium after medium has crossed the Atlantic; impostures have been exposed and defended; and opinion continues to be divided on the subject. The views of a believer, though not a fanatical one, may be quoted from Mr Dale Owen's book, *The Debatable Land*:—

"1. There exists in the presence of certain sensitives of highly nervous organisation a mysterious force, capable of moving ponderable bodies, and which exhibits intelligence. Temporary formations, material in structure and cognisable by the senses, are produced by the same influence—for example, hands which grasp with living power.

"2. This force and the resulting phenomena are developed in a greater or less degree according to the conditions of the sensitive, and in a measure by atmospherical conditions.

"3. The intelligence which governs this force is independent of, and external to, the minds of the investigator and of the medium. For example, questions unknown to either (*sic*), and in language unknown to either, are duly answered.

"4. The origin of these phenomena is an open question."

Now, as a rule, these phenomena are exhibited in the presence of "sensitives," who are paid for exercising their profession, and who prefer to do so in a dark room. Men of science who have attended these exhibitions have not always met with interesting results, and the conclusions at which some of them have arrived may be stated thus:—

1. As a rule, nothing worth notice has occurred at *séances* where competent observers have been present. Spiritualists reply that the spiritual kingdom can only be entered after long and patient attendance at many *séances*, and that the presence of the sceptic destroys the force of the spiritual influences.

2. When strange phenomena have been witnessed, they have often been traced to conscious imposture and *legor*

demain. Believers answer with sorrow that imposture is only too common on the part of mediums diffident of their powers; but the aim of science ought to be to detect the realities that co-exist with the imposture.

3. Where conscious imposture does not come in, *unconscious cerebration* and *unconscious muscular action*, supervening on a state of *expectant attention*, are just as deceitful. That the mediums are in a morbid condition is proved by the feeling of a cold air passing over the hands, like the *aura epileptica.* Unconscious muscular action may be defined as the involuntary response made by the muscles to ideas with which the mind may be possessed when the directing power of the mind is in abeyance. The response given by rapping on the part of the agitated furniture is due to unconscious cerebration—that is, to ideational changes taking place in the cerebrum—of which we may be at the time unconscious through a want of receptivity on the part of the sensorium. The answer given, though not present in conscious thought, may exist in latent thought, and that latent thought may stimulate muscular action towards producing the unconsciously-desired result. In their reply, spiritualists depend on evidence which science hesitates to accept. They say that they have seen such phenomena as no *consciously* exerted muscular power could produce, and heard replies that did not exist even in their *latent* consciousness. Hence they insist on the presence of "a new force."

4. The received spiritualist theory belongs to the philosophy of savages. A savage looking on at a spiritual *séance* in London would be perfectly at home in the proceedings. It is answered that the savage's evidence and belief is an undesigned coincidence of great confirmatory strength.

5. The reported doings and sayings of the spirits are trivial, irreverent, useless, and shocking. Spiritualists reply, with Swedenborg, that death works no immediate change in character or knowledge, and agree with Plato, in the *Phædo*, that the lowest and idlest souls are precisely the most likely to revisit earth. But with perseverance they look for better things.

We must leave the question *sub judice.* No one can be surprised that men of science hold back from devoting valuable time to the investigation of phenomena associated with darkened rooms, hysterics, and confessed imposture. On the other hand, believers will insist on crediting their eyes and ears, and being influenced by hopes and love and fears. Apparitions must be allowed to be an exception to the general ordinance—a disturbing influence in the healthy tide of things. It is more probable that the ordinary laws of nature will hold their sway than that a revolution is about to be effected in all human and divine relations. This is what spiritualists expect, and their attitude has its interest for the student of Man. Perhaps the principal lesson to be gained from the study of the theories of apparitions is that human nature remains essentially the same, beneath the shifting surface of creeds and customs.[1] (A. L.)

APPEAL, in its usual modern sense, is the act by which a decision is brought for review from an inferior to a superior court. In Roman jurisprudence it was used in this and in other significations; it was sometimes equivalent to prosecution, or the calling up of an accused person before a tribunal where the accuser appealed to the protection of the magistrate against injustice or oppression. The derivation from the word *appello,* naturally shows its earliest meaning to have been an urgent outcry or prayer against injustice. Hence it inferred a superior power capable of protecting against petty tyranny. In its meaning of seeking a higher tribunal for recourse against a lower, it does not seem to have been a characteristic of the Republic, where the magistrate was generally supreme within his sphere, and those who felt themselves outraged by injustice threw themselves on popular protection by *provocatio,* instead of looking to redress from a higher official authority. The Empire, however, introduced grades of jurdisdiction, and the ultimate remedy was an appeal to the emperor; thus Paul, when brought before Festus, appealed unto Cæsar. It must be understood that the appeal was actually dealt with by a supreme judge representing the emperor, not by the emperor in person. In the Corpus Juris, the appeal to the emperor is called indiscriminately *appellatio* and *provocatio.* A considerable portion of the 49th book of the Pandects is devoted to appeals; but little of the practical operation of the system is to be deduced from the propositions there brought together.

The ecclesiastical hierarchy, and the gradations of the feudal system, naturally afforded scope in the Middle Ages for appeals from the lower to the higher authority. In matters ecclesiastical, including these matrimonial, testamentary, and other departments which the church ever tried to bring within the operation of the canon law, there were various grades of appeal, ending with the Pope. The European princes in general struggled against this assumption of authority by the court of Rome, and it was the source of many contests between the ecclesiastical and the regal power.

It became customary for ambitious sovereigns to encourage appeals from the courts of the crown vassals to themselves as represented by the supreme judges, and Charlemagne usually enjoys the credit of having set the example of this system of centralisation, by establishing *missi dominici.* The great vassals, however, sought recourse against the decisions of the royal courts in their own order, embodied as the great council or parliament of the nation, and hence arose the appeal to the House of Lords as the court of last resort.

When the progress of civilisation and the art of self-government render judges no longer amenable to the charge of tyranny or fraud, an appellate system changes its character and objects. It in some measure certainly tends to preserve that judicial integrity which renders it unnecessary as the immediate refuge of the persecuted suitor. But its ostensible object is the preservation of uniformity in the law. The attainment of this object renders it unfortunately necessary, in such a country as ours, that no tribunal shall give, in the first instance, in any important question, a decision which is not open to appeal. The process has the double advantage, that it has a tendency to bring every legal difficulty ultimately to one tribunal, where a uniformity of principle may be expected in the application of the law, and, at the same time, stimulates the exertions of the subordinate judge, who knowing that his proceedings will be revised, is careful to bring them as close as he can to those uniform principles of law, which he knows that the court of appeal

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[1] The most eminent defender of modern spiritualism, Mr Alfred Wallace, reports a novel kind of apparition in the *Fortnightly Review* for May 1874. It seems that a young lady medium has the power of sending a semblance of herself into one room, while she is bound hand and foot in another. The pleasing peculiarity of this apparition is that *it* is no mere shadow, like the mother of Odysseus, whom he could not embrace in Hades. Mr Crookes, a Fellow of the Royal Society, has inspected it with a phosphorus lamp, and clasped it in his arms within the medium's sight. In M. Gautier's romance *Spirite*, the lover was not permitted to touch his airy mistress. Truth is indeed stranger than fiction.

will apply. To accomplish this function of an appellate system, it is right that the investigation of the question at issue should have been exhausted in the inferior court, and that the court of appeal should have nothing before it which has not been there considered; for if the inferior court decide on one representation of circumstances, and the court of appeal on another, the public will lose the advantage of having the principle which was applied in the inferior reversed or affirmed in the superior tribunal.

The House of Lords has hitherto been a court of appeal from the chief civil courts in the United Kingdom. The origin of the appellate jurisdiction of the House of Lords was undoubtedly of that partly feudal and partly popular character already alluded to, which made the suitor seek justice from the high court of Parliament, when it was refused in the baronial court, or even by the king's judges. Hence the lords exercised the mixed function of jurymen and judges, and, as in judgments on impeachment, the house might be influenced by private or party considerations, debating and dividing on the question before them. A revolution was silently accomplished, however, by which the function of reviewing the decisions of the courts fell entirely to the lawyers raised to the peerage, or to other judges brought in to give their aid; and the unprofessional lords only attended to give the sanction of a quorum to the proceedings. The letters and memoirs, so late as Queen Anne's reign, show that party or personal influence and persuasion were employed to procure votes on appeals, as they have in later times on railway or other local bills. The last instance probably in which a strong division of opinion was manifested among the unprofessional lords was the celebrated Douglas cause in 1769, when the house was addressed by the dukes of Newcastle and Bedford, but was led by the authoritative opinion of Lord Mansfield on the effect of the evidence,—an opinion which, being treated rather as that of a political partisan than of a judge, was sharply commented on in a work of great ability written by Mr James Stuart, who had a deep personal interest in the cause. The case of O'Connell and others, brought up on writ of error from the Queen's Bench in Ireland, in 1844, may be said to have finally established the precedent, that the judgments of the House of Lords were to be given solely by the law lords. On that occasion there was a difference of opinion among the law lords themselves. The judgment of the majority was strongly against the political feeling of the Government and of the peers as a body, while the law lords who carried the decision had been appointed by previous Governments opposed in politics to the existing cabinet. But all these temptations to a party vote by the unprofessional members were resisted. It has been the constant practice of the House, in cases of difficulty, to consult the judges of the inferior courts, and the decision of the House is usually determined by their opinion.

Of old, in Scotland, there was something anomalous in an appeal to Parliament, as the Court of Session was in its original constitution a committee of Parliament, for the performance of its judicial functions. In the reign of Charles II., however, the courts grew so intolerably corrupt that a determined effort was made to have their judgments overturned, by an appeal which was strictly of the old character of a cry for protection against flagrant injustice. It was called a "protest for remeid of law," and was inserted as one of the national claims in the Petition of Right at the Revolution. There was no allusion to an appeal system in the Treaty of Union; but the House of Lords, when appealed to against the judgments of the Court of Session, acted without hesitation. Many attempts were made, but without effect, to carry appeals from the supreme criminal courts in Scotland to the House of Lords.

The appeal system of this country previous to the Judicature Act of 1873 was constituted in the following manner. The House of Lords sat during the parliamentary session to hear appeals from the superior Courts of Equity and Common Law, from the corresponding courts in Ireland, and from the Court of Session in Scotland. In none of these cases, however, was the appeal directly from the judge of first instance to the final court. In the Common Law Courts, an appeal, under the name of a writ of error, was given from the decision of any one of the Common Law Courts to the decision of members of the other two, sitting in what was called the Court of Exchequer Chamber, and from that court to the House of Lords. In Equity the decisions of the Vice-Chancellors were subject to review before an appeal court, composed of the Lord Chancellor and two Lords Justices of appeal. The same procedure was observed in Ireland. In Scotland the appeal began by a reclaiming note from the Lord Ordinary to one of the divisions of the Court of Session, from which it passed to the House of Lords. The Judicial Committee of the Privy Council served as a court of final appeal for admiralty, ecclesiastical, and colonial cases. Established in 1833 to hear complaints by way of appeal addressed to her Majesty in Council, it was reconstituted in 1851, and again in 1870. At first it was a court composed entirely of *ex officio* judges, but in 1870 four paid judges were appointed—the composition of the court being varied from time to time by the addition of other members specially qualified to consider the special cases in hand. Thus, in ecclesiastical appeals the attendance of certain qualified prelates was provided for. The inconvenience of having two independent courts of final appeal, the unsatisfactory character of the intermediate process, and the uncertain composition of the appeal court in the House of Lords, were among the chief considerations which suggested the recent judicature reform. By the 36 and 37 Vict. c. 66, the several supreme courts are united and consolidated together under the name of the Supreme Court of Judicature in England. The Supreme Court is divided into two great tribunals, the first of which is called the High Court of Justice, and the second the Court of Appeal. The latter is invested with all the powers of the superior appeal courts previously existing, but it may be briefly described as a court of appeal from the High Court of Justice. Power is given to her Majesty to transfer by order all appeals and petitions which ought to be heard by the Judicial Committee of the Privy Council to the Court of Appeal. In ecclesiastical cases it is provided that the Court of Appeal "shall be constituted of such, and so many judges thereof, and shall be assisted by such assessors, being archbishops or bishops of the Church of England," as her Majesty, by any general rule, may think fit to direct. Appeals from inferior tribunals (County Courts, Petty, or Quarter Sessions) are to be determined by the divisional courts of the High Court of Justice, and no further appeal is possible unless by special leave of the divisional court. Appeals may be heard either by the full court of appeal, or by divisional courts thereof, consisting of not less than three judges, and any number of such courts may sit at the same time. The Court of Appeal shall consist of five *ex officio* and not more than nine ordinary judges; her Majesty may also appoint as additional judges, from time to time, persons who have held certain high judicial offices in the United Kingdom or in India. The Lord Chancellor is President of the Court of Appeal, and the ordinary or additional judges are to be styled Lords Justices of Appeal.

The Judicature Act of 1873 made no provision for transferring the Scotch and Irish business of the House of Lords to the new Appeal Court, and it is worthy of mention that a successful motion to that effect in the House of

Commons was treated by the other house as a breach of its privileges, and was finally abandoned. The Amendment Bill of 1874 (withdrawn for want of time at the close of the session) supplied this deficiency, and made some changes in the divisional arrangements of the Appeal Court. Although under the Act of 1873 there was nominally only one appeal, yet as the court was to sit in division, it was feared that there might be some danger of these divisions gradually developing independent and contradictory principles of jurisprudence. It was therefore proposed that one division of the Appellate Court should sit to hear Scotch and Irish and important colonial cases, the rest of the court sitting in sections according to convenience. Should there be a disagreement of opinion among the judges of these lower sections, a rehearing before the first division was to be permitted.

The large proportional amount of the judicial work in the House of Lords, caused by appeals from Scotland, has often been noticed. It proceeds from two causes. In England there was a virtual appeal for writ of error from one of Common Law Courts to the other two, not exemplified in Scotland. But there have always appeared to the disappointed Scotch litigant chances in his favour from his appealing to English judges against the Scotch judges who have decided against him; and the House of Lords being not only a court of law, but a House of Parliament, was believed to be at liberty to take wider views of legal questions than the constitution permitted to the inferior courts. Under the new system, proposed in the Bill of 1874, appeals for Scotland will only be allowed when the cause involves money to the amount of £500, or points of law relating to the right of property. It may be doubted whether the principle of such restriction can in any case be defended, and it is clear that the limit fixed by the bill would exclude many causes of great commercial importance. No express provision is made for the presence of a Scotch judge in the Court of Appeal, but Scotch advocates and judges are to be eligible for appointments to that tribunal, and there would probably always be one, at least, of its members selected for his acquaintance with the law of Scotland.

In France the adoption of the nomenclature of the civil law has made the term, in its French shape of *appel*, of more comprehensive use to express references from a lower to a higher tribunal, than in this country.

The United States, in adopting the structure of the English law, brought with it the practice of appeal and writ of error, but the federal constitution and the jealousy of central power have practically restricted the operation of the system. By the constitution, the Supreme Court of the United States is vested with "appellate jurisdiction, both as to law and fact, with such exceptions, and under such regulations, as Congress should make." It appears to have been held, however, that this does not confer appellate jurisdiction, but only authorises Congress to create it. In the words of Mr Kent, "If Congress had not provided any rule to regulate the proceedings in appeal, the court could not exercise an appellate jurisdiction: and, if a rule be provided, the Court could not depart from it. In pursuance of this principle, the Court decided in *Clarke* v. *Bazadone*, that a writ of error did not lie to that court from a court of the United States territory northwest of the Ohio, because the act had not authorised an appeal or writ of error from such a court."—(*Commentaries*, i. 324.) It was urged that the constitution itself had vested appellate jurisdiction in the Supreme Court, but that Congress may introduce such exceptions as it thinks proper. The action of Congress, it was said, is not required to create the jurisdiction, but is sufficient at any time to remove any part of it. The Court, however, has adhered to the view that its appellate jurisdiction is limited by the judiciary statutes, which are to be understood as making exceptions, and implying a negative on the exercise of such power in every case but those in which it is affirmatively given.

A peculiar and pernicious process which existed until a late period in English criminal law, received the name of appeal. It was a right of prosecution possessed as a personal privilege by an injured party, of which the Crown could not deprive him, directly or indirectly, since he could use it alike when the prisoner was tried and acquitted and when he was convicted and pardoned. It was chiefly known in practice as the privilege of the nearest relation of a murdered person, and was generally employed when the public passions were roused against the accused, on account, not so much of the evidence against him as the atrocity of the crime. Thus, after Colonel Oglethorpe's inquiry and report on the London prisons, when, in 1729, Banbridge and the other jailors were acquitted on indictments for deficiency of evidence, they were hotly pursued by appeals of murder. In the case of Slaughterford, in 1708, the public indignation was roused by the atrocity with which the accused was charged with murdering the woman he had seduced. The evidence was very imperfect, and he was acquitted on indictment; but an appeal was brought, and on conviction he was hanged, as his execution was a privilege belonging to the prosecutor of which the Crown could not deprive him by a pardon. In 1818 a parallel case occurred, when the appeal was ingeniously met by an offer of battle, since if the appellee were an able-bodied man, he had the choice of the two ordeals, combat or a jury. This neutralising of one obsolete and barbarous process by another, called the attention of the Legislature to the subject, and appeal in criminal cases, along with trial by battle, was abolished by 59th Geo. III., cap. 46.

APPENDINI, Francesco Maria, historian and philologist, was born at Poirino, near Turin, on the 4th Nov. 1768. Educated at Rome, he took orders and was sent to Ragusa, where he was appointed professor of rhetoric. When the French seized Ragusa, Napoleon placed Appendini at the head of the Ragusan Academy. After the Austrian occupation he was appointed principal of the Normal Institution at Zara, where he died in 1837. Appendini's chief work was his *Notizie Istorico-critiche sulle Antichità, Storia, e Letteratura dei Ragusei* (1802–3).

APPENZELL (for derivation see below), one of the twenty-two cantons of the Swiss Confederation, is an alpine region, with an area of about 152 square miles, entirely surrounded by the canton of St Gall. The mountains in the south attain a considerable elevation, the highest, Mount Sentis, being 8215 feet in height, and reaching the region of perpetual snow; but towards the north the surface is composed of mere hills and hollows, some of the hills being rather remarkable for their conical shape. The canton is watered by a tributary of the Thur, the Sitter, which takes its rise from a glacier on Mount Sentis, its affluent the Urnäsch, and a number of mountain streams. It was at one time almost covered with forests of fir and pine; but in consequence of the extension of the population, these have been greatly diminished. Peat and wood for fuel are abundant. The climate is cold and variable, but not unhealthy. Subject like the rest of Switzerland to the Franks in the 8th century, Appenzell gradually passed into the hands of the abbots of St Gall; in 1401 it rebelled against what had become an ecclesiastical tyranny; and in 1513 it was admitted into the Swiss Confederation. The violent struggles which followed the Reformation led to its division, in 1597, into two parts—the Inner Rhodes (a word of military origin, like the German *Rotte*), in the south, being appropriated to the Roman Catholics, and the Outer Rhodes, in the north, to the Protestants. This distinction has continued to the present day; the census of 1870 giving the number of Protestants in the Catholic district as only 188, and of Catholics in the Protestant, 2358. Until 1848, indeed, no Protestants, or even Catholic aliens, were allowed to settle in Inner Rhodes. The chief town of that division is Appenzell, and of the other, Trogen. Each district has its own democratical constitution, consisting of a *Landesgemeinde*, or General Assembly, where every freeman above 18 years is bound to appear, and a Great Council, chosen by the people, the members of which must submit their acts to the general approval for their ratification. Outer Rhodes sends two members to the *Nationalrath*, or House of Representatives of the Confederation, and Inner Rhodes one, besides the two members which the canton sends to the *Standerath*, or Senate. Appenzell has taken the civil code of Zurich for its model, and has instituted a court of appeal. The value of real and other property in Outer Rhodes is estimated at £59,028, and in Inner Rhodes at £9600; the revenue of Outer Rhodes at £12,699, and its expenditure, £12,800 (1868); and the revenue of Inner Rhodes at £6031, and its expenditure at £6011. In 1837 the population of the canton was 50,876; in 1860, 60,624, of whom 48,604 belonged to the Protestant division; and in 1870, 60,635, of whom 48,726 belonged to Outer Rhodes. This division, therefore, is far more populous and wealthy than the other part of the canton. Its inhabitants are industrious, and carry on large manufactures of cotton and linen goods and embroidery, while the inhabitants of Inner Rhodes are chiefly engaged in the rearing of cattle and the making of cheese. Since railway communication has made the district more accessible, a great number of strangers come to take advantage of the whey-cure establishments at Gais, Weissbad, Gonten, Urnäsch, &c. A peculiar dialect—differing from the ordinary Swiss German—is spoken throughout the canton. Red is the prevailing colour in the national dress; and athletic sports and rifle-shooting are the favourite amusements.

APPENZELL, the chief town of Inner Rhodes, in the canton of Appenzell, derives its name (*Abbatis Cella*, *Abtenzelle*), like Bischofszell and St Peterzell in the same region, from its ancient ecclesiastical connection. It is situated in the beautiful valley of the Sitter, and has a church with an old Gothic choir, two convents, and a council-house. The *Landesgemeinde* holds its meetings in the open square. In the *Archiv* are preserved a number of ancient banners, and among them one captured from the Tyrolese, with the grotesque inscription, *Hundert Tausend Teufel*. The inhabitants, who are almost entirely Roman Catholics, are largely employed in the production of embroidery, and number about 3700.

APPERLEY, CHARLES JAMES, a sportsman and sporting writer, better known as "Nimrod," the *nom de plume* under which he published his works on the chase and the turf, was born at Plasgronow, near Wrexham, in Denbighshire, in 1777. During the period of his education at Rugby he paid more attention to field-sports than to classics; and between the years 1805 and 1820 he devoted himself almost wholly to fox-hunting, so that he was by early training well fitted for the position of authority he afterwards acquired in the sporting world. About 1821 he began to contribute to the *Sporting Magazine*, under the pseudonym of "Nimrod," a series of articles, which from their racy character did the magazine admirable service. Its circulation doubled within two years; and the proprietor, Mr Pittman, with great liberality, kept for "Nimrod" a stud of hunters, and defrayed all expenses of his tours, besides giving him a handsome salary. The death of Mr Pittman, however, led to a law-suit with the proprietors of the magazine for money advanced to "Nimrod;" and the latter, to avoid imprisonment, had to take up his residence near Calais (1830), where he supported himself by his writings. He died in London, 19th May 1843. The most important of his works are—(1.) *Remarks on the Condition of Hunters, the Choice of Horses*, &c., Lond. 8vo, 1831; (2.) *The Chase, the Turf, and the Road* (originally written for the Quarterly Review), Lond. 1837; (3.) *Memoirs of the Life of the late John Mytton*, Lond. 1837; (4.) *Nimrod's Northern Tour*, Lond. 1838; (5.) *Nimrod Abroad*, 2 vols. 12mo. Lond. 1842; (6.) *The Horse and the Hound* (a reprint from the seventh edition of the *Encyclopædia Britannica*), 1842; (7.) *Hunting Reminiscences*, Lond. 1843.

APPIA VIA, the most celebrated of the ancient Roman roads, connecting the capital with Brundusium. It was commenced by Appius Claudius Cæcus (312 B.C.), who carried it from the Porta Capena to Capua (Livy, ix. 29). Its extension to Beneventum, and ultimately to Brundusium, making its total length about 350 miles, was completed before 30 B.C. The pavement, which rested upon several prepared substrata, was formed by large blocks of hard stone (*silex*) fitted to each other with great exactness. Its breadth was from 14 to 18 feet, excluding the footpaths. The course of the Appian Way is described by Horace, and Statius calls it the Queen of Roads (*Regina Viarum*). From a statement in Procopinus, it appears that the road was in perfect repair in his time (500–565).

APPIAN, an eminent writer of Roman history in Greek under the reigns of Trajan and Adrian. He was a native of Alexandria in Egypt, whence he went to Rome, where he became a distinguished advocate, and was chosen one of the procurators of the empire. He did not treat of the history of the Roman empire as a whole, but gave separate accounts of the various provinces as they were attached to the empire. Of his voluminous work there remains only what treats of the Punic, Syrian, Mithridatic, and Spanish wars, with those against Hannibal, the civil wars, and the wars in Illyricum, and some fragments of the Celtic and Gallic wars,—in all about one-half of the original twenty-two books. An excellent edition of Appian was published by Schweighäuser at Leipsic, in 1785, 3 vols. 8vo, in which the extracts from the lost books are collected. The best edition of the text is that of Bekker, 1853.

APPIANI, ANDREA, the best fresco painter of his age, born at Milan in 1754, died in 1817. He was made pensioned artist to the kingdom of Italy by Napoleon; but having lost his allowance after the events of 1814, he fell into poverty. Correggio was his model, and his best pieces, which are in the church of the Virgin and the royal palace of Milan, almost rival those of his great master. He is also said to have painted Napoleon and the chief personages of his court. Among the most graceful of his oil paintings are his "Venus and Love," and "Orlando in the garden of Armida."

APPIUS CLAUDIUS. See CLAUDIUS.

APPLE. The apple (*Pomme*, Fr.; *Apfel*, Ger.) is the fruit of *Pyrus Malus*, belonging to the Sub-order *Pomaceæ*, of the Natural Order *Rosaceæ*. It is one of the most widely cultivated, and best known and appreciated of fruits belonging to temperate climates. In its wild state it is known as the crab-apple, and is found generally distributed throughout Europe and Western Asia, growing in as high a latitude as Drontheim in Norway. The crabs of Siberia belong to a different species, and are named *Pyrus baccata* and *P. prunifolia*. The apple-tree as cultivated is a moderate sized tree with spreading branches, ovate, acutely serrated or crenated leaves, and flowers in corymbs. The fruit is too well known to need any description of its external characteristics. The apple is successfully cultivated in higher latitudes than any other fruit tree, growing up to 65° N., but notwithstanding this, its blossoms are more susceptible of injury from frost than the flowers of the peach or apricot. It comes into flower much later than these trees, and so avoids the night frost which would be fatal to its fruit bearing. The apples which are grown in northern regions are, however, small, hard, and crabbed, the best fruit being produced in hot summer climates, such as Canada and the United States. Besides in Europe and America, the fruit is now cultivated at the Cape of Good Hope, in Northern India and China, and in Australia and New Zealand.

Apples have been cultivated in Great Britain probably since the period of the Roman occupation, but the names of many varieties indicate a French or Dutch origin of much later date. In 1688 Ray enumerated 78 varieties in cultivation in the neighbourhood of London, and now it is calculated that about 2000 kinds can be distinguished. According to the purposes for which they are suitable, they can be classed as—1st, dessert; 2d, culinary; and 3d, cider apples. The principal dessert apples are the Pippins (*pepins*, seedlings), of which there are numerous varieties. The most esteemed of all apples is the American Newtown Pippin, a globular, juicy, sweet, and highly aromatic fruit; other American varieties of note are Williams's Favourite, Astrakhan, and Gravenstein, and for winter use the Baldwin, Spitzenberg, and Roxbury Russet. As culinary apples, besides Rennets and other dessert kinds, Codlins, and Biffins are cultivated. In England, Herefordshire and Devonshire are famous for the cultivation of apples, and in these counties the manufacture of cider is an important industry. Cider is also extensively prepared in Normandy and in Holland. Verjuice is the fermented juice of crab apples.

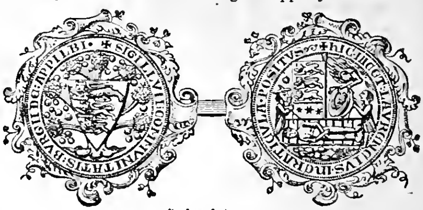
Apples for table use should have a sweet juicy pulp and rich aromatic flavour, while those suitable for cooking should possess the property of forming a uniform soft pulpy mass when boiled or baked. In their uncooked state they are not very digestible, but when cooked they form a very safe and useful food, exercising a gentle laxative influence. According to Fresenius their composition is as follows:—

Apple.	Water.	Sugar.	Free acid.	Albuminous substances. &c.	Salts.
English Rennets, ...	82·04	6·83	0·85	7·92	0·36
White Dessert, ...	85·04	7·58	1·04	2·94	0·44
English Golden Pippin,	81·87	10·36	0·48	5·11	

A large trade in the importation of apples is carried on in Britain, the amount of which is not, however, separately stated in the Board of Trade returns. Our imports come chiefly from French, Belgian, and Dutch growers, and from the United States and British North America. Dried and pressed apples are imported from France for stewing, under the name of Normandy Pippins, and similarly prepared fruits come also from America.

Many exotic fruits, having nothing in common with the apple, are known by that name, *e.g.*, the Balsam apple, *Momordica balsamina*; the Custard apple, *Anona reticulata*; the Egg apple, *Solanum esculentum*; the Rose apple, various species of *Eugenia*; the Pine apple, *Ananassa sativa*; the Star apple, *Chrysophyllum Cainito*; and the apples of Sodom, *Solanum sodomeum*.

APPLEBY, a market and borough town of England, capital of Westmoreland, situated on the Eden, 13 miles S.E. of Penrith. The greater part of Appleby, consisting of a broad, irregularly built street, from which smaller ones branch off, occupies the slope of a hill on the left bank of the river, in the parish of Appleby St Lawrence; but on the opposite bank, in the parish of Appleby St Michael, is the suburb of Bongate, which is connected with the rest of the town by a fine old stone bridge. Appleby contains an



Seal and Arms.

ancient castle, two parish churches, as well as Wesleyan places of worship, a town and a county hall, a jail, an hospital for thirteen poor women, and a grammar school. There is a municipal corporation, and previous to the Reform Act of 1832 the town returned two members to parliament. It has for a long time been a place of small importance, with little trade, and hardly any manufactures. Population of the Improvement Commissioners' District in 1871, 1989.

APPRAISER (from *ad* and *pretium*, value), one who sets a value upon property, real or personal. By 46 George III. c. 43, appraisers must possess a license, the duty payable for which is at present £2 annually. By a statute of William and Mary, two sworn appraisers must be employed by the sheriff to value any goods taken under distress for rent. The business of appraiser is usually combined with that of auctioneer.

APPRENTICE—APPRENTICESHIP. Apprenticeship (from *apprendre*, to learn) is a contract whereby one person, called the master, binds himself to teach, and another, called the apprentice, undertakes to learn some trade or profession, and to serve his master for a certain time. The contract is generally created by indenture, but any writing properly expressed and attested will suffice.

The *Civilians* are silent on the subject of this contract, nor does it seem to have had any connection with the division of the Roman citizens into tribes or colleges. So far as can be seen it arose in the Middle Ages, and formed an integral part of the system of guilds and corporations by which skilled labourers of all kinds sought protection against the feudal lords, and the maintenance of those exclusive privileges with which in the interests of the public they were favoured. In those times it was believed that the arts and sciences would not flourish unless such only were allowed to practise them as had given proofs of reasonable proficiency and were formed into bodies corporate, with certain powers of self-government and the exclusive monopoly of their respective arts within certain localities.

It has sometimes been supposed that these mediæval corporations were confined to such occupations as are now followed by artisans. This, however, is a mistake. The word *universitas* is the correct Latin name for any corporation whatsoever; and in mediæval parlance it was just as proper to speak of the university of smiths or tailors, as of the university of Paris or Oxford. It is, indeed, very probable that, at the dawn of returning civilisation, the humbler arts first received the attention and the fostering care of the state; but it is certain that as each lost art or science was recovered, its professors were formed into a university or corporation, composed of such as were entitled to practise and teach, and such as were in course of learning. The former were the masters, the latter the apprentices. Hence the term *Apprentice* was applied indifferently to such as were being taught a trade or a learned profession, and even to undergraduates or scholars who were qualifying themselves for the degree of doctor or master in the liberal arts. When barristers were first appointed by Edward I. of England, they were styled *apprenticii ad legem*—the serjeants being *servientes ad legem*; and these two terms corresponded respectively to the trade names of apprentices and journeymen. During the middle ages the term of apprenticeship was seven years, and this period was thought no more than sufficient to instruct the learner in his profession, craft, or mystery, under a properly qualified master, teacher, or doctor—for these names were synonymous—and to reimburse the latter by service for the training received. After this the apprentice became himself a master and a member of the corporation, with full rights to practise the business, and to teach others in his turn; so also it would seem that undergraduates had to pass through a curriculum of seven years before they could attain the degree of doctors or masters in the liberal arts. On the Continent of Europe these rules were observed with considerable rigour, both in the learned professions and in those which we now designate as trades. In England they made their way more slowly, and did not receive much countenance from our ancestors, who were always jealous of anything savouring of interference with the freedom of trade. Nevertheless the formation of guilds and companies of tradesmen in England dates probably from the 12th century, and it is almost certain that the institution of apprenticeships cannot be of much later date. In 1388 and 1405 it is noticed in Acts of Parliament. By various subsequent statutes provisions were made for the regulation of the institution, and from them it appears that seven years was its ordinary and normal term in the absence of special arrangement. By the 5th of Eliz. c. 4, this was made the law of the land, and it was enacted that no person should exercise any trade or mystery without having served a seven years' apprenticeship. In no place did the apprentices become so formidable by their numbers and organisation as in London. During the great rebellion they took an active part as a political body, and were conspicuous after the Restoration by being frequently engaged in tumults. It was probably owing to this circumstance, quite as much as to economical considerations of freedom of trade, that the Act of Elizabeth never found much favour with the courts of law. Soon after the great rebellion we find the apprentice laws strongly reprobated by the judges, who endeavoured, on the theory that the Act of Elizabeth could apply to no trades which were not in existence at its date, to limit its operation as far as possible. Such limitation of the Act gave rise to many absurd anomalies and inconsistencies, *e.g.*, that a coachmaker could not make his own wheels, but must buy them of a wheel-wright; while the latter might make both wheels and coaches, because coachmaking was not a trade in England when the Act of Elizabeth was passed. For the like reason all the great manufactures which have arisen in Manchester and Birmingham in modern times were held exempt from the operation of the statute. Concurrently with the dislike to the apprentice laws which such anomalies generated, the doctrines of the celebrated Adam Smith, that all monopolies or restrictions on the freedom of trade were injurious to the public interest, had gradually been making their way, and notwithstanding much opposition, an Act was passed in 1814 (54 Geo. III. c. 96), by which the statute of Elizabeth, in so far as it enacts that no person shall engage in any trade without a seven years' apprenticeship, was wholly repealed. The effect of this Act has been to give every person the fullest right to exercise any occupation or calling of a mechanical or trading kind for which he deems himself qualified. Apprenticeship, therefore, which was formerly a compulsory, has now become a voluntary contract. It is still, however, the usual avenue to such avocations, because experience has shown that it is the only effectual means of acquiring such a knowledge of the mechanical arts as shall enable a man to exercise them with advantage. In the case of the learned professions, the principles and theories which gave birth to corporations with monopolies, and required apprenticeship or its equivalents, have—contrary to what has taken place in trade—been not only maintained but intensified; that is to say, not only have such bodies retained and even extended in some cases their exclusive privileges, but in general no one is allowed to practise in such professions unless his capabilities have been tested and approved by public authority. Thus, no man is allowed to practise law or medicine in any of their branches who has not undergone the appropriate training by attendance at a university or by apprenticeship—sometimes by both combined. Entrance to the church is guarded by similar checks; and even in the case of education great advances have been made to bring the practice of that art under the like restrictions. In such instances the old principle—now abandoned in trade—of granting a monopoly to those possessing a certain standard of qualification is maintained in greater vigour than ever.

As already noticed, Dr Adam Smith and most of his school strongly disapproved of apprenticeship, but only as it would seem when applied to trade and manufactures. They urged that the institution interfered with the property which every man has or ought to have in his own labour, and interfered not only with the liberty of the workman, but with that of such as might choose to employ him, and who were the best judges of his qualification. They further argued, that such laws tended to restrain competition to a much smaller number than would otherwise enter a trade; that a long apprenticeship, or indeed any at all, was unnecessary even for the nicest mechanical arts; that a few weeks or even days were sufficient to enable a man to set to work in such trades as clock and watch making; and that if the workman was from the outset paid the full price of his work, under deduction of such materials as he might spoil from carelessness or inexperience, he would learn his art more effectually, and be more apt to acquire habits of attention and industry, than by working under a master who had a right to share in the produce of his labour. It was further contended that the whole system of apprenticeship, like that of the corporations of which it formed an integral part, was a mere device by which masters sought to limit the number of entrants into their respective trades, and so enhance their monopolies at the expense of the general public. That there is considerable truth in much of this reasoning is undeniable. At the time when Dr Smith began to attack the trade corporations, the narrow and vexatious rules of apprenticeship by which they sought to guard their exclusive privileges were, like their privileges, grievous restraints on the freedom of trade. But taking all this in its worst view will hardly justify the sweeping charges brought against the institution of apprenticeship. It is not conceivable that an institution, which for centuries found acceptance in every part of Europe, should have no better justification than the greed of master workmen. The abolition of the laws which rendered apprenticeship compulsory has not, as Dr Smith and his followers thought, led to its disuse. On the contrary, it or its equivalents have been voluntarily submitted to by such men as desired to exercise a trade to a profit; for the public were not long in discovering that the regularly trained artisan was the only one whose work could be relied on. It is not very easy to see why those principles of monopoly, based on ascertained proficiency, which are so rigorously enforced in the learned professions, should not at least have some application in the case of skilled artisans. It is also worthy of notice that the rise of trades' unions has been coincident with the fall of the old trade corporations - thus indicating that artisans feel the necessity for some more powerful and orderly protection than the mere operation of the blind principle of supply and demand. For these and similar reasons, it is believed that few practical men will in the present day deny the advantages of apprenticeship. No one would probably advocate the restoration of the old guilds with their exclusive privileges; but many would perhaps incline to advise the institution of some order or degree by which, in certain trades, the workman who has passed through a regular apprenticeship may be distinguished from the man who is not so qualified. (F. W. C.)

APRICOT, the fruit of *Prunus armeniaca* (Linn.) or *Armeniaca vulgaris*, according to others. Under the one name it is a species of the genus to which the plums belong, the other establishes it as a distinct genus of the natural order *Rosaceæ*. The apricot is, like the plum, a stone fruit, cultivated generally throughout temperate regions, and used chiefly in the form of preserves and in tarts. The tree is said to be a native of Armenia (hence the name *Armeniaca*), and it is found commonly in mountainous countries throughout Asia. It flowers very early in the season, and is a hardy tree, but the fruit will scarcely ripen in Britain unless the tree is trained against a wall. A great number of varieties of the apricot, as of most cultivated fruits, are distinguished by cultivators. The kernels of several varieties are edible, and in Egypt those of the Musch-Musch variety form a considerable article of commerce. The French liqueur *Eau de Noyaux* is prepared from bitter apricot kernels.

APRIES (Ἀπρίης), the name by which Herodotus and Diodorus designate Pharaoh-Hophra, the eighth king of the twenty-sixth Egyptian dynasty. See EGYPT.

APRIL was, in the old Roman reckoning, the second month of the year, but is counted in the Julian calendar as the fourth. The derivation of the name is unknown, though as far back as Varro we find the traditional etymology, *omnia aperit*, "it opens everything," which is supported by comparison with the modern Greek use of ἄνοιξις (opening) for spring; while some would make out a connection with *Aphrodite* (Venus), and Grimm suggests the name of a hypothetical god or hero, *Aper* or *Aprus*. Among the Romans this month was sacred to Venus, the *Festum Veneris et Fortunæ Virilis* being held on the first day. On the fourth and the five following days, games (*Ludi Megalenses*) were celebrated in honour of Cybele; on the fifth there was the *Festum Fortunæ Publicæ*; on the tenth (?) games in the circus, and on the nineteenth, equestrian combats, in honour of Ceres; on the twenty-first—which was regarded as the birthday of Rome—the *Vinalia urbana*, when the wine of the previous autumn was first tasted; on the twenty-fifth, the *Robigalia*, for the averting of mildew; and on the twenty-eighth and four following days, the riotous Floralia. In many countries of Europe, as England, France, and Germany, the first of April has for long been appropriated to a facetious custom, for which no very satisfactory origin has been assigned. To send an unsuspecting or ignorant person on some bootless errand is the great endeavour of the day. In Scotland the unfortunate subject of the trick is called a gowk—which has now, though the words were probably at one time different, the meaning both of "fool" and "cuckoo,"—and the mischievous errand-sending is "hunting a gowk." In France the dupe is called *poisson d'Avril*, or April-fish. One remarkable theory traces the custom to Noah, as sending out his dove on such a quest; it is also referred either to the miracle plays representing the sending of our Saviour from Annas to Caiaphas and from Pilate to Herod, or to the change, in France, in 1564, of New Year's day to the first of January, which left the first of April destitute of anything but a burlesque of its former festivities; and more recently an identification has been attempted with the Hindoo festival of Huli, which is celebrated in a similar manner on the 31st of March. No references to all-fools'-day have been found in our earlier literature; and it seems that both England and Germany have derived the fashion from France. St George's day is the twenty-third of the month; and St Mark's Eve, with its superstition about those who were doomed to die, falls on the twenty-fourth. In China the symbolical ploughing of the earth by the emperor and princes of the blood takes place in their third month, which frequently corresponds to our April; and in Japan a pleasant domestic festival, called the Feast of Dolls, is celebrated in the same month. The days of April (*journées d'Avril*) is a name appropriated in French history to a series of insurrections at Lyons, Paris, and elsewhere, against the government of Louis Philippe in 1834, which led to violent repressive measures, and to a famous trial known as the *Procès d'Avril*. (See Chambers's *Book of Days*; Grimm's *Geschichte der Deutschen Sprache*, cap. "Monate.")

A PRIORI and A POSTERIORI. The philosophical distinction expressed by these terms is to be explained by referring to the phraseology of Aristotle. According to him there may be a double starting-point in knowledge. When our individual progress in learning is chiefly considered, the things with which we are first and best acquainted may be termed earlier and *prior*; whereas the truths of a more general, primary, and fundamental character, to which we are subsequently led, have a later and *posterior* position. But if we lose sight of our personal interest in knowledge, then the priority may be more justly claimed by whatever is the cause or principle from which something else springs. In this sense the causal, original, and primary in the objective world is by nature prior (πρότερον φύσει); whilst the secondary and derivative existence is posterior. Priority in the first acceptation is only relative to us, and for general purposes may be called accidental; in the second acceptation, the priority is absolute, and without qualification. It is the second acceptation which Aristotle laid down as the properly philosophical one, and which regulates the usage of the phrases *a priori* and *a posteriori* by the schoolmen. In that sense of the term there can evidently be no *a priori* demonstration of first and fundamental principles. According to Aquinas, for example, there can be no *a priori* knowledge of God; because He, as uncaused and uncreated, cannot be deduced from anything prior in causation to Himself, and can only be apprehended rationally by means of that which is consequent upon His action, viz., the creatures of the natural world. In other words, our knowledge of Him must be *a posteriori*. It is obvious that science in the highest sense must be *a priori*, if *vere scire est per causas scire*; *i.e.*, the knowledge must spring from an insight into causes, which are the true primaries. By an extension of this usage an argument is said to follow an *a priori* path, when from the basis of some conception it proceeds to evolve by analysis all or some of the logical consequences; whereas, the mode of reasoning, which endeavours to gather into a single formula the various facts of observation, is described as *a posteriori*. The argument of Anselm, which, from the mere conception of God, proposes to deduce his existence, is an example of *a priori* reasoning. An *a priori* reasoner has to predict what is or will be, by considering what ought to be in accordance with certain presuppositions. He tries by argument to assign beforehand the place of a fact which may not yet have been discovered by observation. From the analysis of certain given conditions, or by constructing the total product from some given elements, he seeks to anticipate experience. Of course, if the original conception be bad or defective, the conclusions will be false or inadequate. Often too, what claims to be the mere deduction from a conception, is secretly and perhaps unconsciously supplemented by more efficient elements of proof. It is this circumstance, that imperfect knowledge is taken as the ground for further conclusions, which has brought *a priori* reasoning into discredit. Apart from these defects, however, this style of argumentation merely expresses the natural and blameless tendency of the mind to make every acquired truth a sort of lever and fulcrum from which to move the yet undiscovered and untried; and error is introduced only where there is a failure to correct this tendency by constant recurrence to the processes of verification. The *a priori* argument is based upon what was originally given through experience; but before this experiential truth becomes *a priori*, it must lose its first and empirical character, and be invested with the attributes of universality and necessity. In this sense, which since the time of Kant has been commonly given to the word, the *a priori* is the opposite of the empirical and contingent. Any truth which is relatively universal and necessary may in its own sphere form the basis of an *a priori* argument; and if there be anything which is absolutely universal and necessary throughout the whole range of knowledge, it will be in a supreme sense *a priori*. Such, according to Kant, is the self-contained and original faculty of mind, the forms and powers of the intellect and senses, as contradistinguished from the materials presented by the senses and elaborated by the understanding. To ascertain the special constitution of this *a priori* region, thus marked out by the criteria of universality and necessity, to determine the features of thought when it is independent of and prior to all experience, was the theme of the *Critique of the Pure Reason*. The general or universal form and faculty of knowledge, thought in its native purity, constitutes the *a priori* element: whilst the particularising data of experience, drifting in from the unknowable thing-in-itself, make up the region of the *a posteriori*. An example of an *a priori* science, according to Kant, in this sense of the term, as not dependent upon experience, is seen in pure mathematics; and there may also, according to him, be a pure or *a priori* philosophy of nature; but there can be no pure or *a priori* doctrine of the ultimate ideas which regulate experience,—that is, metaphysics in the older sense is impossible. (W. W.)

APSE (Gr. ἀψίς; Lat. *absis, tribuna, concha*; Fr. *abside, chevet, rond-point;* Ital. *apside, tribuna*; Ger. *Ablauf*), the semicircular or polygonal termination to a church. These forms were no doubt derived from the *concha* or *bema*, in the classic and early Christian basilica. In both cases it was the place appropriated to those who administered justice, the prætor's chair in the one being represented by the bishop's throne in the other. The altar stood not within the apse, but on the chord of its arc. Sometimes the apse is a simple semicircle; sometimes in large churches out of this a smaller semicircle springs, as Becket's Crown at Canterbury, and at Sens, Langres, and in many other churches abroad. Sometimes the choir finishes with three apses—one to the central aisle, and one to each side aisle, as at Autun. Sometimes the plan is a semicircle, each bay of which has a projecting semicircular apse, forming a sort of cluster of apses, as at Beauvais, Troyes, Tours, &c. The later choir at Mans is encircled by no less than thirteen apses, the centre one being twice the depth of the others, and forming the Lady-chapel. In some small churches of the Norman period, there is a sort of *double chancel*, one square, and the other an apse projecting eastward, each of which has its own arch, as at Sutton, East Ham, Darent, &c. Large circular and polygonal apses generally have radiating chapels within, as at Westminster Abbey. The earliest cathedral at Canterbury had an apse at each end, if we may trust the old plan; and there are several instances of the same kind in France and Germany. Apses project from the north and south ends of the transepts, and from their east sides in a few cases abroad, the only example of this in England being at Norwich.

APSHERON, a peninsula of Asia, in Georgia, extending from the eastern extremity of the Caucasus range for about 40 miles into the Caspian Sea, and terminating in Cape Apsheron. It produces naphtha, salt, and saffron in great abundance; and has long been celebrated among the fire-worshippers of Asia for the sacred fires that issue from its soil. On its southern coast is the port of Baku.

APT, the Roman *Apta Julia*, a town of France, in the department of Vaucluse, situated on the left bank of the Calavon, a tributary of the Durance, 30 miles east of Avignon. It is surrounded by ancient and massive walls, and is well built, although several of its streets are narrow and irregular. The chief object of interest is the cathedral, a building combining different styles of architecture, founded about the year 1050 on the site of a much older edifice, but not completed until the latter half of the 17th century. There are many Roman remains in and near the town, including a fine bridge, which is said to have been constructed by Julius Cæsar. The chief manufactures of Apt are those of woollen and cotton goods, silk, confectionery, earthenware, candles, leather, and brandy, and there is besides a considerable trade in fruit, grain, and cattle. Apt was at one time the chief town of the Vulgientes, a Gallic tribe; it was destroyed by Julius Cæsar, who subsequently restored it, conferring upon it the title Julia; it was much injured by the Lombards and the Saracens, but its fortifications were rebuilt by the counts of Provence. Population (1872), 5892.

APULEIUS, LUCIUS, celebrated as a philosopher and a writer of romance, was born at Madaura in Numidia, about 125 A.D. As the son of one of the principal inhabitants, he received an excellent education, first at Carthage and subsequently at Athens. After leaving Athens he undertook a long course of travel, principally with the view of obtaining initiation into religious mysteries. On a journey to Alexandria he fell sick at Œa (Tripoli), and was received into the house of Sicinius Pontianus, a former fellow-student. The widowed mother of Pontianus, Pudentilla, became enamoured of the handsome young philosopher, who, at her son's request, as he affirms, consented to marry her. The lady's wealth rendered this step distasteful to the other members of her family, by whom, after the premature death of Pontianus, Apuleius was indicted on a charge of having gained her affections by magical arts. He easily established his innocence, and his spirited, highly entertaining, but inordinately long defence (*Apologia, sive de Magia*), is our principal authority for his biography. From allusions in his subsequent writings, and the mention of him by St Augustine, we gather that the remainder of his prosperous life was devoted to literature and philosophy, that he exercised the priestly office, and frequently declaimed in public; and that statues were erected in his honour by Carthage and other cities. Many errors have found their way into his biography, from the supposition of his identity to a certain extent with Lucius, the hero of his romance. The contrary appears from the introduction of Lucius as a Greek, who professes to have only with great difficulty acquired Latin, Apuleius's own mother tongue. Lucius also takes a vow of poverty and chastity, which must have been but ill observed by the spouse of the opulent and amorous Pudentilla.

There is little of Apuleius's own invention in the work on which his fame principally rests. The *Metamorphoses* or *Golden Ass* (which latter title seems not to be the author's own, but to have been bestowed in compliment), was founded on a narrative in the *Metamorphoses* of

Lucius of Patræ, a work extant in the time of Photius. From Photius's account (impugned however by Wieland and P. L. Courier), this book would seem to have consisted of a collection of marvellous stories, related in an inartistic fashion, and in perfect good faith. The literary capabilities of this particular narrative attracted the attention of Apuleius's contemporary, Lucian, who proceeded to work it up in his own manner, adhering, as Photius seems to indicate, very closely to the original, but giving it a comic and satiric turn. Apuleius followed this rifacimento, making it, however, the groundwork of an elaborate romance, interspersed with numerous episodes, of which the beautiful story of Cupid and Psyche is the most celebrated, and altering the denouement to suit the religious revival of which he was an apostle. There is no reason to conclude with Warburton, that he wrote in direct antagonism to Christianity; or with Thomas Taylor, that "his intention was to show that the man who gives himself to a voluptuous life becomes a beast." The book is, nevertheless, a remarkable illustration of the contemporary reaction against a period of scepticism, of the general appetite for miracle and magic, and of the influx of Oriental and Egyptian ideas into the old theology. It is also composed with a well-marked literary aim, defined by Kretzschmann as the emulation of the Greek sophists, and the transplantation of their *tours de force* into the Latin language. Nothing, indeed, is more characteristic of Apuleius than his versatility, unless that it be his ostentation and self-confidence in the display of it. The dignified, the ludicrous, the voluptuous, the horrible, succeed each other with bewildering rapidity; fancy and feeling are everywhere apparent, but not less so affectation, meretricious ornament, and that effort to say everything finely which prevents anything being said well. The Latinity has a strong African colouring, and is crammed with obsolete words, agreeably to the taste of the time. Few books accordingly suffer less by translation. When these defects are mitigated or overlooked, the *Golden Ass* will be pronounced a most successful work, original in treatment though not in invention, invaluable as an illustration of ancient manners, and full of entertainment from beginning to end. The most famous and poetically beautiful portion is the episode of Cupid and Psyche, adapted from a popular legend of which traces are found in most fairy mythologies, which explains the seeming incongruity of its being placed in the mouth of an old hag. As observed by Friedländer, this discriminating recognition of the beauty of a wild flower of folk lore is as much to the credit of Apuleius's taste and feeling as the invention of it could have been to his imagination. The allegorical purport he has infused into it is his own, and entirely in the spirit of the Platonic philosophy. Don Quixote's adventure with the wineskins, and Gil Blas's captivity among the robbers, are palpably borrowed from Apuleius; and several of his humorous episodes, probably current as popular stories long before his time, reappear in Boccaccio.

Of Apuleius's other writings, the *Apology* has been already mentioned. The *Florida* are a collection of excerpts from his declamations, ingenious but highly affected, and in general perfect examples of the sophistical art of saying nothing with emphasis. The pleasing little tract *On the God of Socrates* expounds the Platonic doctrine of beneficent dæmons. Two books on Plato treat of his life, and his physical and ethical philosophy; a third, treating of logic, is generally considered spurious. Apuleius informs us that he had also composed numerous poems in almost all possible styles, and several works on natural history, some in Greek. In the preparation of these he seems to have attended more closely to actual anatomical research than was customary with ancient naturalists.

The character of Apuleius, as delineated by himself, is attractive; he appears vehement and passionate, but devoid of rancour; enterprising, munificent, genial, and an enthusiast for the beautiful and good. His vanity and love of display are conspicuous, but are extenuated by a genuine thirst for knowledge, and a surprising versatility of attainments. His place in letters is accidentally more important than his genius strictly entitles him to hold. He is the only extant example in Latin literature of an accomplished sophist in the good sense of the term. The loss of other ancient romances has secured him a peculiar influence on modern fiction; while his chronological position in a transitional period renders him at once the evening star of the Platonic, and the morning star of the Neoplatonic philosophy.

The most complete edition of Apuleius is Oudendorp's (Lugd. Bat. 1786–1823); the best modern edition is Hildebrand's (Leipsic, 1842). The translations and imitations of the *Golden Ass* in modern languages are innumerable. The episode of Psyche has afforded the subject of a drama to Thomas Heywood, and of narrative poems to Shakerley Marmion, and Mrs Tighe. There are good English versions by Sir G. Head, and in Bohn's Classical Library. The style of Apuleius has been thoroughly investigated by L. Kretzschmann, *De Latinitate L. Apulei Madaurensis* (Regimonti, 1865). (R. G.)

APULIA, the name applied to a district of southern Italy, the limits of which were not very definitely or permanently marked. It is usually regarded as having been bounded by the country of the Frentani on the N., Samnium on the W., Calabria and Lucania on the S., and the Adriatic on the E. The northern portion comprised the district sloping eastward from the Apennines, but did not take in any part of the mountains themselves; while the southern portion was occupied by a rocky off-shoot of the main chain, which left only a narrow but fertile strip of land along the sea. On the northern part of the coast was the remarkable mountain-mass of Garganus, forming an enormous promontory. Apulia was watered by the Tifernus (*Biferno*), the Frento (*Fortore*), the Cerbalus (*Cervaro*), the Aufidus (*Ofanto*), and a number of intermittent mountain streams. The soil for the most part was calcareous and arid, but in winter afforded abundant pasturage for the sheep, that in ancient times as now were driven during the summer to the neighbouring highlands of Samnium. Of the mingled population of Apulia, the Apulians proper (of Oscan race, it is supposed), the Daunians (perhaps of Pelasgian origin), and the Peucetians or Pœdiculi (likewise Pelasgian), seem to have been the principal elements. The prevalent language, according to Mommsen's investigations, was distinct from the Oscan and related to the Greek. Direct Greek influence—probably emanating from Tarentum—is evident in the workmanship and inscriptions of the coins and vases and other remains which have been discovered throughout the region. The more important towns were Larinum (?), Teanum, Luceria, Arpi, Salapia, Sipontum, Canusium, Barium, Egnatia, and Venusia. Reduced under Roman dominion in the 4th century B.C., Apulia for the most part continued true to the Roman cause till the time of the second Punic war, when it was greatly distracted and suffered grievously from the hostile operations of both the belligerents. It belonged to the second region of Augustus, and from the reign of Constantine was governed along with Calabria by a "*Corrector.*" For several centuries after 476 it was alternately under the power of the Lombards, the Goths, the Saracens, and the emperors of the East; and about the 10th century was regularly governed by the last by means of a "catapan" or deputy, who has left the designation of his office, *Catapanata*, in the modern corruption *Capitanata*, applied to the northern portion of the present Apulia. It was conquered by the Normans under William Bras-de-Fer, who took the title of *Comes Apuliæ* in 1042, was raised along with Calabria to a dukedom by Robert Guiscard in 1057, and in 1127 was united to the Sicilian monarchy. The name

Apulia is still employed as a geographical, but no longer as an ethnological or political designation.

APURE, a river of Venezuela, formed by the confluence of the Orivante and the Sarare in 7° N. lat., and 71° W. long., and joining the Orinoco, after a course of about 500 miles. Its chief tributaries are the Caparo and the Portuguesa.

APURIMAC, or TAMBO, a Peruvian river which rises in the lagoon of Villafro, near Caylloma, flows in a generally northward direction, and, receiving the waters of the Velille, the San Tomas, the Mamara, the Pachachaca, the Pampas, the Mantaro, and the Perene, falls into the Ucayali, an affluent of the Amazon. The river formed by the Tambo—or Catongo, as it is called in this part of its course—and the Mantaro receives the name of Ene, and is joined by the Perene, a river large enough for the passage of steamers. About 30 miles further down it forms a great cataract, which breaks the navigation. After receiving the Muyupu and the Vilcamayu or Urubamba, the stream, under the name of Ucayali, flows north to join the other head-streams of the Amazon near Nauta. The navigation of the Apurimac below the falls is greatly hindered by its strong and rapid current. The whole length of its course is about 600 miles.

AQUAMBO or AKUAMU, a country in the interior of the Gold Coast of Africa, extending along both banks of the Rio Volta or Aswada. The portion to the west of the river is under British protection; and that on the east, with the exception of a narrow strip along the bank, is subject to the king of Dahomey.

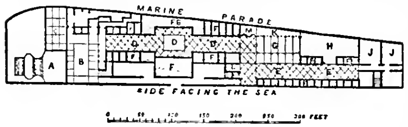
AQUAPIM, a country of considerable extent in the interior of the Gold Coast of Africa, immediately behind Accra. It is watered by the Densu, Dinskoi, or Seccoom, and is finely diversified with cultivated valleys and wooded hills of considerable elevation. The most important place is Akropong.

AQUARIANS, a name given to various sects of Christians in the primitive church who substituted water for wine in the communion service. This they did on principles of abstinence and temperance, or because they thought it unlawful under any circumstances to eat flesh or drink wine. Epiphanius calls them *Encratites*, from their abstinence; Augustine, *Aquarians*, from their use of water; and Theodoret, *Hydroparastatæ*, because they offered water instead of wine. Entirely distinct from those Aquarians upon principle, were others who used water at morning communion in order that they might not be discovered by the smell of wine.

AQUARIUM. This word is used to denote a vessel, or collection of vessels, in which marine or fresh water animals may be kept, and in which marine or sweet water plants may be grown. The invention or rather growth of the modern aquarium cannot, in the absence of precise data, be accurately traced. The aquarium, as we find it at Hamburg or Brighton, has, like many other things now in daily use, been elaborated from small beginnings. It is known that more than two centuries ago marine animals were, for the purposes of study and observation, removed from the sea and kept in confinement; and there is extant a drawing, of the date of 1742, which represents the form of an aquarium containing zoophytes. Esper, a distinguished entomologist, a century ago kept aquatic insects in water for observation. Sir John Graham Dalyell, the author of *Rare and Remarkable Animals of Scotland*, 2 vols. 4to, 1847–48, *The Power of the Creator displayed in the Creation*, 3 vols. 4to, 1851–58, and numerous other works, was during his lifetime a keen student of marine animals; and, at his house in Edinburgh, he had constructed for the purposes of observation an aquarium of a very humble kind indeed, but quite sufficient for his purpose. It is well known that some of the animals which he kept for the purposes of study lived for a very long period in confinement: one sea anemone is mentioned on good authority as having been taken from the sea in the year 1828, and being alive and well in 1873 (W. A. Lloyd). Sir John's tanks, as has been stated, were of the humblest description, and never contained any of that vegetation which forms so beautiful and interesting a feature of the modern aquarium, and which, as Priestley had discovered long before, purifies the water in which it is kept growing. About the year 1839 a movement was made towards the construction of aquariums of a more elaborate description, which lasted for more than twenty years during which time a large number were made, and many descriptive works published on the subject. Agencies were during that period established in London and elsewhere for the supply of animals, and some at the same time made it a business to purvey sea water—the obtaining of this, and keeping it fresh, being with many persons who lived far from the sea a great difficulty. Indeed the difficulty was so great that an artificial compound was in numerous instances resorted to for lack of genuine sea-water. A solution of this difficulty came tardily, in 1841. Mr Ward at that time constructed in London a fresh-water aquarium, in which aquatic plants were very successfully grown for the purpose of keeping the water pure and the animals healthy, and a year later, Dr George Johnston of Berwick-on-Tweed, accidentally discovered, in the course of making an experiment for another purpose, that the animal and plant life of the sea could also be made to support each other. For a period of sixty days he kept some animals in a jar without once changing the water, and thus solved the problem. Early in 1847 Mrs Thynne of London successfully investigated the problem, whether it was possible to keep the animals in good condition of health without changing the water. In 1849 Mr R. Warington, also of London, and afterwards Mr P. H. Gosse, conducted successful experiments having for their object the balancing of vegetable and animal life, which afterwards came to be thoroughly recognised. Sea-weeds, however, do not bear transplanting, but sea-water is so impregnated with the seeds or germs of vegetable life, that when a few stones or fragments of rock are taken from the ocean, marine vegetation speedily commences and proceeds. Mr Price, Mr Lankester, Mr Bowerbank, and others, also made experiments in the same direction, and in 1853 a fish-house or aquarium of considerable size was constructed by the Zoological Society of London in their garden in the Regent's Park. This erection gave such an impetus to the popular aquarium movement as rendered it almost a mania, and for a year or two these scientific toys, some of them of large size, became much appreciated household ornaments. The movement was further accelerated by Mr Gosse and Mr Warington, who published formulæ for the manufacture of artificial salt water, in which sea animals would thrive as well as in their native element. Many large public aquariums have been erected since the example was set by the Zoological Society of London. A great aquarium has been usually a popular feature of the numerous Continental fishery-exhibitions held since 1860, particularly at those of Amsterdam, Boulogne, Havre, Arcachon, and the Hague. These, of course, were temporary aquariums, ending when the exhibition of which they formed a part came to a close; but permanent aquariums are now a feature of several large towns and cities. In England there is a very large aquarium at Brighton; while at the Crystal Palace there is one on a smaller scale, as also at Manchester and Southport, and preparations are being made [1874] for the erection of similar edifices in other towns and cities of Great Britain. The aquarium at Hamburg has already been mentioned; there are others at Berlin and Vienna; and the aquarium at Naples affords special accommodation and opportunity for skilled naturalists pursuing delicate scientific investigations.

The modern aquarium is essentially different from the vivaria or fish-stews of ancient times. These were constructed for every day kitchen use, for the purpose of supplying the tables of their wealthy possessors with various kinds of fish; some of those kept being of great value. Wonderful stories are told by ancient authors of the pains taken to procure fine breeds of fish, and the care with which they were fed and fattened for use. Fish were borrowed and returned; the keeping of them became a fashion, and extravagant sums of money were expended on the purchase of rare kinds. The remains of vivaria and fish-stews are still to be found in the neighbourhood of Naples, and at other places in Italy.

The dimensions of the great aquarium at Brighton are as follows:—Its area is 715 feet in length by 100 feet in breadth. It contains many tanks, some of them being of



Ground Plan of Brighton Aquarium.

A, entrance court; B, entrance-hall and reading-room; C, restaurant; D, D, western corridor; E, E, eastern corridor; F, F, tanks (all shaded in plan); F 6, the large tank, No. 6; G, conservatory; H, rockwork, fernery, and cascade; I, I, space with tanks on table; J, J, engine, stores, &c.; K, rockwork with ponds for seal, &c.; L, grotto; M, heating apparatus.

vast capacity; there is one in particular (No. 6) which contains 110,000 gallons of water, and has a plate-glass front 130 feet long, through which the habits of very large fish may be studied. The rock-work of the tanks is entirely artificial, and admirably adapted to afford shelter to the fish and crustaceans which disport in them. The management of a large aquarium, such as that at the Crystal Palace or at Brighton, involves constant anxiety and daily trouble: the fish must of course be fed so that they may enjoy good health, and to ensure this they must live under conditions as nearly as possible the same as they have been accustomed to in the waters from which they have been taken. At one time much difficulty was experienced in keeping the inhabitants of sweet-water tanks in good health; in numerous instances the fish died in a day or two after their places of residence had been changed; and it wss not till after many different plans had been tried, that safe modes of keeping them in a healthy state were found out. Thousands of fish died in ornamental fresh-water tanks from over-attention, from a too frequent changing of the water, and from lack of a supply of those elements of growth which are essential to all animated nature.

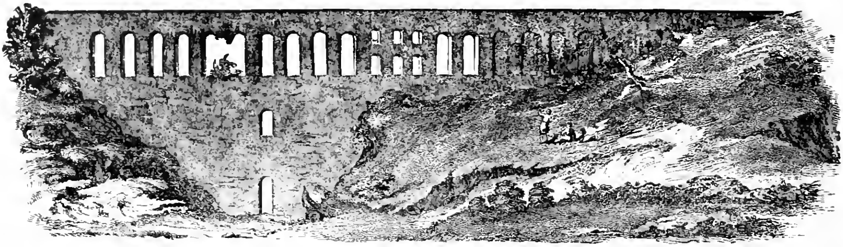
The aquariums at Brighton and the Crystal Palace exemplify two distinct systems of construction and management. At the former there is no actual circulation of water from one tank to another—but it can, if necessary, be renewed from the sea; the mass of the water in the reserve cisterns is small as compared with that in the show tanks, and aeration is effected by pumping air into the tanks through tubes of large diameter. Purification of the water is also assisted by the presence of large bivalve molluscs in the tanks. At the Crystal Palace aquarium, a constant circulation is maintained from one tank to another; the bulk of water in the reservoir is five times as much as that in the show tanks, while aeration is accomplished by carrying a main over their entire length, from which, under pressure, a small stream of water pours from a tap into each, breaking the surface of the water, and carrying down to the bottom of the tanks, and distributing over the body of their contents, myriads of minute bubbles of air, which present an enormous oxidising surface to the water, rendering it bright and sparkling.

It does not answer very well, even when an aquarium is at the sea-side, to be constantly changing the water, as the new supply is so disturbed and impregnated with impurities as to be fatal to delicate animals, besides not being in a proper state for exhibition. Some of the inhabitants of an aquarium foul the water very much more than others, notably the flat fish family, and provision has to be made for this by putting such other animals in the same tank as will aid in purifying the water. Various small animals have of course to be provided as food for the larger marine specimens, others of them act as scavengers, helping to keep the water constantly sweet and clean. The light admitted to the fish in the tanks is also a matter of careful adjustment. As the animal life and vegetable life mutually support each other, the kind of material necessary for maintaining the "compensating system" must be watchfully supplied. Mr W. R. Hughes of Birmingham recommends the growth of sea-lettuce (*Ulva latissima*) in tanks, as suitable both for oxygenating the water and for food for the fishes; the stock plants being introduced in the autumn months, when they are loaded with spores. Now that such excellent aquariums as those at Brighton, Manchester, Southport, and Sydenham are in full working order, the construction of others will not be difficult, even when projected on a larger scale. Distance from the sea is of no consequence, as sea-water may be obtained by railway, and can be kept stored as already suggested.

Scientific discovery, or the promotion of experiments in natural history, is usually no direct part of the plan of modern aquariums, except in so far as this may be incidental to the daily conduct of the collection. Nevertheless, it is not too much to expect that the aquariums already in existence, and those which are projected, may be made useful in determining many questions connected with the life and growth of our food fishes, in regard to which naturalists and economists are alike ignorant. The fish of which we know most is the salmon, and our knowledge of that "monarch of the brook" arises from the fact of its being accessible to constant observation. It would tend to the better regulation of our fisheries, and to the augmentation of our food supplies, if we knew as much about the herring or the haddock as we know about the salmon. Were a large marine observatory erected by the State, say at Brighton, or were the present aquarium there considerably extended, the best results might follow. Precise information might be obtained as to the period of spawning of the common herring, the length of time which the ova require to come to life, and the age at which the fish becomes reproductive. The conditions under which fish grow and remain in good health, the best kinds of food on which to feed them, the best methods of protecting them from their numerous enemies, are all questions which a properly conducted aquarium would aid our naturalists to study. It is well known that very uneconomical modes of fishing are at present resorted to, and that the largest portion of our fish is captured at a time when fish ought not to be captured—at a time, indeed, when they are most unfit for use. It is only by studying the habits of these denizens of the ocean, in some place where they can be constantly under observation,—such as a great aquarium, where the conditions of their captivity should resemble as much as possible their native *habitat*,—that we can ever hope to fathom the mysteries of the great deep, and ultimately have at our command the treasures of the sea. (See Gosse, *The Aquarium*, 1856; the Guide-Books of the Crystal Palace and Brighton Aquariums; Hughes, *On the Principles and Management of the Marine Aquarium*, 1874.) (J. G. B.)

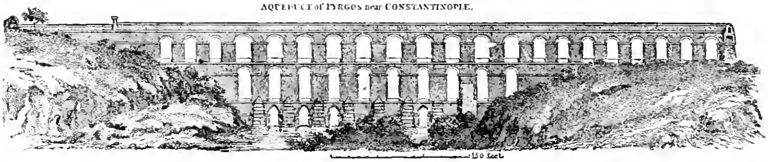
AQUEDUCT.

Aqueduct near ANTIOCH.



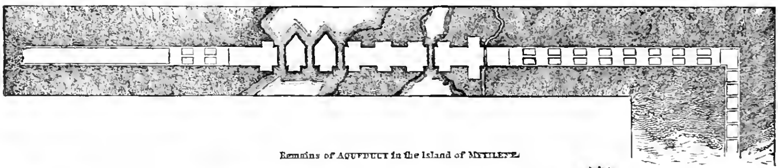
150 feet

AQUEDUCT of PYRGOS near CONSTANTINOPLE.



150 feet

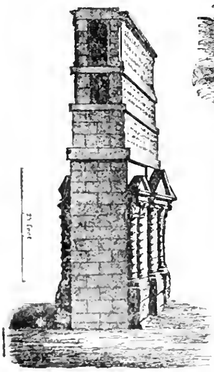
Ground Plan.



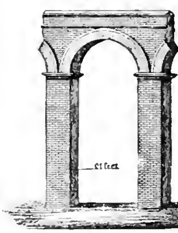
Remains of AQUEDUCT in the Island of MYTILENE.

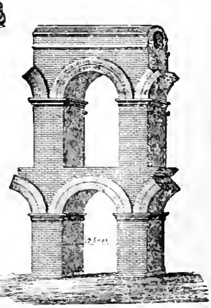
150 feet

PORTA MAGGIORE at Roma.



Arches of ROMAN AQUEDUCTS





AQUEDUCT

AQUEDUCT, a conduit or channel for the conveyance of water (Lat. *aquæductus*), but commonly a structure of masonry erected to conduct water across a valley at a high level, though structures of this kind would be more properly termed aqueduct bridges. This distinction it is necessary to bear in mind, more particularly when dealing with the undertakings of this class carried out by the Greeks and Romans respectively, because, from the fact of the former having apparently seldom if ever constructed aqueduct bridges, it has been usual to institute a very unfavourable comparison between them and the Romans, who, with imperial disdain of obstacles, furnished the cities of their immense empire with a series of constructions of this kind for the supply of water, which still in their ruins excite our astonishment. True to the difference in national genius the Greeks, following the analogy of nature, in which in their own country they saw the water collected in the hills passing for miles along subterranean courses, and issuing in cool fountains at the coast, adapted their system of conduits to the physical formation of a district, cutting tunnels and canals, rather than bridging over valleys, and as a consequence no conspicuous monument of their system now remains. But even if what they did was so little as to justify Strabo (v. p. 235) in charging them with neglect in this matter as compared with the carefulness of the Romans, it is still clear from the records that they accomplished much, and that in this, as in other respects, they were the instructors of the Romans. It is here to be premised that the term aqueduct applies only to the conveyance of such water as was used for drinking or other useful purposes, and not to the draining of marshes, though in both cases the works may often have been of the same kind. The insufficiency of water, supplied by natural springs and cisterns hewn in the rock, which in an early age had satisfied the small communities of Greece, had become a pressing public question by the time of the Tyrants, of whom Polycrates of Samus and Pisistratus of Athens distinguished their rule by extensive works to meet the exigencies of their states. For this purpose the former obtained the services of Eupalinus, an engineer celebrated for the skill with which he had carried out the works for the water supply of Megara, under the direction of the Tyrant Theagenes (*circa* 625 B.C.) At Samus the difficulty lay in a hill which rose between the town and the water source. Through this hill Eupalinus cut a tunnel 8 feet broad, 8 feet high, and 4200 feet long, building within the tunnel a channel 3 feet broad and 11 ells deep. The water, flowing by an accurately reckoned declivity, and all along open to the fresh air, was received at the lower end by a conduit of masonry, and so led into the town, where it supplied fountains, pipes, baths, cloacæ, &c., and ultimately passed into the harbour. In Athens, under the rule of Pisistratus (B.C. 560), a similarly extensive, if less difficult, series of works was completed to bring water from the hills Hymettus, Pentelicus, and Parnes. From Hymettus were two conduits passing under the bed of the Ilissus, and most part of the course cut in the rock. Pentelicus, richer in water, supplied another conduit, which can still be traced from the modern village of Chalandri by the air shafts built several feet above the ground, and at a distance apart of 40–50 metres; the diameter of these shafts is 4–5 feet, and the number of them still preserved is about sixty. Tributary channels conveyed into the main stream the waters of the district through which it passed. Outside Athens, those two conduits met in a large reservoir, from which the water was distributed by a ramification of underground channels throughout the city. These latter channels vary in form, being partly round, partly square, and generally walled with stone; the chief one, that under the bazaar, is sufficiently high and broad to allow two men to pass in it. Sometimes pipes of baked clay were laid within them. The conduit from Mount Parnes appears to have been reconstructed in later times. Some of these aqueducts continue to supply Athens to this day, and are described as marvels of enterprise and skill (E. Curtius, *über die Wasserbauten der Hellenen*, in the *Archäol. Zeit.* 1847, p. 19). In Sicily, the works by which Empedocles, it is said, brought the water into the town of Selinus, are no longer visible; but it is probable that, like those of Syracuse, they consisted chiefly of tunnels and pipes laid under ground. The system of conduits in Syracuse which Thucydides says (vi. 100) the Athenians partly destroyed on the Sicilian expedition, still supplies the town with an abundance of drinkable water; and at one point, where the tunnel passes under the sea to the island of Ortygia, presents what has long been regarded as a remarkable achievement for early times. An example of what appears to have been the earliest form of aqueduct in Greece has been discovered in the island of Cos (Ross, *Inselreise*, iii. p. 131), beside the fountain Burinna on Mount Oromedon. It consists of a bell-shaped chamber, built underground in the hill side, to receive the water of the spring and keep it cool; a shaft rising from the top of the chamber supplied fresh air. From this reservoir the water was led by a subterranean channel, 35 metres long and 2 metres high.

Of the constructions for the conveyance of water in Italy in early times, there is an example at Tusculum, consisting of an oblong basin, divided into several chambers, which received the water of a spring, and then distributed it by pipes (*tubi, fistulæ*) or canals. The basin is built of blocks of stone, which, along the sides, overlap each other, till they meet and form a roof—a principle of building which was afterwards supplanted by vaulting, and which occurs also in the earliest Greek masonry. The pipes were either of lead or baked clay. When the course lay in soil, gullies were cut and conduits of masonry built within them. When rocky ground intervened, tunnels were pierced, and in both cases shafts (*spiramen, lumen*) were made at intervals of about 240 feet, to admit light and fresh air. The inside of the walls of these channels received a coating impervious to water, composed of chalk and crushed fragments of tile. Where the course was interrupted by an inequality in the ground, a vertical pipe (*venter*) was placed reaching to the surface or above it. The water rushing up this pipe was freshened by contact with the air, and again fell back to the new course which it had to take. Works of this kind, undertaken for the public convenience, were paid for out of the public purse, a tax being levied for the use of the water.

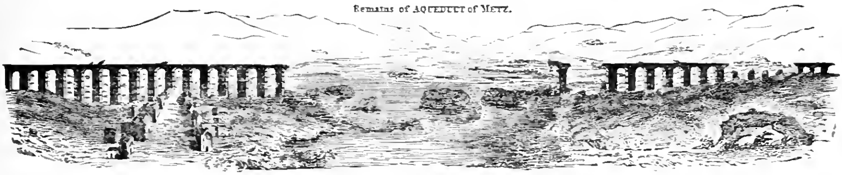
If, to obtain a proper incline, the water-course had to be carried above ground, the simple plan was to support it on a stone wall, and in this case the conduit itself was also built of blocks of stone, coated with a stucco impervious to water. But since a solid wall across a valley would have cut off the usual traffic, it was found necessary to break up the wall, by means of arches, into a series of pillars, and with this commenced the system of aqueduct bridges, which have proved to be the most striking monuments of the Roman empire. As perhaps the best known instance of this double purpose, of an archway under which traffic might pass, and over which water might be conveyed, there is the Porta Maggiore at Rome (Plate III.) The waters conveyed over it in two separate channels, are the AQUA CLAUDIA and the ANIO NOVUS, and from the three inscriptions above the arches it appears (1.)—that the Emperor Claudius had constructed the so-called Aqua Claudia Aqueduct from the springs Cæruleus and Curtius, 45 miles from Rome; (2.) that the same emperor had constructed the so-called Anio Novus Aqueduct from the 62d milestone from Rome; (3.) that the Emperors Vespasian and Titus had restored these splendid undertakings of Claudius. Both aqueducts had been begun by Caligula, 38 A.D., and were completed ten years after by Claudius. The two springs from which the Aqua Claudia took its rise were in the Sabine hills near the 35th milestone, on the Via Sublacensis. It was augmented by part of the Aqua Martia, famous for the goodness of its water, and, owing to bends in the course, reached the length of 45 miles, as stated in the inscription, 35 miles of it being under and 10 above ground. The Anio Novus, so called to distinguish it from an older aqueduct, the Anio Vetus, took its rise in the river Anio at the 62d milestone, on the road just named, the water being first collected in a large basin, where it was allowed to purify itself. At the 32d milestone it was augmented by the clearer water of the spring, *rivus Herculaneus*. The entire length of 62 miles was partly above and partly below ground. About 6 miles from Rome it approached the Aqua Claudia, and from that point the two waters travelled together to the city in two distinct channels, one above the other, and supported by a chain of arches, which at one place reached the height of 109 feet. But in height these arches must yield to those of the aqueduct at Nismes, the ancient Nemausus, erected in the time of Augustus, which rose to 180 feet. The Pont du Gard, as the aqueduct at Nismes is now called, consists, as will be seen from Plate IV., of three rows of arches striding across the valley of the river Gardon. In the lowermost row are six arches, of which one has a span of 75 feet, the others each 60 feet. In the second row are twelve arches, each with a span of 75 feet. In the third row are thirty-six smaller arches, immediately above which was the water-course. As a bridge, the Pont du Gard has no rival for lightness and boldness of design among the existing remains of works of this class carried out in Roman times..

Besides the two principal aqueducts at Rome already described, there remain to be noticed twelve more which assisted in the supply of water for the city. These are (1.) AQUA APPIA, which took its rise at the foot of the Alban mountains on the Præneste road, between the 7th and 8th milestones, and measured from its source to the Porta Trigemina 11,180 paces, of which 11,130 were below ground. It appears to have been the first important enterprise of the kind at Rome, and was the work of the old Censor Appius Claudius, from whom it derived its name. The date of its construction was the year of Rome 442, according to Frontinus, an overseer of aqueducts (*curator aquarum*) under the empire, whose work *De Aquæduct. urb. Romæ* we still possess. (2.) ANIO VETUS, constructed forty years after the last-mentioned aqueduct, by the Censor Manlius Curius Dentatus, with the help of L. Papirius Censor, who finished it. From its source near Tivoli, on the left side of the Anio, it flowed 43,000 paces, of which 42,779 were below ground, and 221 above. At the distance of 2 miles from Rome (Frontinus, i. 21) it parted into two courses, one of which led to the *horti asiniani*, and was thence distributed; while the other (*rectus ductus*) led by the temple of Spes to the Esquiline gate, the site of which was near the modern Villa Negroni, where, in 1861, was found a subterranean conduit and an inscribed stone, which left no doubt as to its having been one of the stones set up to mark the distances of the Anio Vetus. (3.) AQUA MARTIA, rising on the left side of the Via Valeria, traversed 61,710 paces, of which 54,247 were underground, and the remaining distance carried partly on solid wall and partly on arches. It was the work of Quintus Martius Rex, not of Ancus Martius the fourth king of Rome, as Pliny (*N.H.*, xxxi. 3) fancied, and took its name from its constructor. Its waters were celebrated for their coolness and excellent quality. (4.) AQUA TEPULA, from its source in the district of Tusculum, flowed 10,000 paces, mostly above ground, and on the same series of arches as carried the Aqua Martia, but at a higher level. It was the work of the Censors Cn. Servilius Cæpio and L. Crassus Longinus, and was completed in the year 126 B.C. Again, partly on the same structure of arches, and with a still higher channel, flowed—(5.) AQUA JULIA, from a source near that of the last-mentioned aqueduct to within 7000 paces of the walls of Rome, where the joint waters were received in a reservoir, and thence distributed in various channels to the city. Its entire length was 15,426 paces. It was constructed in the year 34 B.C. by Marcus Agrippa, to whose zeal to meet public wants in this direction were due the two other aqueducts—(6.) AQUA VIRGO, and (7.) AQUA CRABRA or DAMNATA, the former as well known for the goodness of its water as was the latter for the inferiority which procured it the designation of Damnata. The Aqua Virgo, from its origin at a copious spring in a marsh on the Collatine way, not far from the ancient Gabii, measured 14,105 paces, along which it was conveyed in pipes, partly under and partly above ground, on a solid substructure or on arches. It was completed in the year 48 B.C. (8.) AQUA ALSIETINA or AUGUSTA rose in Etruria, on the Via Claudia, and travelled 22,172 paces, of which 358 were on arches. It was the work of Augustus, whose object was to furnish by it water for gardens and other than drinking purposes. (9.) AQUA TRAJANA, rising in Lake Sabatinus (Bracciano), was constructed by Trajan. (10.) AQUA ALEXANDRINA, rising in the district of Tusculum, was the work of Alexander Severus. (11.) AQUA SEPTIMIANA seems to have been only a branch led from the Aqua Julia to supply the baths of the emperor from whom it takes its name, Septimius Severus. (12.) AQUA ALGENTINA rose on Mount Algidus; at whose instance it was made is unknown. Of the fourteen aqueducts which supplied ancient Rome, three remain in use at the present time, furnishing the modern city with abundance of water. The first of the three is the Aqua Virgo, now known as Fontana di Trevi, supplying the best water in Rome. It was restored by Pope Pius IV. The next is the Aqua Claudia, known as the Aqua Felice or di Termini, which was restored by Sixtus V. The third is the Aqua Trajana, called, from the Pope who restored it, viz., Paul V., Aqua Paole.

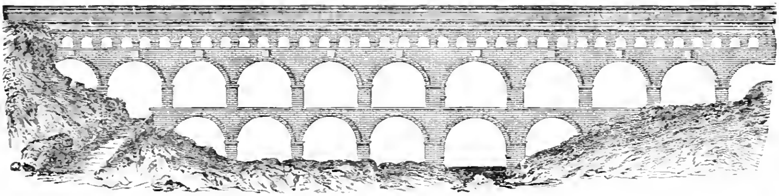
At regular intervals along the course of an aqueduct were built reservoirs (*castella*), to enable repairs to be made at any point, and also to let off water for the population of the district through which it passed. It was the law that material necessary for repairs should be supplied from the private property nearest to where the damage was, and should be conveyed at the cost of the owner of such property. *Castella* of smaller dimension were also required in many parts of the city. Of these, it was said, there were 247 in Rome. To allow the water to purify itself before being distributed in the city, large basins (*piscinæ limariæ*), were built outside the walls. For the process of purification salt was used (Vitruvius, viii.) These piscinæ were covered in with a vaulted roof, and were usually on a colossal scale, as in the example still preserved at Fermo, which consists of two stories, each having three oblong basins communicating with each other; or the Piscina Mirabile at Baiæ, which is covered in by a vaulted

AQUEDUCT.

Remains of AQUEDUCT of METZ.



AQUEDUCT or PONT du GARD near NISMES.



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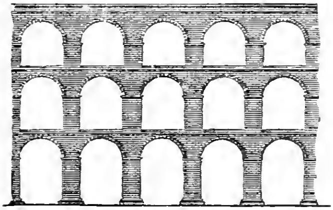
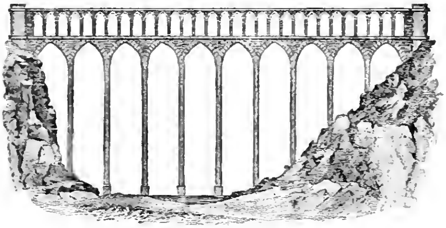
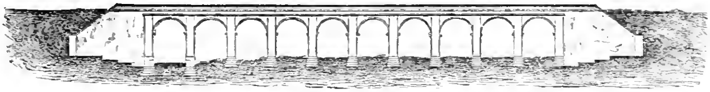


AQUEDUCT DELLE TORRÉ, SPOLETO.

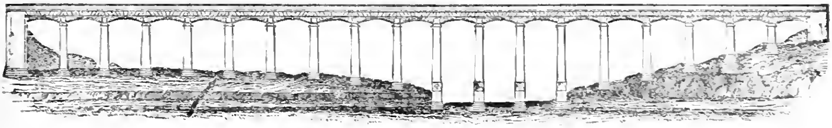


100 feet

CHIRK AQUEDUCT. (Ellesmere Canal)



DEE AQUEDUCT. (Ellesmere Canal)



Scale to all the Figures excepting Spoleto. [illegible] feet

roof, supported on forty-eight pillars, and perforated to permit the escape of foul air. Two stairs lead by forty steps to the bottom of the reservoir. In the middle of the basin is a sinking to collect the deposit of the water. The walls and pillars are coated with a stucco so hard as to resist a tool. The oversight of aqueducts was placed, in the times of the republic, under the ædiles and censors, though the latter appear to have taken part in work of this kind rather from their financial interest in the matter. Under the empire this task devolved on special officials styled *Curatores Aquarum*.

Among aqueducts outside of Italy, constructed in Roman times and existing still, the most remarkable, next to the Pont du Gard at Nismes already described, are—(1.) The aqueduct bridges at Segovia and Tarragona in Spain, the former being 2400 feet long, with 159 arches of greatly admired masonry, in two tiers, and reaching the height of 102 feet. The bridge at Tarragona is 876 feet long, and 83 feet high. (2.) At Mayence are the ruins of an aqueduct 16,000 feet long, and carried on from 500 to 600 pillars. Similar witnesses of Roman occupation are to be seen in Dacia, Africa, and Greece. (3.) The aqueduct at Metz (figured on Plate IV.), which originally extended across the Moselle, here very broad, conveyed to the city an abundance of excellent water from Gorsa. From a large reservoir at the source of the aqueduct the water passed along subterranean channels built of hewn stone, and sufficiently spacious for a man to walk in them upright. Similar channels received the water after it had crossed the Moselle by this bridge, at the distance of about 6 miles from Metz, and conveyed it to the city. The bridge consisted of only one row of arches. The middle arches have given way under the force of the river, but the others are still perfectly solid. (4.) On Plate III. is figured one of the principal bridges of the aqueduct of Antioch, 700 feet long, and at the deepest point 200 feet high. The lower part consists almost entirely of solid wall, and the upper part of a series of arches with very massive pillars. The masonry and design are rude. The water supply was drawn from several springs at a place called Battelma, about 4 or 5 miles from Antioch. From these separate springs the water was conducted by channels of hewn stone into a main channel, similarly constructed, which traversed the rest of the distance, being carried across streams and valleys by means of arches or bridges. (5.) At the village of Morea, about an hour's distance N.W. from the town of Mytilene, is the bridge of an aqueduct, figured on Plate III. The water-course is carried above massive pillars built of large hewn blocks of grey marble, and connected by means of three rows of arches, of which the uppermost is of brick. The bridge extended about 500 feet in length, and at the deepest was from 70 to 80 feet high. Judged by the masonry and the graceful design, it has been thought to be a work of the age of Augustus. Remains of this aqueduct are to be seen at Larisson Lamarousia, an hour's distance from Morea, and at St Demetri, two hours and a half from Ayasso, on the road to Vasilika.

The aqueduct near Spoleto, which now serves also as a bridge, is deserving of notice as an early instance of the use of the pointed arch, belonging as it does to the 7th or 8th century. It has ten arches, remarkable for the elegance of their design and the airy lightness of their proportions, each over 66 feet in span, and about 300 feet in height. (See Plate IV.)

The aqueduct of Pyrgos, near Constantinople (figured on Plate III.), is a remarkable example of works of this class carried out in the later times of the Roman empire. It consists of two branches, of which only one is seen in elevation on the plate. The other branch stood nearly at right angles to this, and is seen partly on the plan. From this circumstance it was called the Bended or Crooked Aqueduct, to distinguish it from another termed the Long Aqueduct, situated near the source of the waters. The branch seen in elevation extends 670 feet in length, and is 106 feet in height at the deepest part. It is composed of three rows of arches, those in each row increasing in width from the bottom to the top—an arrangement very properly introduced with the view of saving materials without diminishing the strength of the work. The two upper rows consisted of arches of semicircles, the lower of Gothic arches; and this circumstance serves to fix the date of the structure, as these last were not introduced until the 10th century. The breadth of the building at the base was 21 feet, and it diminished with a regular batter on each side to the top, where it was only 11 feet. The base also was protected by strong buttresses or counterforts, erected against each of the pillars. The other branch of the aqueduct was 300 feet long, and consisted of twelve semicircular arches.

This aqueduct serves to convey to Constantinople the waters of the valley of Belgrade, one of the principal sources from which the city is supplied. These are situated on the heights of Mount Hæmus, the extremity of the Balkan Mountains, which overhangs the Black Sea. The water rises about 15 miles from the city, and between 3 and 4 miles west of the village of Belgrade, in three sources, which run in three deep and very confined valleys. These unite a little below the village, and then are collected into a large reservoir. After flowing a mile or two from this reservoir, the waters are augmented by two other streams, and conveyed by a channel of stone to the Crooked Aqueduct. From this they are conveyed to another which is the Long Aqueduct; and then, with various accessions, into a third, termed the Aqueduct of Justinian. From this they enter a vaulted conduit, which skirts the hills on the left side of the valley, and crosses a broad valley 2 miles below the Aqueduct of Justinian, by means of an aqueduct, with a double row of arcades of a very beautiful construction. The conduit then proceeds onward in a circuitous route, till it reaches the reservoir of Egri Kapan, situated just without and on the walls of the city. From this the water is conducted to the various quarters of the city, and also to the reservoir of St Sophia, which supplies the seraglio of the grand signior. The Long Aqueduct is more imposing by its extent than the Crooked one, but is far inferior in the regularity of design and disposition of the materials. It is evidently a work of the Turks. It consists of two rows of arcades, the lower being forty-eight in number, and the upper fifty. The whole length was about 2200 feet, and the height 80 feet. The Aqueduct of Justinian is a very excellent work, and without doubt one of the finest monuments which remain to us of the Middle Ages. It consists of two rows of large arcades in the pointed style, with four arches in each. Those of the lower story have 52 feet of span, the upper ones 40 feet. The piers are supported by strong buttresses, and at different heights they have little arches passing through them, which relieve the deadness of the solid pillar. The length of this aqueduct is 720 feet, and the height 109 feet. This aqueduct, though it bears the name of Justinian, was probably erected in the time of Constantine.

Besides the waters of Belgrade, Constantinople was supplied from several other principal sources, one of which took its rise on the heights of the same mountains, 3 or 4 miles east of Belgrade. This was conveyed in a similar manner by an arched channel, elevated, when it was necessary, on aqueduct bridges, till it reached the northern parts of the city. It was in the course of this aqueduct that the contrivance of the *souterasi* or hydraulic obelisks, described by Andreossy (in his voyage to the Black Sea and account of the Thracian Bosphorus) was constructed, which excited some attention, as being an improvement on the method of conducting water by aqueduct bridges. "The souterasi," says Andreossy, "are masses of masonry, having generally the form of a truncated pyramid or an Egyptian obelisk. To form a conduit with souterasi, we choose sources of water, the level of which is several feet higher than the reservoir by which it is to be distributed over the city. We bring the water from its sources in subterranean canals, slightly declining until we come to the borders of a valley or broken ground. We there raise on each side a souterasi, to which we adapt vertically leaden pipes of determinate diameters, placed parallel to the two opposite sides of the building. These pipes are disjoined at the upper part of the obelisk, which forms a sort of basin, with which the pipes are connected. The one permits the water to rise to the level from whence it had descended; by the other, the water descends from this level to the foot of the souterasi, where it enters another canal under ground, which conducts it to a second and to a third souterasi, where it rises and again descends, as at the last station. Here a reservoir receives it and distributes it in different directions by orifices of which the discharge is known." Again he says, "it requires but little attention to perceive that this system of conducting tubes is nothing but a series of syphons open at their upper part, and communicating with each other. The expense of a conduit by souterasi is estimated at only one-fifth of that of an aqueduct with arcades." There seems to be really no advantage in these pyramids, further than as they serve the purpose of discharging the air which collects in the pipes. They are in themselves an evident obstruction, and the water would flow more freely without any interruption of the kind. In regard to the leaden pipes, again, they would have required, with so little head pressure as is stated, to be used of very extraordinary dimensions to pass the same quantity of water as was discharged along the arched conduits. There is something, therefore, which would require explanation in the account Andreossy gives of these pyramids, if, indeed, he did not misunderstand the nature of them.

The other principal source from which Constantinople is supplied, is from the high grounds 6 or 8 miles west of the town, from which it is conducted by conduits and arches, in the same manner as the others. The supply drawn from all these sources, as detailed by Andreossy, amounted to 400,000 cubic feet per day. The charge of the water-works at Constantinople belongs to a body of 300 Turks and 100 Albanese Greeks, who form almost an hereditary profession.

In ancient Egypt and Babylonia a different problem of water supply was presented, both countries being flat and traversed by great rivers, from which they were subject to regular inundations. Hence canals with large basins took the place of the aqueducts of Greece and Rome, and the stupendous scale on which in Egypt the waters of the Nile, and in Babylonia the waters of the Tigris and Euphrates, were utilised, was a marvel to ancient travellers.

In France various aqueducts have been formed after the manner of the Romans. The most remarkable are those constructed in the reign of Louis XIV., at vast expense, for conducting water from Marly to Versailles. The famous aqueduct bridge of Maintenon, which was erected for conveying the waters of the river Eure to Versailles, is without doubt, in point of magnitude and height, the most magnificent structure of the kind in the world. In Plate IV. a view is given of a portion of this work, on the same scale as the others there represented. Had the whole been delineated on the same scale, it would have extended to four times the breadth of the plate. It extends about 4400 feet in length, that is, about five-sixths of a mile, is upwards of 200 feet in height, and contains 242 arcades, each divided into three rows, forming in all 726 arches about 50 feet span. Of the subterranean aqueducts in France the finest is that of Arcueil, which serves to conduct water to that village. It is 44,300 feet in length, or upwards of 8 miles, extending from the valley of Arcueil to the castle at the gate of St Jaques, all built of hewn stone. It is about 6 feet in height, and has on each side a foot-path 18 inches wide; it has a declivity of 1 foot in 1300. Another aqueduct of this kind is that of Rocquancourt, part of the system which brings water to Versailles; it is 11,760 feet in length, or upwards of 2 miles, and has a declivity in its whole course of only 3 feet. In some parts of its course it was necessary to make excavations 80 or 90 feet deep, which rendered the execution very difficult.

The great waterworks that supply the city of Marseilles with the water of the Durance, by a canal about 60 miles in length, are among the boldest undertakings of the kind in modern times. This canal, begun in 1839, and completed in 1847, is conveyed through three chains of limestone mountains by forty-five tunnels, forming an aggregate length of 8½ miles, and across numerous valleys by aqueducts; the largest of which, the Aqueduct of Roquefavour, over the ravine of the River Arc, about 5 miles from Aix, surpasses in size and altitude the ancient Pont du Gard. The immense volume of water, which passes at the rate of 198,000 gallons per minute, is carried across as in the old Roman aqueducts by a channel of masonwork. The height of this aqueduct is 262 feet, and its length 1287.

One other aqueduct of modern construction is worthy of notice. In those parts of British India where the fall of rain is scanty and uncertain, recourse is had to artificial irrigation, and the waters of many of the rivers of the country have been rendered available for this purpose by means of public works constructed by the Government. Of these the most important is the Ganges Canal, which traverses the North-Western Provinces of Bengal, and distributes over their vast area nearly the whole volume of the waters of the Ganges. The canal begins at the point where the river issues from the mountains, and enters the plains of Bengal. About 20 miles from its source, the line of the canal crosses the valley of the Solani river, and the works for effecting the transit are designed on a scale worthy of the undertaking. The valley is between 2 and 3 miles in width. An earthen embankment is carried across, raised on an average between 16 and 17 feet above the surrounding country, and having a width of 350 feet at its base, and 290 feet in the upper part. This embankment forms the bed of the canal, which is protected by banks 12 feet in depth, and 30 feet wide at the top. To preserve these banks from the effects of the action of the water, lines of masonry formed into steps extend on each side throughout their entire length. The Solani river is crossed by an aqueduct 920 feet long, having side walls 8 feet thick and 12 deep, the depth of the water being 10 feet. The water of the canal passes through two separate channels. That of the River Solani flows under fifteen arches, having a span of 50 feet each, constructed in the most substantial manner, and springing from piers resting on blocks of masonry sunk into the bed of the river. The cost of the aqueduct was upwards of £160,000. In grandeur of design, solidity of construction, and, above all, in extensive utility, it may challenge competition with any similar work in the world.

Within the last century, the invention and improvement of the manufacture of cast iron has completely changed the mode of conducting water into cities, by the introduction of cast-iron pipes instead of the stone conduits of former times. These pipes can now be formed of almost any dimensions, and united together into a continued series so closely as to prevent the escape of the water even under a violent pressure, arising from the altitude of the fountainhead. They enable us, therefore, to take advantage of and give effect to the fundamental principle of hydrostatics, that the fluid tends continually to a level, even though it be confined in the smallest or most complicated system of pipes; so that however low it be carried in any valley, or to whatever distance, still it will rise on the opposite side to the original altitude of the fountainhead—a principle which is most important indeed in such works, seeing that by it we are not restricted, as the Romans were, almost to a perfect level in the line of the conduit. We have seen that, for the purpose of attaining this level or very gentle declivity all along the conduit, they were under the necessity of raising it by arcades continued in one unbroken series, frequently 30 or 40 miles in extent; and, in addition to this, they had often to prolong the length of the track by a circuitous route, turning and winding for miles out of its course, for the very purpose of increasing its length.

But the use of pipes enables us to dispense with these long arcades all raised nearly to the same level with the fountainhead; because the conduit may be varied in its level to any extent, and still will rise at last to its original altitude. The pipes, therefore, are merely laid all along the surface of the ground, with a cover of 2 or 3 feet of soil to place them beyond the reach of frost. To prevent, however, the frequent or abrupt alternations of rise and fall, any sudden inequalities in the ground are equalised by cuttings and embankments, but not to anything like the extent that would be required to raise the whole to a level. This, therefore, forms a very great improvement in the method of conducting water, the greatest indeed which has ever been made in this important branch of practical mechanics. That it was not introduced by the Romans, is not to be ascribed, as many have supposed, to their ignorance of the hydrostatic principle that the fluid would rise to a level in the opposite branches of the same train of pipes. They were well acquainted with this principle, and a portion of a leaden pipe, supposed to have been used in the baths of Caracalla, has been found, which sets this matter at rest; but, from the low state of the arts at that period, they were unable to give effect to the principle. They had not the means of fabricating pipes of such a magnitude as would have been required for the enormous quantities of water consumed in Rome, and at the same time, of strength sufficient to withstand the pressure from the fountainhead. Lead was the only material that could be used by them for the purpose; and besides the enormous thickness that so weak a material would have required, and the impracticability of their forming pipes, and uniting them together endwise, they were too well acquainted with the tendency of lead to render the water unwholesome by its poisonous impregnation. The use of cast iron was quite unknown. There remained, therefore, no resource but in the aqueducts, which, though attended no doubt with vast expense, and requiring great enterprise, skill, and patience, were yet attainable by these means, and formed when completed a simple and very perfect mode of effecting the object. Now, however, when the manufacture of cast iron has been brought to such perfection, and methods contrived for uniting perfectly together all the pipes into one connected train, this improved system has been universally adopted.

In former editions of this work (under this heading) the works of the Edinburgh Water Company, undertaken in 1819, and designed by Mr Jardine, civil engineer, were described; but as there is little which can properly come under the popular definition of Aqueduct, they will be more consistently referred to in the article WATERWORKS.

Croton Aqueduct, New York.

The Croton Aqueduct, by which the city of New York is supplied with water, was justly regarded at the time of its execution, from 1837 to 1842, as one of the most magnificent works of the kind in modern times (figs. 1 to 5).

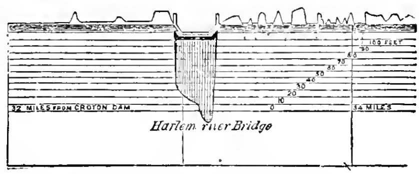


FIG. 1.—Part Section of Croton Waterworks.

Its length from the Croton Lake to the receiving reservoir is $38\frac{1}{4}$ miles. The original reservoir, called Croton Lake, is formed by an embankment across the Croton Creek, a small stream of wholesome water falling into the Hudson. It covered 400 acres, and contained about 500,000,000 gallons of water. To the valley of the Harlem River, a distance of 33 miles, the aqueduct (fig. 2,) is built of stone, brick, and cement, arched over and under, 6 feet 3 inches wide at the bottom, 7 feet 8 inches at the top, and 8 feet 5 inches high, and capable of discharging 60,000,000 gallons per day. It is carried over the Harlem Valley in iron pipes, laid upon a magnificent bridge (figs. 3 and 4) 1460 feet long, constructed of arches 114 feet above

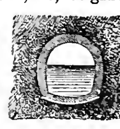


FIG. 2.—Tunnel in soft ground.

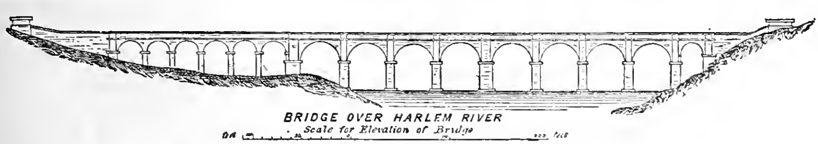


Fig. 3.

high-water mark at Yorkville. These pipes passed into a receiving reservoir capable of holding 150,000,000 gallons, and from thence the water was conducted for $2\frac{1}{2}$ miles to a distributing reservoir, containing 20,000,000 gallons, by a double line of iron pipes, 3 feet in diameter. From this reservoir the water was distributed to the city.

The Croton water was originally introduced into New York in 1842, when the population was about 450 000 persons, and from that time to 1848, 18,000,000 gallons per day gave an abundant supply. In 1872, with a population of 1,000,000 persons, the quantity required was 88,000,000 gallons per day. Thus, between 1848 and 1872, while the population little more than doubled, the consumption of water increased nearly five times. This fact, coupled with severe droughts in 1870 and 1871, when the natural volume of the Croton River fell to 27,000,000 gallons per day, caused great anxiety, and shewed the necessity of largely extended works. It was estimated that the basin above the Croton Dam, 339 square miles in area, would give 300,000,000 gallons per day on the average, if the water could be impounded, and that, therefore, abundant water could be obtained by increasing the number or capacity of the impounding reservoirs. New reservoirs were therefore projected, one of which, to contain 3,000,000,000 gallons, was expected to be completed in the autumn of 1872. With this the gross storage would be 4,670,000,000 gallons, in addition to the daily produce of the Croton River, which, at its minimum as stated, is 27,000,000 gallons per day. Another reservoir to contain 3,700,000,000 gallons was also projected, and will, it is presumed, be constructed when necessary (fig. 5). To meet the growing demand for water, the reservoirs were not only increased as described, but the means of distribution were largely extended, and in one part of the city six lines of pipes 4 feet in diameter were laid side by side.

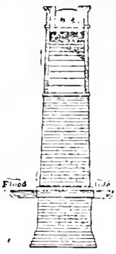


Fig. 4.—Cross section of bridge.

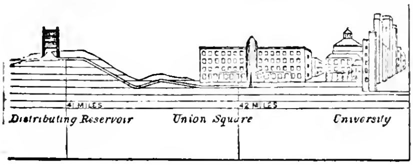


Fig. 5.—Part section of Croton Waterworks.

Manchester Waterworks.

The works by which the city of Manchester and its suburbs are now supplied with water, and which have been in course of construction from the year 1848 to the present time (1874), are perhaps, in some respects, the most stupendous works of the kind which have ever been constructed, in which difficulties of no ordinary character have been successfully overcome. These remarks, however, relate especially to the impounding reservoirs, which are seven in number, with embankments varying from 70 to 100 feet above the level of the valley in which they are constructed, and cannot, therefore, be properly alluded to here. As the conveyance of the water to the city is, however, by aqueduct, a few words explanatory of the general scheme will be necessary.

The water is collected from the river Etherow and its tributaries, which, rising on the westerly slope of the Pennine chain of hills, flow into the river Mersey, and so into the Irish Sea. The drainage ground from which the water is collected lies nearly midway between Manchester and Sheffield. Its area is about 19,300 acres. It rises in parts to an elevation of about 1800 feet above the level of the sea, and about 1200 or 1300 feet above the deep and romantic valley of Longdendale, in which the main collecting reservoirs are situated. The district consists of the shales and sandstones which constitute the lower portion of the Coal Measure formation—the upper millstone grit forming the cap of the steep escarpments on each side of the valley, while the lower millstone grit, which may be said to separate the Coal Measure shale from the limestone shale, is found in the bottom. The waters produced by this geological formation are among the purest in the world. The spring water is especially brilliant, highly aerated, containing little or no foreign matter, and extremely soft. It is at all times very abundant, the district yielding much more spring water than the usual quantity, in proportion to the area from which the springs issue. The quantity of water flowing from the drainage ground would, if wholly stored, afford a gross supply of about 40,000,000 gallons per day, of which about 13,000,000 gallons per day have to be delivered as compensation to the mills on the stream, leaving about 27,000,000 gallons per day as the supply available for the city and its suburbs.

The water of heavy rains and wet seasons is collected in large impounding reservoirs, the gross capacity of which is 4,233,000,000 gallons. In some of these reservoirs the turbid and coloured water is impounded, where it is allowed to settle and purify, and is subsequently given as compensation to the stream; and in others, the pure water, when more than sufficient for the wants of the city, is collected. Here it is stored till required, and then given in addition to the spring water, when that is in itself deficient in quantity. The spring water is separately collected, and conveyed to the city by aqueducts specially constructed for the purpose. In heavy rains, which swell the streams, and especially in autumn, the water is discoloured, but by a simple and ingenious contrivance, every stream is made to separate its coloured water from its pure water—the coloured water being passed to reservoirs set apart for the storage of such water, and the pure water being sent at once to Manchester, or passed to reservoirs in which it is stored for future use.

The aqueducts by which this water is conveyed from the springs and from the reservoirs, consist for the most part of tunnel and covered conduit, 6 feet in diameter, with a fall of 5 feet in a mile, with cast-iron syphon pipes of large dimensions across one valley, which has to be passed before the highest service reservoir is reached. From this reservoir to the city, about 8 miles distant, cast-iron pipes are laid along or under the public roads, to convey the water to various other reservoirs at lower elevations, from which the city and its suburbs are conveniently supplied.

In the main valleys in which the spring water is collected, or the flood and turbid waters conveyed by separate channels, the aqueducts are chiefly open, and are, to a great extent, formed of concrete 6 inches thick on the sides and bottom, faced with dry stone pitching 9 inches in thickness. They are cheap, easily constructed, and perfectly successful.

The area and capacities of all the reservoirs are as follows:—

Name.	Area.	Capacity.	Depth.
	Acres.	Gallons.	Feet.
Woodhead, ...	135	1,235,000,000	72
Torside, ...	160	1,474,000,000	84
Rhodes Wood, ...	54	500,000,000	68
Vale House, ...	63	343,000,000	40
Bottoms, (estimated)	46	399,000,000	50
Arnfield, ...	39	209,000,000	52
Hollingworth, ...	13	73,000,000	52
Godley, ...	15	61,000,000	21
Denton, No. 1,...............	7	30,000,000	20
Denton, No. 2,...............	6	23,000,000	20
Gorton, Upper,..............	34	123,000,000	26
Gorton, Lower,..............	23	100,000,000	29
Prestwich, ...	4½	20,000,000	22
	599½	4,590,000,000	

Loch Katrine Aqueduct, Glasgow.

The Loch Katrine Aqueduct of the Glasgow Waterworks is the modern aqueduct which has most probably attracted the largest share of public attention.

The appropriation of the beautiful waters of Loch Katrine—rendered classical by Sir Walter Scott—the romantic, rugged, and almost impassable Highland country through which the aqueduct had to be constructed, and the distance from Loch Katrine to Glasgow, all contributed to lend a special interest to the undertaking. It is, however, a very simple work in itself, for, with but little artificial addition, Loch Katrine, Loch Venachar, and Loch Drunkie were converted into impounding reservoirs, the first for the supply of the city, and the two latter for compensation.

The area and capacity of these reservoirs are as follows:—

	Area at Summer Level.	Extent to which Lochs can be raised or lowered.	Height of raised Level above ordnance datum.	Capacity	Drainage Area.	Proportion of Storage to each Acre of Drainage Area.
	Acres.	ft. in.	Feet.	Gallons.	Acres.	Gallons.
Loch Katrine,	3,000	Raised 4 0 Drawn 3 0 7 0	367	5,687,500,000	22,800	249,450
Loch Venachar,	865	Raised 5 9 Drawn 6 0 11 9	269	2,656,250,000	21,500	123,544
Loch Drunkie,	83	Raised 25 0	416	750,000,000	1,500	500,000
Totals,	3,948			9,093,750,000	45,800	

The length of the aqueduct from Loch Katrine to Glasgow is about 35 miles, of which 27 may be considered as the aqueduct proper The remaining 8 consist of two lines of cast-iron pipes, by which the water is conveyed from the large service reservoir at Mugdock to the city of Glasgow. The aqueduct is principally in tunnel or covered conduit, but there are three valleys which are crossed by iron syphon pipes of large diameter, and there are numerous aqueduct bridges of varied character, suited to the peculiarities of the districts in which they had to be constructed. The tunnels and covered conduits are 8 feet high and 8 feet wide, with an inclination of 10 inches in a mile, and are capable of conveying about 50,000,000 gallons of water in twenty-four hours. The syphon pipes across the valleys have an inclination of 1 in 1000, or about 5 feet in a mile, and it requires two pipes of 4 feet in diameter and one of 3 feet in diameter, to convey the quantity of water in a day which the aqueduct will deliver.

The work required the greatest engineering accuracy and skill, and so perfectly have the lines and levels been kept, that it was only upon the closest examination that the joinings in the tunnels could be detected.

The work was commenced in the spring of 1855, opened by her Majesty the Queen in October 1859, and finally completed in the course of 1860.

The cost of the engineering works of the aqueduct, including the conversion of the various lochs mentioned into reservoirs, and exclusive of land, and of the distribution of the water in the city of Glasgow and its neighbourhood, was £668,000; but the gross cost of the water supply, including the purchase of two water companies, distribution, and everything, has been, to May 1873, £1,756,793.

The following description of the aqueduct was given by the engineer at a banquet given to him in Glasgow after the completion of the works:—

"It is impossible to convey to those who have not personally inspected it, an impression of the intricacy of the wild and beautiful district through which the aqueduct passes for the first 10 or 11 miles after leaving Loch Katrine. From the narrowest point at which it was found the ridge between Loch Katrine and Loch Chon could be pierced, the country consists of successive ridges of the most obdurate rock, separated by deep wild valleys, in which it was very difficult in the first instance to find a way. There were no roads, no houses, no building materials,—nothing which would ordinarily be considered essential to the successful completion of a great engineering work for the conveyance of water; but it was a consideration of the geological character of the material, which gave all the romantic wildness to the district, that at once determined me to adopt that particular mode of construction which has been so successfully carried out. For the first 10 miles, the rock consists of mica schist and clay slate—close, retentive material, into which no water percolates, and in which, consequently, few springs are to be found. This rock, when quarried, was unfit for building purposes; there was no stone of a suitable description to be had at any reasonable cost or distance, no lime for mortar, no clay for puddle, and no roads to convey material. Ordinary surface construction, therefore, was out of the question; but I saw that if tunnelling were boldly resorted to, there would be no difficulty, beyond the cost and time required in blasting the rocks, in making a perfectly watertight and all-enduring aqueduct; there would be no water to hamper and delay us in the shafts and tunnels, and little would require transporting through the country but gunpowder and drill iron. This course was therefore determined upon, and my expectations have been realised to the very letter. The aqueduct may be considered as one continuous tunnel. As long as the work continued in the primary geological measures, we had no water; and even after it entered the Old Red Sandstone, and where it subsequently passed through trap rock, there was much less than I expected; so that our progress, at no part of the work, was ever materially interfered with by those incidents which usually render mining operations costly and uncertain."

The rock, however, especially the mica slate, proved extremely hard and difficult to work. At several points along the side of Loch Chon the progress did not exceed 3 or 4 lineal yards in a month at each face, although the work was carried on day and night. The average progress through the mica slate was about 5 yards in a month. In drilling the holes for blasting, a fresh drill was required for every inch in depth on the average, and about sixty drills were constantly in use at each face. The cost of the gunpowder alone, consumed in the first $7\frac{1}{2}$ miles of the aqueduct, was £10,540, and there were about 175 miles of fuse burned in firing it. The average cost per yard of this length of the aqueduct was over £13, or £23,000 per mile. (Figs. 6 to 11, are cross sections of the aqueduct, showing the general construction in various kinds of ground.) The built and tunnelled part is all capable of passing 50,000,000 gallons per day.

The aqueduct bridges over the ravines are somewhat peculiar, varying in character according to the circumstances of the district. In the wilder and more inaccessible parts there are five extensive iron ones, varying in length from 124 to 332 yards, all of similar construction. (See fig. 12.) At the ends of these bridges, in the shallowest parts of the ravines, the aqueduct has a cast-iron trough supported on a solid dry stone embankment of the stone of the district, carefully set by hand; the stone embankment being 9 feet wide at top, with a batter of 3 inches to the foot on each side. The deeper parts of the ravines or valleys are crossed by malleable iron tubes 8 feet wide by $6\frac{1}{2}$ feet high inside, supported by piers at intervals of 50 feet. The bottoms and sides of these tubes are ⅜ inch thick, and the tops $\frac{7}{16}$ inch thick, strengthened by angle and T iron. Fig. 13 shows a section of these tubes. The cast-iron troughs (fig. 14) are 8 feet broad and 4 feet deep, and ⅝ inch thick, and were capable of passing at this depth upwards of 20,000,000 gallons a day. Provision was

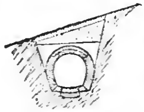


Fig. 6.—Open cutting not water-tight

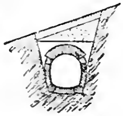


Fig. 7.—Open cutting water-tight, but lined.

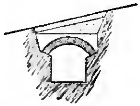


Fig. 8.—Open cutting in rock.

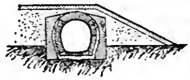


Fig. 9.—Aqueduct above surface of ground.

Fig. 10.—Tunnel lined.

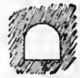


Fig. 11.—Tunnel through water-tight rock.

made for adding 2½ feet to the height of the sides when additional water was required, and this has since been done. The bottoms of the malleable-iron tubes are 3 feet below

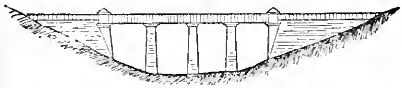


Fig. 12.—Iron Aqueducts at Culegarton.

the bottoms of the troughs, so that they should always be full of water, for the purpose of securing the same temperature both in the bottom and top of the tubes, and so pre-

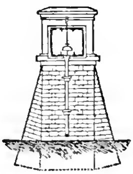


Fig. 13.—Section through Iron Tube.

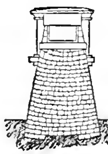


Fig. 14.—Section through Cast-iron Trough.

venting unequal expansion and contraction. The aqueduct at the crossing of small mountain streams (of which there were many) was carried in cast-iron troughs similar to those already described, supported upon cast-iron beams over the space left for the stream.

The first deep valley which required to be crossed by piping is that of the Duchray water, about 55 chains wide. The pipes first laid down were 4 feet diameter in 9 feet lengths, with spigot and faucet joints, run up with lead in the usual way. At the lowest point the pipes are under a pressure of 165 feet. The river itself is crossed by cast-iron arched girders of 60 feet span; and here, as well as at the small basins at each end of the piping, and at all other places where masonry was required, provision was made for laying two additional lines of pipes, one 4 feet and the other 3 feet in diameter. These pipes have since been laid. After passing through the ridge of Old Red Sandstone conglomerate by the Clashmore tunnel, the aqueduct for 5 miles is for the greater part in open cutting, with masonry sides, and a dry rubble arch covered with 2 feet of puddle, and then covered in.

The Endrick valley, like that of the Duchray, is crossed by cast-iron syphon pipes for 2¼ miles in length. Where they cross the river Endrick at the bottom of the valley, the pipes are 1⅝ inches thick, and have to sustain a pressure of 238 feet. The pipes are carried across small depressions in the valley by resting them upon stone piers, and at the crossing of two roads, and of the Forth and Clyde railway, they are further supported by cast-iron brackets. The pipes at these exposed places have flange joints, and they have been covered with woollen felt to prevent expansion and contraction. There is a short tunnel 110 yards long on this length of piping of dimensions sufficient to carry the three lines of pipes. The construction of the aqueduct, for the 5 miles extending from the valley of the Endrick to the valley of the Blane, presents the same general features as those already described. Good building stone was abundant in this district, and the bridges are all

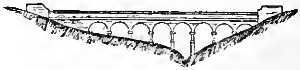


Fig. 15.—Duntreath Aqueduct.

of masonry. Fig. 15 is an elevation of one of the aqueduct bridges near Killearn at 19 miles from Loch Katrine;

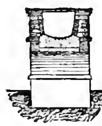


Fig. 16.—Section through Arch.

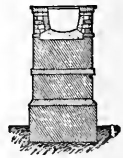


Fig. 17.—Section through Pier.

and figs. 16 and 17 are details of the Ballewan Aqueduct bridge (fig. 18)

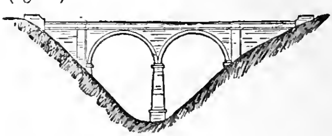


Fig. 18.—Ballewan Aqueduct.

The piping across the Blane is about 54 chains long, with a depression of 125 feet. The Blane water itself is crossed by a stone bridge, and there are basins at each end of the pipes as before. The last piece of the aqueduct is a tunnel 2640 yards long, through a ridge of amygdaloidal trap, separating the valley of the Blane from the valley of the Allander. The tunnel is 250 feet below the summit of the hill.

Mr Bateman, at the banquet referred to, summarised the works along the line of aqueduct in nearly the following words:—"There are in the whole work eighty distinct tunnels, upon which forty-four vertical shafts have been sunk for facilitating and expediting the completion of the work." Besides the tunnel at the commencement of the aqueduct, called the Loch Katrine Tunnel, 2325 yards in length, and upwards of 500 feet below the summit of the hill, and the Mugdock Tunnel at the end of the aqueduct, 2640 yards in length, there are "others, 700, 800, 1100, and 1400 yards in length. Not to speak of smaller constructions, there are twenty-five important iron and masonry aqueducts over rivers and ravines, some 60 and 80 feet in height, with arches of 30 feet, 50 feet, and 90 feet in span. The number of people employed, exclusive of iron-founders

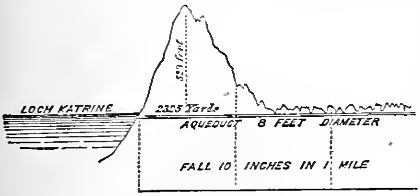


FIG. 19.—Part Section of Loch Katrine Aqueduct.

and mechanics, has generally been about 3000; and for the greater part of these, huts and roads and all other accommodation had to be provided, the country for the most part being of the wildest and most inaccessible description."— . . . . . "At the picturesque, 'turf and timber' village of Sebastopol, as the miners called it, at the head of Loch Chon, several hundreds of work-people were accommodated. Provision stores, reading-rooms, a school-house and church, and a resident medical man and school-master were provided for them."

The aqueduct from its commencement at Loch Katrine to the Mugdock reservoir, is 25¾ miles long, 13 of which were tunnelled, 3¾ miles are iron piping across valleys, and the remaining 9 miles consist of "cut and cover" conduit and bridges. Where the ground was cut open the conduit was covered in, and the surface restored after the aqueduct was built. At the bridges the aqueduct is covered with timber to prevent its being choked by snow. Most of them are furnished with grooves in the masonry to receive stop planks, and with discharge sluices to facilitate the emptying of the aqueduct, when it is necessary to inspect or make repairs. Overflows are constructed at a number of the bridges, to discharge the water if it should be necessary to stop the flow suddenly at any point. The total cost of the aqueduct at the time the water was introduced into the city, was £468,000, or an average of £18,000 per mile.

It has been already stated that the 4-feet pipes across the valleys on the line of aqueduct were intended to deliver 20,000,000 gallons a day. By the well-known modification of Eytelwein's formula, deduced from Du Buat's experiments and more elaborate formulæ, the computed discharge is 21,500,000 gallons a day nearly, and by Weisbach's formulæ, 21,750,000 gallons a day. These pipes, however, have discharged 24,000,000 gallons a day without their being completely gorged, and their ultimate discharge has therefore yet to be determined. The whole of the pipes used in the works were coated with coal pitch and oil, according to the process patented by Dr R. A. Smith of Manchester, and first used by Mr Bateman in the Manchester Waterworks. This coating, when well done, imparts a smooth glassy surface to the pipes, and prevents, at least for a number of years, the usual, and it may be said, inevitable oxidation. Weisbach found that for wooden pipes 2½ and 4½ inches diameter, the coefficient of resistance was 1·75 times as great as for "metallic pipes," giving a discharge about 14 per cent. less; and M. Morin has shown, in a paper which it is believed is published in detail in the *Mémoires des Savants Etrangers*, the influence the state of the surface has upon the discharge of a pipe, amounting, in cast-iron pipes coated with pitch, and in glass pipes, to an increase of nearly one-third in the discharge.

It has also been pointed out by M. Morin, whose deductions are principally from observations by M. Darcy, director of the waterworks of Paris, that for large sizes the diameters of the pipes seem also to exercise a more decided influence on the discharge than has been hitherto assigned to them. Late observations on the flow of gas through pipes by M. Arson, engineer of the Paris Gas Company, tend to confirm the views of M. Morin.

At the Mugdock Service Reservoir, 7 or 8 miles from Glasgow, the water is first discharged into a basin, from which it passes over cast-iron gauge plates, 40 feet wide, brought to a thin edge. The depth of water passing over these plates is regularly recorded and the discharge computed. From the basin the water falls into an upper division of the main reservoir, about 2 acres in extent, and from this it is discharged into the reservoir. The reservoir has a water surface of 60 acres, and a depth when full of 50 feet; it contains 548,000,000 gallons, and is 317 feet above ordnance datum. It admits of repairs being made upon the aqueduct without interrupting the supply of water to the city. Two earthen embankments were necessary to form the reservoir; the main embankment is 400 yards long and 68 feet high, and the easterly embankment 240 yards long and 50 feet high, each with a puddle wall in the centre, and pitching on the front slope in the usual way.

The water is drawn from the reservoir by pipes laid in a tunnel through the hill between the two embankments, there being no pipes through the embankments themselves.

At the end next the reservoir there is a stand-pipe so arranged that water can be drawn at various heights, and about 50 yards from the reservoir, the water passes into a circular well cut out of the rock, 40 feet in diameter and 63 feet deep, and is strained by passing through copper wire-cloth, 40 meshes to the inch, arranged in oak frames, forming an inner well of octagonal shape 25 feet diameter; and from this latter the water finally passes into the two lines of pipes leading to the city. Water can also be drawn direct from the gauge basin, and from the upper compartment of the reservoir into the straining well, by a line of 4-feet pipes through the bottom of the reservoir. These works, including road and stream diversions, cost about £56,000.

The two pipes leading from the straining well are each 42 inches diameter, and are intended to deliver the whole 50,000,000 gallons a day; but on emerging from the tunnel, which is 440 yards in length, they are diminished to 36 inches, and they are continued of this size to the city. Provision was made for additional pipes, which have since been laid. The different lines of pipes are laid side by side for about 3 miles, after which they diverge—one line being carried by the Great Western Road for the supply of the low districts of the city, and the other by Maryhill for the supply of the high districts. These pipes come together again, and are arranged so as to communicate when necessary at St George's Road near the commencement of the city, up to which point their respective lengths from the straining well are 7 miles for the low district main, and 6½ miles for the high. Each of these lines of pipes crosses the River Kelvin and the Forth and Clyde Canal, and at these places provision was made for additional pipes. Eleven feet were added to the width of the Kelvin Bridge on the Great Western Road, by cast-iron girders, to carry the low district mains. The two middle spans are each 93 feet, and the two side arches 37 feet span.

The total cost of the works at their completion, in 1860, was as follows:—

Work at the Lochs, ...	£ 36,000	
Aqueduct, 25¾ miles long, ...	468,000	
Mugdock Reservoir, ...	56,000	
Main Pipes, 36 inches diameter,......	123,000	
Distribution in the city, ...	78,000	
Total for works, ...		£761,000
Land and Compensation, ...	£70,000	
Parliamentary expenses, Engineering, and Sundries, ...	87,000	
		157,000
Total, ...		£918,000

Vienna Waterworks.

A still more recent work, consisting mainly of aqueduct construction, is the enterprise for supplying the city of Vienna with water. The water is obtained from the springs of Kaiserbrunn and Stixenstein, both situated at the foot of the Styrian Alps, which separate Austria from Styria. The Kaiserbrunn spring is situated 1146 English feet above the Danube at Vienna, and the Stixenstein spring 996 feet. The water is conducted by aqueduct to a receiving reservoir at Rosenhugel, 277 feet above the Danube, and distant 2 miles from Vienna. The length of the aqueduct from Kaiserbrunn to the receiving reservoir on the Rosenhugel, is 56½ English miles. A branch of 3·9 English miles conducts the Stixenstein spring to this aqueduct. The gradients of the aqueduct vary much in the upper or early parts; but towards the end they become more regular. The gradients have been thus varied for the purpose of keeping the canal as much as possible along the level of the ground, so as to avoid high embankments. In order to keep the water cool in summer, and to secure it from freezing in winter, the water is always 6 feet below the surface; and in places where embankments were unavoidable, the aqueduct has been covered to the same extent. The size of the aqueduct varies from 4 feet 6 inches in height, by 2 feet 6 inches in width, to 6 feet 6 inches in height, by 4 feet in width. In order to facilitate the discharge, and to reduce friction, the inside of the aqueduct has been plastered with a coating 2 inches thick of Portland cement and sand, in the proportion of one of cement to two of sand. This coating was laid on in three layers, the last being a very thin layer of pure cement, which, when hardened, was rubbed with iron plates till it became perfectly smooth and polished. The work was commenced in the winter of 1869-70, and completed in the month of September 1873. The aqueduct is constructed for the purpose of supplying about 3,200,000 cubic feet per day, or 20,000,000 gallons. There are

FIG. 20.—Baden Bridge, Vienna Waterworks (7 out of 43 arches).

several important aqueduct bridges along the line of works. Of these the principal is the aqueduct of Baden, which consists of forty-three large arches, with spans varying from 5 klafters to 8½ klafters, and the greatest height 15 klafters 5 feet 5 inches, or 96·6 English feet, from the foundation of the pier to the top of the aqueduct. The arches are of brickwork, as well as the vaulting of the canal. The piers, together with the backing of arches and the sides of the canal, are faced with ashlar, and filled up with rubble masonry. The canal is covered on the top with earth, which is then covered with 9 inches of paving in rubble masonry

The Mödling Aqueduct is, although one of the shortest, perhaps the finest on the whole line of the works. It is situated in a very narrow gorge, with high rocks rising on the side. The canal or aqueduct passes through a tunnel on one side, and after crossing the aqueduct enters imme-

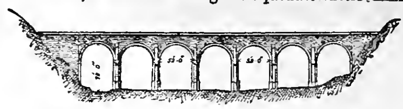


FIG. 21.—Mödling Bridge, Vienna Waterworks.

diately into another tunnel on the other. This aqueduct bridge consists of spans of 9 klafters, or 55·98 English feet, in width, and is built entirely of bricks, with the exception that the piers are pointed with ashlar. The abutments, the foundations of which are excavated in the rock, are built of rubble masonry, faced with ashlar. The other chief aqueducts are—the one at Liesing with forty-six arches, very similar to that of Baden, and that of Mauer with thirteen arches, built of bricks, and making a fine curve across the valley.

The receiving reservoir on the Rosenhugel, where the aqueduct ends, is divided into two parts, capable together of holding 80,000 cubic feet English. From this reservoir the water is taken to two other distributing reservoirs, from which the city is supplied. The cost of the work, together with the network of pipes in Vienna, has been about 25,000,000 florins or £2,000,000 sterling. The chief engineer of the work was Herr Carl Junker of Vienna, and the contractor Mr Antonio Gabrielli of London. The works were completed and opened in the autumn of 1873.

Water Supply of Paris.

The question of improving the water supply of this city was the subject of minute and careful investigations, extending over a period of four or five years, (from 1854 to 1859.)

Many projects were submitted to the Prefecture of the Seine, but the one finally adopted was that studied by Mr Belgrand and the engineers of the municipality of Paris. The scheme consisted in appropriating the waters of the Sonne and the Soude, together with the Soudon and the Dhuis, all being tributaries of the Marne, and flowing through chalk districts.

The population of Paris, for the supply of which the scheme was laid out, was taken at 2,000,000, and the waters from the sources selected were intended for the domestic supply only—the existing supplies to Paris, which have become gradually polluted and unfit for domestic use, being made available for all the other general wants of the population. The quantity of water which it was estimated would be required for the domestic purposes of such a population was taken at 100,000 cubic metres per diem, or about 22,000,000 gallons per day; and the works have been laid out for conveying this quantity. Gaugings of the various streams selected, showed that in 1855, when the flow was at the lowest, the produce of the Sonne and the Soude was 1081 litres per second, the Soudon 100, the Dhuis 315; making a total of 1496 litres per second, or about 28,000,000 gallons per day. At the time of lowest water in 1857, however, the Sonne and the Soude together only yielded 880 litres per second, or 16,762,000 gallons per day, while in 1858, which was an exceptionally dry year (indeed the driest year on record in this locality), they yielded together only 285 litres per second, or 5,417,280 gallons per day; while in both these years the Soudon and the Dhuis gave almost the same quantities as in the year 1855.

In order to meet the contingency of such a dry season as 1858, Mr Belgrand's project contemplated sinking wells or adits in the chalk, and obtaining therefrom what he terms "the subterranean reservoirs of water therein contained,"—artificial supplies, which would supply any deficiency in the quantity yielded by the streams. The works comprised what are termed conduits of derivation, being subsidiary conduits for collecting the waters from the various streams, and conducting them to the commencement of the main aqueduct that conveys the waters of the combined sources to Paris. The main aqueduct commences at a level of about 105 metres above the sea. It is a little over 180 kilometres in length (about 110 English miles), and terminates at Paris in service reservoirs at Belleville, at a level of 83½ metres above the sea. The subsidiary conduits are about 80 kilometres in length, and upon these and the main aqueduct there are seventeen bridges, 6 kilometres of conduit constructed upon arches, 7 kilometres of syphon piping, and 28 kilometres of tunnel. The estimated cost of the ordinary works was about 19,000,000 francs, or £760,000, to which must be added about 2½ million francs, or £100,000, for special works, where the aqueduct had to be constructed through difficult ground, and 4½ million francs, or £180,000, for compensation to riparian owners on the streams which were selected as the sources of the supply, as well as to the owners of mills who might be injured by the abstraction of the water, and for the purchase of the lands through which the aqueduct had to be constructed; making a total estimated outlay on the works at the sources of the supply, and for the subsidiary and main aqueducts up to the distributing at Belleville, of 26,000,000 francs or £1,040,000.

The commission, to whom were referred all the projects which had been suggested, in their report, considered on the 18th of March 1859, recommended that the sum to be voted for the works should be 30,000,000 francs, or £1,200,000, thus increasing the estimate by 4,000,000 francs, or £160,000, with the view of providing ample means to cover any unforeseen works or difficulties which might be encountered during the carrying out of the project. The works have since that time been carried out substantially in accordance with the ideas and designs of Mr Belgrand, and under his direction and supervision; but they are not yet (1874) completed. The water from these sources is naturally very hard, but it is bright, fresh, and well aerated.

Although the system of pipes has superseded the use of stone channels all raised to a level in the conveyance of water, there are still cases, such as those of canals, where the water must be kept on a perfect level, and where, therefore, aqueduct bridges are still necessary in conveying it over the valleys; and of these we have long had examples in France, on the Languedoc canal. The first aqueduct bridges for canals in this country were those made by the Duke of Bridgewater, under the direction of the celebrated Brindley, and which, being quite new here, excited no small degree of astonishment. The first and largest was the aqueduct at Barton Bridge for conveying the canal across the Irwell, 39 feet above the surface of the water. It consisted of three arches, the middle one 63 feet span, and admitting under it the largest barges navigating the Irwell with sails set. It was commenced in September 1760; and in July of the following year the spectacle was first presented in this country, of vessels floating and sailing across the course of the river, while others in the river itself were passing under them. Since that period canal aqueducts have become more common; and many excellent examples are to be found both in England and Scotland. Of these are the aqueducts over the river Lune on the Lancaster canal, designed by Rennie,—a very excellent and splendid work of five arches, each 72 feet span, and rising 65 feet above the level of the river; and the Kelvin aqueduct, near Glasgow, which conveys the Forth and Clyde canal over the valley of Kelvin, consisting of four arches, each 70 feet span, and rising 70 feet above the level of the river. Plate IV. contains views of two other principal aqueducts, viz., those of Pont y Cysyllte and Chirk in Wales. Of these the Pont-y-Cysyllte aqueduct by Mr Telford is justly celebrated for its magnitude, simplicity of design, and skilful disposition of the parts, combining lightness with strength in a degree seldom attempted. This aqueduct serves to convey the waters of the Ellesmere canal across the Dee and the vale of Llangollen, which it traverses. The channel for the water is made of cast-iron, supported on cast-iron ribs or arches, and these resting on pillars of stone. The iron being much lighter than stone arches, this in one reason why the pillars have been reduced apparently to such slender dimensions. They are quite strong enough, however, as experience has proved. The whole length of the aqueduct is about 1000 feet, and consists of nineteen arches, each 45 feet span. The breadth of the pillars at the top is 8 feet, and the height of the four middle ones is 115 feet to the springing. The pillars have a slight taper, the breadth of the middle ones at the base being 15 feet. The height from the surface of the water in the Dee to that in the canal is 126 feet 8 inches. The channel for the water consists of cast-iron plates, cast with flanches, and these screwed together with bolts; they are represented in the drawing, between the arched ribs and the railing. The lines there show the joinings of the different plates. In order to preserve as much water-way as possible, the channel is made the full width of the canal and towing-path, and the latter projected over one side, and supported inside by posts resting on the bottom of the canal. The aqueduct of Chirk was designed by the same able engineer, and serves also to convey across a valley the waters of the same canal. This aqueduct was the first in which iron was employed. Hitherto the channel for the waters had been constructed of stone, or partly of stone and partly of clay puddle, which it was generally found very difficult to keep water-tight for a length of time. It was determined, therefore, by Mr Telford, to try the effect of cast-iron, and to lay it at first only on the bottom. The plates were accordingly laid directly over the sprandril walls, which they served to bind together, and united by flanches and screws. The sides of the channel were built with stone facings and brick hearting laid in water-lime mortar. This plan succeeded completely, and the quantity of masonry in the aqueduct was thereby greatly reduced. The aqueduct itself is 600 feet long, and 65 feet high above the river, consisting of ten arches, each 42 feet span. The piers are 10 feet thick.

An aqueduct near Edinburgh, conveying the waters of the Edinburgh and Glasgow Union Canal across the valley of the Water of Leith at Slateford, is an elegant structure, similar in plan to that of Chirk, only that the water-channel is composed entirely of cast-iron, which is moreover built in with masonry. It is about 500 feet in length, and consists of eight arches, each 45 feet span; and the height of the canal is about 70 feet above the level of the river. On this canal another aqueduct of the very same construction occurs in crossing the valley of the Almond, and having several more arches. There are, in different parts of the country, various other aqueducts, but, excepting the formation of the water-way, these structures differ in no respect from bridges, particularly those undertaken not so much with the view of crossing rivers as of raising the level of the road entirely out of the valley,—an object now become of great importance, from the improvements in modern modes of conveyance. For the principles and mode of construction of these works, as well as of the aqueduct bridges so far as the arch is concerned, see articles ARCH and BRIDGE.

For further information on the subject of ancient aqueducts, see E. Curtius, "Ueber Städtische Wasserbauten der Hellenen," in *Archäologische Zeitung*, 1847; Sextus Julius Frontinus, *De Aquæductibus Urbis Romæ Libri II.*, with the Commentaries of Polenus (Patav. 1722) and Rondelet (Paris, 1820); Raphael Fabretti, *De Aquis et Aquæductibus Veteris Romæ Dissertatio;* Plinii *Hist. Nat.* lib. xxxvi. cap. xv.; Montfaucon, *Antiquité Expliquée*, tome iv. tab. 128; Governor Pownall's *Notes and Description of Antiquities in the Provincia Romana of Gaul;* Belidor's *Architecture Hydraulique*, containing a drawing of the aqueduct of Maintenon; also *Mém. Acad. Par.;* Andreossy, *Voyage à l'Embouchure de Mer Noire, ou Essai sur le Bosphore; Philosophical Transactions Abridged*, vol. i.; and Link's *Travels in Portugal.* And for modern aqueducts, see Rickman's *Life of Telford*, 1838; Schramke's *New York Croton Aqueduct; Second Annual Report of the Department of Public Works of the City of New York in* 1872; *Mémoires sur les Eaux de Paris*, presentés par le Préfet de la Seine au Conseil Municipal, 1854 and 1858; *Recherches statistiques sur les sources du Bassin de la Seine*, par M. Belgrand, Ingénieur en chef des ponts et chaussées, 1854. "Description of Mechanical arrangements of the Manchester Waterworks," by John Frederic Bateman, F.R.S., Engineer-in-chief, from the *Minutes of Proceedings of the Institution of Mechanical Engineers*, 1866; *The Glasgow Waterworks*, by James M. Gale, Member Inst. C.E., 1863 and 1864; *The Report of the Royal Commission on Water Supply, and the Minutes of Evidence*, 1867 and 1868.

(A. S. M.—J. F. B.)

AQUILA, a town of Italy, capital of the province of Abruzzo Ulteriore II., beautifully situated on the Aterno, about 56 miles from Rome. It is a well-built place, containing a citadel, which dates from 1534, a cathedral (*S. Bernardino du Siena*), as well as numerous other churches and religious establishments, a theatre, a fine town-hall, and a number of ancient mansions, such as the *Palazzo Torres*, with its picture-gallery, and the *Palazzo del Governo*, the residence of Margaret of Austria. Its chief manufactures are paper, linen, and wax; and it has a large trade in saffron, the principal product of the surrounding district. Aquila was founded about the year 1240, by the emperor Frederick II. who peopled it with the inhabitants of the ancient *Amiternum*, the birthplace of Sallust, the ruins of which are still to be seen about 3 miles from the town. It soon became a very flourishing city; but war, pestilence, and especially earthquakes (1703, 1706), have done much to reduce its importance. Population, 16,607.

AQUILA (Ἀκύλας), a native of Pontus, who flourished about 130 A.D., celebrated for his translation of the Hebrew Scriptures into Greek. His history is involved in much obscurity; but, according to Epiphanius (*De Pond. et Mens.*, c. 15), he was a kinsman of the Emperor Hadrian, who employed him in rebuilding Jerusalem (Ælia Capitolina), and was converted to Christianity, but on being reproved for practising the pagan astrology, apostatised to Judaism. This account, however, is more than doubtful. Aquila's version of the Scriptures was exceedingly close and accurate, and is said to have been used in place of the Septuagint in the synagogues. Though the Christians generally disliked it, alleging without due grounds that it rendered the Messianic passages incorrectly, Jerome and Origen speak in its praise. The few fragments that remain are published in the *Hexapla* of Origen, and in Dathe's *Opuscula*, Lips. 1746.

AQUILA, Caspar, the Latin name of Kaspar Adler, a celebrated German theologian who espoused the cause of the Reformation. He was born at Augsburg in 1488; and after studying there as well as at Berne and Leipsic, and for several years in Italy, he was appointed pastor of Jenga, a village near Augsburg. Here he embraced the doctrines of Luther; but his boldness and zeal in the cause of the reformed faith led the bishop of Augsburg to order his arrest. Aquila passed the winter of 1519–1520 in the prison of Dillingen, and was only liberated through the influence of Isabella of Denmark, sister of the emperor Charles V. From Dillingen he went to Wittenberg, where he became personally acquainted with Luther; and thence he went as tutor to the family of Franz von Sickingen, in the castle of Ebernburg. After a short stay at Eisenach, Aquila was appointed professor of Hebrew at Wittenberg, where he rendered valuable assistance to his colleague Luther in his translation of the Old Testament. In 1527 he became pastor, and the following year Protestant bishop at Saalfeld; but his vehement opposition to the *Interim* of Charles V. in 1548, obliged him to flee from the place, and accept the offer from the countess of Schwarzburg of a temporary asylum in her castle of Rudolfstadt. He was appointed to the deanery of Schmalkalden in 1550, and restored two years after to his office at Saalfeld, where, without further molestation, he continued to discharge his duties till his death, 12th November 1560. The writings he has left are chiefly sermons and controversial works.

AQUILA, Serafino dell', a famous Italian poet and improvisatore, was born in 1466 at the town of Aquila, from which he took his name, and died in the year 1500. He spent several years at the courts of Cardinal Sforza and Ferdinand, duke of Calabria; but his principal patrons were the Borgias at Rome, from whom he received many favours. Aquila seems to have aimed at an imitation of Dante and Petrarch; and his poems, which were extravagantly praised during the author's lifetime, are occasionally of considerable merit. His reputation was in great measure due to his remarkable skill as an improvisatore and musician. His works were printed at Venice in 1502, and there have been several subsequent editions.

AQUILEIA, an ancient city, at the head of the Adriatic, founded or at least colonised by the Romans about 181 B.C., which, on account of its commanding the north-eastern entrance into Italy, soon rose into importance as a commercial centre and as a military post. Connected by the Æmilian way with the capital and the south, it was also the starting-place of the roads to Rhætia, Pannonia, Istria, and Dalmatia. The surrounding territory was highly fertile, and yielded abundance of wine; while gold was found in considerable quantities in the neighbourhood. Aquileia was chosen by Julius Cæsar as headquarters for his forces in Cisalpine Gaul, and was frequently the *point d'appui* of imperial campaigns. It was strongly fortified by Marcus Aurelius in 160, and was able in 238 to frustrate the long-continued siege of Maximin. About this time it was one of the most important and flourishing cities of all Italy. It was recognised as the capital of Venetia, and allowed to have the altogether exceptional privilege of a mint. In 361 the city was captured by Jovinus; and in 381 it was the seat of a council, in which St Ambrose obtained the excommunication of Palladius. In 388 it surrendered to Theodosius the Great his antagonist Maximus; and in 425 Joannes, the rebel against Theodosius II., was led in derision through its streets on an ass, and then beheaded in its circus. In 452 it was taken and destroyed by Attila, and though restored by Narses in 552, it never recovered its former prosperity. At the council of 556 its bishop—whose predecessors can be traced back to the 3d century—separated from the Church of Rome, and took the title of Patriarch, which was recognised by Pope Sergius I. at the council of 698, when the schism was brought to a close. By 924, under the rule of its patriarchs, it was strong enough to extend its authority over Friuli; and it continued to enjoy considerable prosperity, until it was at length deprived of most of its possessions by Venice in 1420. Its patriarchs had indeed already removed their residence to the castle of Udine, and the Venetian conquest only hastened the decay that had previously begun. The patriarchate was abolished in 1758, and the territory divided into the two bishoprics of Udine and Gorizia. It is now a small fishing village of 1956 inhabitants, containing a number of interesting remains of its ancient splendour, and often rewarding the researches of the antiquary with relics of value. (Gian. Dom. Bertoli, *Le Antichite di Aquileja, profane e sacre*, Ven. 1739.)

AQUILLIUS, Manius, was Roman consul in 101 B.C., and successfully reduced a revolt of slaves in Sicily. He was afterwards accused of receiving money illegally, but was acquitted by an artifice of his counsel, who exhibited to the people the scars of wounds received by his client in war. In 88 B.C. he acted as legate against Mithridates, by whom he was defeated and taken prisoner. Mithridates treated him with great cruelty, and finally put him to death by pouring molten gold down his throat.

AQUINAS, Thomas [Thomas of Aquin or Aquino], was of noble descent, and nearly allied to several of the royal houses of Europe. He was born in 1225 or 1227, at Rocca Sicca, the castle of his father Landulf, count of Aquino, in the territories of Naples. Having received his elementary education at the monastery of Monte Cassino, he studied for six years at the University of Naples, leaving it in his sixteenth year. While there he in all probability came under the influence of the Dominicans, who were then the rising order in the church, and were doing their utmost to enlist within their ranks the ablest young scholars of the age, for in spite of the opposition of his family, and especially of his mother (an opposition which was overcome only by the intervention of Pope Innocent IV.), he assumed the habit of St Dominic in his seventeenth year.

His superiors, seeing his great aptitude for theological study sent him to the Dominican School in Cologne, where Albertus Magnus, the most famous thinker of his age, lectured on philosophy and theology. In 1245 Albertus was called to Paris, and there Aquinas followed him, and remained with him for three years, at the end of which he graduated as bachelor of theology. In 1248 he returned to Cologne with Albertus, and was appointed second lecturer and *magister studentium*. This year may be taken as the beginning of his literary activity and public life. Ere he left Paris he had thrown himself with ardour into the controversy raging between the University and the Begging Friars respecting the liberty of teaching, resisting both by speeches and pamphlets the authorities of the University; and when the dispute was referred to the Pope, the youthful Aquinas was chosen to defend his order, which he did with such success as to overcome the arguments of the celebrated William of St Amour, the champion of the University, and one of the most celebrated men of the day. In the year 1257, along with his friend Bonaventura, he was created doctor of theology, and began to give courses of lectures upon this science in Paris, and also in Rome and other towns in Italy. From this time onwards his life was one of incessant toil, and we marvel at the amount of literary work he was able to do, when we remember that during his short public life he was continually engaged in the active service of his order, was frequently travelling upon long and tedious journeys, and was constantly consulted on affairs of state by the reigning pontiff.

In 1263 we find him at the chapter of the Dominican order held in London. In 1268 he was lecturing now in Rome and now in Bologna, all the while engaged in the public business of the church. In 1271 he was again in Paris, lecturing to the students, managing the affairs of the church, and consulted by the king, Louis VIII., his kinsman, on affairs of state. In 1272 the commands of the chief of his order and the request of King Charles brought him back to the professor's chair at Naples. All this time he was preaching every day, writing homilies, disputations, lectures, and finding time to work hard at his great work the *Summa Theologiæ*. Such rewards as the church could bestow had been offered to him. He refused the archbishopric of Naples and the abbacy of Monte Cassino. In January 1274 he was summoned by Pope Gregory X. to attend the council convened at Lyons, to investigate and if possible settle the differences between the Greek and Latin churches. Though suffering from illness, he at once set out on the journey; finding his strength failing on the way, he was carried to the Cistercian monastery of Fossa Nuova, in the diocese of Terracina, where, after a lingering illness of seven weeks, he died on the 7th of March 1274. After his death the highest honours which the church could bestow were awarded to the memory of Thomas. He was canonised in 1323 by Pope John XXII., and in 1567 Pius V. ranked the festival of St Thomas with those of the four great Latin fathers, Ambrose, Augustine, Jerome, and Gregory. Still higher is the honour implied in the fact, that no theologian save Augustine has had the same influence on the theological thought and language of the Western Church, and that no man has better fulfilled the ideal of the monkish life than Thomas of Aquin.

The writings of Thomas are of very great importance for philosophy as well as for theology, for he is the spirit of scholasticism incarnate, and has done more than any other writer save Augustine to fashion the theological language of the Western Church. The mediæval spirit, in all its various manifestations, aimed at universal empire by way of external and visible rule. Its idea of the State was the Holy Roman Empire actually embracing and dominating over all the countries in Europe; its idea of the Church, that visible and tangible catholicity which existed before the great Reformation; and in the department of knowledge it showed its characteristic quality in its desire to embrace in one system, under one science, the whole of human thought. It so happened that, in the break between the old world and the new, the sole institution which survived was the church, and the only science which was preserved was philosophy. Hence, when scholasticism arose, the science which it found ready to its hand was theology, and its task became that of bringing all departments of knowledge under the dominion of this one sovereign science. All through the period of scholasticism, from its beginning under Scotus Erigena down to its decline under Gabriel Biel, this aim of establishing an empire of science was kept in view, and no fresh advance in knowledge in any fresh field of investigation was ever held to be made or taken possession of until its results had been brought under the influence of the master science, and made to occupy their proper and subordinate place. Aquinas occupies the central point in the history of scholasticism, because he, more than any other, was trained by nature and education to do the most that could be done to realise the scholastic ideal, and present a condensed summary of all known science, under the title of *Summa Theologiæ*.

The principles on which the system of Aquinas rested were these. He held that there were two sources of knowledge—the mysteries of Christian faith and the truths of human reason. The distinction between these two was made emphatic by Aquinas, who is at pains, especially in his treatise *Contra Gentiles*, to make it plain that each is a distinct fountain of knowledge, but that revelation is the more important of the two. It is important to mark what Aquinas means by revelation and by reason. Revelation is a source of knowledge, rather than the manifestation in the world of a divine life, and its chief characteristic is that it presents men with mysteries, which are to be believed even when they cannot be understood. Revelation is not Scripture alone, for Scripture taken by itself does not correspond exactly with his description; nor is it church tradition alone, for church tradition must so far rest on Scripture. Revelation is a divine source of knowledge, of which Scripture and church tradition are the channels; and he who would rightly understand theology must familiarise himself with Scripture, the teachings of the fathers, and the decisions of councils, in such a way as to be able to make part of himself, as it were, those channels along which this divine knowledge flowed. Aquinas's conception of reason is in some way parallel with his conception of revelation. Reason is in his idea not the individual reason, but fountain of natural truth, whose chief channels are the various systems of heathen philosophy, and more especially the thoughts of Plato and the methods of Aristotle. Reason and revelation are both of them separate sources of knowledge, which have their appropriate channels; and man can put himself in possession of each, because he can bring himself into relation to the church on the one hand, and the system of philosophy, or more strictly Aristotle, on the other. The conception will be made clearer when it is remembered that Aquinas, taught by the mysterious author of the writings of the Pseudo-Dionysius, who so marvellously influenced mediæval writers, sometimes spoke of a natural revelation, or of reason as a source of truths in themselves mysterious, and was always accustomed to say that reason as well as revelation contained two kinds of knowledge. The first kind lay quite beyond the power of man to receive it, the second was within man's reach. In reason, as in revelation, man can only attain to the lower kind of knowledge; there is a higher kind which we may not hope to reach.

But while reason and revelation are two distinct sources of truths, coming to men by two distinct means of conveyance, the supernatural and the natural means for the delivery of truth, and apprehended by two distinct faculties, reason and faith, the truths which each reveal are not in themselves contradictory; for in the last resort they rest on *one* absolute truth—they come from the one source of knowledge, God, the Absolute One. Hence arises the compatibility of philosophy and theology which was the fundamental axiom of scholasticism, and the possibility of a Summa Theologiæ, which is a Summa Philosophiæ as well. All the many writings of Thomas are preparatory to his great work the *Summa Theologiæ*, and show us the progress of his mind training for this his life work. In the *Summa Catholicæ Fidei contra Gentiles* he shows how a Christian theology is the sum and crown of all science. This work is in its design apologetic, and is meant to bring within the range of Christian thought all that is of value in Mahometan science. He carefully establishes the necessity of revelation as a source of knowledge, not merely because it aids us in comprehending in a somewhat better way the truths already furnished by reason, as some of the Arabian philosophers and Maimonides had acknowledged, but because it is the absolute source of our knowledge of the mysteries of the Christian faith; and then he lays down the relations to be observed between reason and revelation, between philosophy and theology. This work, *Contra Gentiles*, may be taken as an elaborate exposition of the method of Aquinas. That method however, implied a careful study and comprehension of the results which accrued to man from reason and revelation, and a thorough grasp of all that had been done by man in relation to those two sources of human knowledge; and so, in his preliminary writings, Thomas proceeds to master the two provinces. The results of revelation he found in the Holy Scriptures and in the writings of the fathers and the great theologians of the church; and his method was to proceed backwards. He began with Peter of Lombardy (who had reduced to theological order, in his famous book on the *Sentences*, the various authoritative statements of the church upon doctrine) in his *In Quatuor Sententiarum P. Lombardi libros.* Then came his deliverances upon undecided points in theology, in his *XII. Quodlibeta Disputata*, and his *Quæstiones Disputatæ*. His *Catena Aurea* next appeared, which, under the form of a commentary on the Gospels, was really an exhaustive summary of the theological teaching of the greatest of the church fathers. This side of his preparation was finished by a close study of Scripture, the results of which are contained in his commentaries, *In omnes Epistolas Divi Apostoli Expositio*, his *Super Isaiam et Jeremiam*, and his *In Psalmos.* Turning now to the other side, we have evidence, not only from tradition but from his writings, that he was acquainted with Plato and the mystical Platonists; but he had the sagacity to perceive that Aristotle was *the* great representative of philosophy, and that his writings contained the best results and method which the natural reason had as yet attained to. Accordingly Aquinas prepared himself on this side by commentaries on Aristotle's *De Interpretatione*, on his *Posterior Analytics*, on the *Metaphysics*, the *Physics*, the *De Anima*, and on the other psychological and physical writings of the great master, each commentary having for its aim to lay hold of the material and grasp the method contained and employed in each treatise. Fortified by this exhaustive preparation, Aquinas began his *Summa Theologiæ*, which was to be for human thought what the Holy Roman Empire was for the bodies, and the Holy Catholic Church was for the souls of men. It was to be a visible empire of thought, exhaustive, all-embracing, and sovereign. The *Summa Theologiæ* was meant to be the sum of all known learning, arranged according to the best method, and subordinate to the dictates of the church; that was the intention of the book; practically it came to be the theological dicta of the church, explained according to the philosophy of Aristotle and his Arabian commentators. The *Summa* is divided into three great parts, which shortly may be said to treat of God, Man, and the God-Man. The first and the second parts are wholly the work of Aquinas, but of the third part only the first 90 quæstiones are his; the rest of it was finished in accordance with his designs. The first book, after a short introduction upon the nature of theology as understood by Aquinas, proceeds in 119 questions to discuss the nature, attributes, and relations of God; and this is not done as in a modern work on theology, but the questions raised in the physics of Aristotle find a place alongside of the statements of Scripture, while all subjects in any way related to the central theme are brought into the discourse. The second part is divided into two, which are quoted as *Prima Secundæ* and *Secunda Secundæ*. This second part has often been described as ethic, but this is scarcely true. The subject is man, treated as Aristotle does, according to his τέλος, and so Aquinas discusses all the ethical, psychological, and theological questions which arise; but any theological discussion upon man must be mainly ethical, and so a great proportion of the first part, and almost the whole of the second, has to do with ethical questions. In his ethical discussion Aquinas distinguishes theological from natural virtues and vices: the theological virtues are faith, hope, and charity; the natural, justice, prudence, and the like. The theological virtues are founded on faith, in opposition to the natural, which are founded on reason; and as faith with Aquinas is always belief in a proposition, not trust in a personal Saviour, conformably with his idea that revelation is a new knowledge rather than a new life, the relation of unbelief to virtue is very strictly and narrowly laid down and enforced. The third part of the *Summa* is also divided into two parts, but by accident rather than by design. Aquinas died ere he had finished his great work, and what has been added to complete the scheme is appended as a *Supplementum Tertiæ Partis.* In this third part Aquinas discusses the person, office, and work of Christ, and had begun to discuss the sacraments, when death put an end to his labours.

The best edition of the works of Aquinas is the Venice one of 1787, in twenty-eight 4to vols. It contains the useful dissertations of Bernhard de Rubeis. The Abbé Migne has published a very useful edition of the *Summa Theologiæ*, in four 8vo vols., as an appendix to his *Patrologiæ Cursus Completus.* See *Acta Sanct.*, vii. Martii; Touron, *La vie de St Thomas d'Aquin avec un exposé de sa doctrine et de ses ouvrages*, Paris, 1737; Dr Karl Werner, *Der Heilige Thomas von Aquino*, 1858; and Dr R. B. Vaughan, *St Thomas of Aquin, his Life and Labours*, London, 1872. For the philosophy of Aquinas, see Albert Stöckl, *Geschichte der Philosophie des Mittelalters*, ii.; Hauréau, *De la Philosophie Scolastique*, tome ii.; and Ueberweg's *History of Philosophy*, vol. i. (T. M. L.)

AQUITANIA. This was, in the time of Julius Cæsar, the name given to that part of Gallia which lay between the Garumna and the Pyrenees, and was inhabited by a race distinct from the Celtæ. According to Bial and Belloguet, Aquitani is probably a form of Auscetani, a Hispanic lengthening of Ausces (Ausks, Wasks, Basques), and Aquitania would thus be radically identical with Gascony (Wasconia), a word of much later introduction into geographical nomenclature. Though the greater proportion of the Aquitanian tribes made submission to Cæsar, it was not till 28 B.C. that the region was fairly brought under the Roman yoke by M. Valerius Messala. In keeping with the imperial policy of denationalisation, the term Aquitania was extended, in the division of Gallia under Augustus, to the whole stretch of country south and east of the continuous course of the Loire and the Allier, and thus ceased to be of ethnographical import. In the 3d century after Christ this extended Aquitania was divided into three parts. *Aquitania Prima* consisted of the eastern portion of the district between the Loire and the Garonne; *Aquitania Secunda*, of the western part of the same district; and *Aquitania Tertia* or *Novempopulania*, of the region between the Pyrenees and the Garonne, or the original Aquitania. Like the rest of Gaul, Aquitania absorbed a large measure of Roman civilisation which continued to distinguish the district down to a late period. In the 5th century the Visigoths established themselves in Aquitania Secunda, and in some cantons of Narbonensis Prima and Novempopulania. As their power also included Spain, it was usual to speak of their Gallic possessions as Spain likewise. The Merovingian kings extended their authority nominally to the Pyrenees; but as Guizot has remarked (*Essais*, No. ii.) "the conquest of Aquitania by Clovis left it almost as alien to the people and king of the Franks as it had formerly been." For a time indeed, about 630, the Aquitanians rallied round Haribert (Charibert), the brother of Dagobert, in hope of national independence, even under a Frankish ruler; but the usual story that their ducal family was descended from him rests on a forgery (*v.* Henri Martin, *Hist. de France*, vol. ii. p. 137). About the end of the 7th century, an adventurer named Eudes or Eudon had made himself master of the region. Attacked by the Saracens, he inflicted on them a crushing defeat but, on their reappearance, was obliged to call in the aid of Charles Martel, who, as the price of his assistance, claimed the homage of his ally. He was succeeded by his son Hunald, who, after carrying on a war against the aggressions of Pepin the Short, retired to a convent, and left the conflict and the kingdom to Guaifer (Waifer). For nine years he strenuously maintained the hopeless strife, till his assassination in 768. With him perished for a time the national independence, but not the national individuality, of the Aquitanians. The kingdom of Aquitania was bestowed by Charlemagne on the infant Louis in 781; and from him it was transmitted to his son Pepin, on whose death the Aquitanians loyally chose Pepin the younger, but were opposed by Louis, who gave the crown to Charles the Bald. Hence ensued a long period of confusion and conflict, which resulted in the comparative success of Charles, who granted the Aquitanians a nominal separation from Neustria, and gave them his son Charles, eight years old, to be their nominal king (855)—nominal, not only because he was a child, but because his kingdom was in a state of anarchy through domestic faction and foreign invasion. On his death (866), Louis the Stammerer succeeded to the titular sovereignty. About 886 Guilhem (William) the Pious, count of Auvergne, the founder of the abbey of Cluny, obtained the title of Duke of Aquitania, and transmitted it (918) to Guilhem II. He was followed in succession by Raimond Pons, count of Toulouse (d. 950), Guilhem Tête d'Etoupes, count of Poitiers (d. 963), Guilhem Fier-à-Bras, whose sister was married by Hugh Capet (970), and Guilhem the Great (977–1030), who had hard work to maintain his ground, but at last changed his title into an effective lordship. His duchy almost reached the limits of the I. and II. Aquitania of the Romans, but did not extend south of the Garonne, that district having been ever since the 6th century in the possession of the Gascons. Guilhem refused the empire offered him by the Italians, and died at Maillezais. Meanwhile civilisation and refinement were gradually increasing. The names of Guilhem VI. (d. 1038), Guilhem VII., who joined Gascony and Bordeaux to his duchy, and married his daughter to Henry the Black, and Guilhem VIII. bring us down to Guilhem IX., who succeeded in 1086, and made himself famous as crusader and troubadour. Guilhem X. (d. 1137) married his daughter to Louis VII. of France, and Aquitania went as her dowry. On her divorce from Louis and marriage with Henry II. of England (1152), her possession passed to her new husband, and from that time continued to follow the fortunes of the English territories in France. The name Guienne, the modern corruption of Aquitania, seems to have come into use about the 10th century. An interesting literary relic of the struggle between the Franks and the Gallo-Roman inhabitants of Aquitania exists under the title of *Walther d'Aquitaine* (see Fauriel's *Poésie Provençale*), but the historical value of this work has been questioned.

ARABESQUE, a term to which a meaning is now commonly given that is historically incorrect. We apply it to the grotesque decoration derived from Roman remains of the early time of the empire, not to any style derived from Arabian or Moorish work; the term is therefore a misnomer. Arabesque and Moresque are really distinct; the latter is from the Arabian style of ornament, developed by the Byzantine Greeks for their new masters, after the conquests of the followers of Mahomet; and the former is a term pretty well restricted to varieties of cinquecento decoration, which have nothing in common with any Arabian examples in their details, but are a development derived from Greek and Roman grotesque designs, such as we find them in the remains of ancient palaces at Rome, and in ancient houses at Pompeii. These were reproduced by Raphael and his pupils in the decoration of some of the corridors of the Loggie of the Vatican at Rome: grotesque is thus a better name for these decorations than Arabesque.

This technical Arabesque, therefore, is much more ancient than any Arabian or Moorish decoration, and has really nothing in common with it except the mere symmetrical principles of its arrangement. Pliny and Vitruvius give us no name for the extravagant decorative wall-painting in vogue in their time, to which the early Italian revivers of it seem to have given the designation of grotesque, because it was first discovered in the arched or underground chambers (*grotte*) of Roman ruins—as in the golden house of Nero, or the baths of Titus. What really took place in the Italian revival was in some measure a supplanting of the Arabesque for the classical grotesque, still retaining the original Arabian designation, while the genuine Arabian art, the Saracenic, was distinguished as Moresque or Moorish. So it is now the original Arabesque that is called by its specific names of Saracenic, Moorish, and Alhambresque, while the term Arabesque is applied exclusively to the style developed from the debased classical grotesque of the Roman empire.

There is still much of the genuine Saracenic element in Renaissance Arabesques, especially in that selected for book-borders and for silver-work, the details of which consist largely of the conventional Saracenic foliations. But the Arabesque developed in the Italian cinquecento work repudiated all the original Arabian elements and devices, and limited itself to the manipulating of the classical elements, of which the most prominent feature is ever the floriated or foliated scroll; and it is in this cinquecento decoration, whether in sculpture or in painting, that *Arabesque* has been perfected.

We will first briefly describe the Saracenic, as the elder sister of the two styles, which was ingeniously developed by the Byzantine Greek artists for their Arabian masters in the early times of Mahometan conquest. Every natural object was proscribed; the artists were, therefore, reduced to making symmetrical designs from forms which should have no positive meaning; yet the Byzantine Greeks, who were Christians, managed to work even their own ecclesiastical symbols, in a disguised manner, into their tracery and diapers; as the lily, for instance. The cross was not so introduced; this, of course, was inadmissible; but neither was the crescent ever introduced into any of this early work in Damascus or Cairo. The crescent was itself not a Mahometan device till after the conquest of Constantinople in 1453 A.D. The crescent, as the new moon, was the symbol of Byzantium; and it was only after that capital of the Eastern empire fell into the hands of the Turks that this symbol was adopted by them. The crescent and the cross became antagonist standards, therefore, first in the 15th century. And the crescent is not an element of original Moorish decoration.

The Alhambra diapers and original Majolica (Majorca) ware afford admirable specimens of genuine Saracenic or Moorish decoration. A conventional floriage is common in these diapers; tracery also is a great feature in this work, in geometrical combinations, whether rectilinear or curvilinear; and the designs are rich in colour: idolatry was in the reproduction of natural forms, not in the fanciful combination of natural colours. These curves and angles, therefore, or interlacings, chiefly in stucco, constitute the prominent elements of an Arabian ornamental design, combining also Arabic inscriptions; composed of a mass of foliation or floral forms conventionally disguised, as the exclusion of all natural images was the fundamental principle of the style in its purity. The Alhambra displays almost endless specimens of this peculiar work, all in relief, highly coloured, and profusely enriched with gold. The mosque of Touloun, in Cairo, 876 A.D., the known work of a Greek, affords the completest example of this art in its early time; and Sicily contains many remains of this same exquisite Saracenic decoration.

Such is the genuine Arabesque of the Arabs, but a very different style of design is now implied by the term—the Arabesque of the cinquecento, a purely classical ornamentation. This owes its origin to the excavation and recovery of ancient monuments, and was developed chiefly by the sculptors of the north, and the painters of Central Italy; by the Lombardi of Venice, by Agostino Busti of Milan, by Bramanti of Urbino, by Raphael, by Giulio Romano, and others of nearly equal merit.

Very beautiful examples in sculpture of this cinquecento Arabesque are found in the churches of Venice, Verona, and Brescia; while in painting, the most complete specimens are those of the Vatican Loggie, and the Villa Madama at Rome and the ducal palaces at Mantua. The Vatican Arabesques, chiefly executed for Raphael by Giulio Romano, Gian Francesco Penui, and Giovanni da Udine, though beautiful as works of painting, are often very extravagant in their composition, ludicrous, and sometimes æsthetically offensive; as are also many of the decorations of Pompeii. The main features of these designs are balanced scrolls in panels; or standards variously composed, but symmetrically scrolled on either side, and on the tendrils of these scrolls are suspended or placed birds and animals, human figures and chimeras, of any or all kinds, or indeed any objects that may take the fancy of the artist. But he is limited by the laws of æsthetics; his designs must be symmetrical or they will want harmony, and they must not offend against mechanical possibility or the principle of gravitation, or they will be ridiculous: nothing that outrages æsthetic sensibility can ever be beautiful. The most perfect specimens of cinquecento Arabesque are certainly found in sculpture. As specimens of exquisite work may be mentioned the Martinengo tomb, in the church of the Padri Riformati at Brescia, and the façade of the church of Santa Maria dei Miracoli there, by the Lombardi; and many of the carvings of the Château de Gaillon, France—all of which fairly illustrate the beauties and capabilities of the style.

This kind of decoration need not, however, be limited to architectural panels and pilasters; it is applicable for large surface decoration, and for manufactures, whether in wood or metal, or textile. It affords as much room also for the display of colour as of form: some of the surface decorations of Gærtner, in Munich, are splendid examples of delicacy of colour, showing how much may be effected by harmonious combinations in scroll-work of the most delicate gradations and tints. Good specimens of Arabesque, in manufactures, in casts, and in copies in colour, may now be seen in the South Kensington Museum. For fuller details of style, see Wornum, *Analysis of Ornament*, &c., 4to edition, 1874, illustrated. (R. N. W.)

ARABGIR, or ARABKIR, a town of Turkey in Asia, in the vilayet of Sivas, situated in a deep ravine near a small tributary of the Euphrates, 150 miles S.S.W. of Trebizond. The inhabitants are enterprising and prosperous, many of them leaving their native city to push their fortunes elsewhere, while of those that remain the greater part are employed in the manufacture of silk and cotton goods, or in the production of fruit. The present town was built at a comparatively recent date, but about 2 miles to the north-east is the old town, now called Eski Shehr, containing the ruins of a castle and of other buildings. Arabgir contains about 6000 houses. About three-fourths of the population are Turks, and the remainder Armenians.

ARABIA

Sources of information. OUR information in regard to the physical character of Arabia must be chiefly derived from the accounts given by European travellers; amongst whom Niebuhr, Burckhardt, Wallin, Welsted, and Palgrave have been on this occasion chiefly consulted; and to their works the reader must necessarily be referred for a variety of details impossible to compress into a summary like the present.

Extent of Arabia. Arabia is a peninsula stretching from north-west to south-east, between 30° and 12° 45′ N. lat., and between 32° 30′ and 60° E. long. Its form is that of an irregular parallelogram, almost a triangle indeed, bounded on the W., S., and E. by the Red Sea, the Indian Ocean, and the Persian Gulf respectively; on the N., where runs its narrowest limit, it joins on to the mainland of Syria. Its correct boundary in this direction would be assigned by a line drawn transversely, west and east, from Suez to the head of the Persian Gulf. But some writers, Burckhardt included, add to this extent all the Syrian desert behind Palestine, and the valleys of the Jordan and Orontes up to the village of Anah, on the Euphrates, 34° N. lat.; and then down again by the right bank of that river to where, joined by the Tigris, it takes the name of Shatt-el-Arab, and

so to the Persian Gulf again. Roman geographers make Arabia the further present of Mesopotamia; and Abul-Feda, an Aleppine of the 13th century, would even bring its denomination so far north as to include Aleppo. We will, however, accept the first-mentioned as the most correct line of demarcation. According to this, the extreme length of the Arabian peninsula, from the head of the gulf of Akabah to the straits of Bab-el-Mandeb would be about 1300 miles; its greatest breadth, in 23° N. lat., from the Red Sea coast, west, to Ras-el-Hadd, east, 1500 miles; and its apex, where it joins on to the continent of Asia, rather under 900 miles.

Western coast. The western coast is washed by the Red Sea. It exhibits a range of low mountains, seldom exceeding 2000 feet in height, abrupt in outline, and generally barren; between them and the sea is a narrow and sandy strip fringed along the margin with coral reefs. Its aspect from the sea is almost everywhere desolate in the extreme. Nor does the entire coast-line present a single harbour, properly speaking, where anything larger than an ordinary schooner could find entry; only roadsteads, the approaches to which are often rendered difficult by shoals and reefs. The Arab side of the Red Sea, especially in the southern half, is thickly studded with small islands, some of which—Kotembel and Pebel Tar in particular—are of volcanic origin. A few fishermen inhabit some of them; but none—the island of Perim, near the entrance of the Bab-el-Mandeb straits, lately occupied by a British garrison, alone excepted—are of any importance.

South-eastern coast. The south-eastern coast, extending from Bab-el-Mandeb up to Ras-el-Hadd, is not less dreary than that of Hejaz in appearance, and, like it, presents a low and barren mountain range, diversified only by jagged rocks amid tracts of sand; but it possesses several good harbours—that of Aden in particular, now a British coaling station, about 100 miles east of Bab-el-Mandeb; that of Dafar, further up; and that of Keshum; though the two last, owing to the want of traffic with the interior, now serve as mere ports of refuge. Along this shore lie several islands, the largest being that of Mozeyrah, near Ras-el-Hadd, but they are only the haunts of a few half-savage fishermen, or are wholly desert.

Persian Gulf coast. The third coast, reaching from Ras-el-Hadd to the top of the Persian Gulf, is of a more cheerful character. Its easterly half, from Ras-el-Hadd to Cape Musandam, is in general fertile, well-cultivated, and backed up by the lofty forest-sprinkled chain of Jebel Akhdar, or the "Green Mountain." Here is situated the excellent harbour of Mascat, one capable of admitting the largest vessels to an almost land-locked shelter; besides other smaller but secure ports. Passing Cape Musandam to the west and north, the coast, though low and sandy in some places, is in others palm-fringed and cultivated; and the neighbourhood of the shallow harbour of Kateef, opposite Bahreyn, is especially fertile. Near the head of the gulf is the harbour, a very good one, of Koweyt, called also Grane. It furnishes the best ships and sailors of these seas. Many islands stud the Gulf Ormuz, famous in Persian and, later, in Portuguese history. Near the narrow entrance, by Cape Musandam, not far off, extends Ishm, a large and fertile island; higher up lie side by side the sister islands of Bahreyn, Menaneh, and Moharrik, where commence, and continue eastward all along the neighbouring coast of Katar, the most productive pearl fisheries in the world. But countless shoals and reefs render the navigation of the Persian Gulf scarcely less dangerous than that of the Red Sea; storms, too, often arise suddenly on its waters, and shipwrecks are of frequent occurrence.

General features. Arabia, taking it as a whole, cannot be called a fertile country. Its general features are those of an elevated table-land, backed up by low mountains to the west, and gradually rising in the direction of the east and south, where we find it bordered by a second and loftier mountain range. The mountains, if we except Jebel Akhdar in Oman, are almost wholly barren on their sea side; but are occasionally fertile enough on their inner ranges, especially in Yemen and the southerly districts. Their outlines are rugged and precipitous to a degree that, joined with the refraction of an over-heated atmosphere, gives them from a distance an appearance of being of a much greater height than they really are. Behind them lies an uninterrupted ring of sterile desert, broadest on the south and east, where it expands into a huge waste of burning sand; narrower towards the west and north, where it is more rocky in its character. Within this belt rises a series of table-lands, undulating in long slopes, and intersected with deep valleys; the former rich in pasturage, the latter in field and garden produce. This central plateau constitutes about one-third of the total superficies of the peninsula; the desert ring another third: the coast ranges make up the rest.

Divisions of Arabia.

In describing Arabia, the ancients, whose knowledge on the subject was slight, were accustomed to lay down an imaginary tripartite division, founded on the natural qualities of those districts with which they were more or less acquainted; and accordingly portioned off Arabia into Petræa, Deserta, and Felix, or the Stony, the Desert, and the Happy; without, however, assigning any very distinct boundaries to these regions. More modern geographers, Eastern and European, have, with better but still inadequate information, either multiplied or confounded the main divisions of the peninsula. Much indeed of its surface is even now unknown to us, except by the uncertain hearsay of Arab narrators. However, the ground-plan laid down by Niebuhr, the most accurate and painstaking of travellers, is substantially correct, and has been so often confirmed, never invalidated, by later discoveries, that we may safely follow its indications.

Sinaitic peninsula.

Beginning from the north-west, the first district we meet with is that of the Sinaitic peninsula, a small triangle having its apex on the Red Sea, its base on Palestine, and its sides formed by the Gulf of Suez on the west, and that of Akabah on the east. It is a mere collection of naked rocks and craggy precipices, intersected by long narrow defiles and sandy valleys, in which tamarisk bushes, dwarf acacias, thorny shrubs, and some kinds of euphorbia, are almost the only vegetation; in a few favoured spots a cluster of wild date-palms may occasionally be met with; and the scanty soil after the spring rains becomes sprinkled over with thin blades of grass that the summer suns soon wither. Running water, except a few rivulets, the result of the spring or autumn rains, none of which outlast the summer, there is none; but in its stead the traveller meets with a stagnant and brackish pool here and there under the shelter of some overhanging rock, or a not less brackish well. In the centre of this dreary district rises the famous mountain group, one particular summit of which, though not the highest, is conjectured to have been the Biblical Sinai. At its foot lies Wadi Feyran, a valley several miles in extent, and the only tolerably fertile piece of ground in the whole region. The climate, allowing for the increase of heat consequent on a southerly latitude, resembles in the main that of Syria,—rainy in the winter and early spring, with passing storms in autumn; at other times it is uniformly dry and clear. The summer temperature reaches in the valleys, and particularly in the great desolate gully called the "Ghowr," which is a continuation of the Dead Sea hollow, a height of 118° Fahr. in the shade; during the night it often falls to 70°, or even lower. Winter is cold, but ice and snow seldom occur except upon the heights, where the Sinai group in particular becomes snow-capped every year for a period varying from a few days to over two months. The atmosphere is healthy, except in autumn and in early spring.

Geology.

Between the gulfs of Akabah and Suez the geological formations are almost exclusively plutonic or volcanic,—the latter occupying in general a lower range than the former; metamorphic belts, chiefly of gneiss and slate, are also to be met with. Basalt and greenstone are the most usual volcanic forms, and the subterraneous action that once produced them does not yet seem to be wholly exhausted, for hot springs are of frequent occurrence throughout the region, and earthquakes, accompanied by loud underground noises, are by no means uncommon. The hot wells near Suez, called "Eyoon Moosa," or the "Fountains of Moses," are well known; as also are those entitled "Hammam Pharaoon," or the "Bath of Pharaoh," the waters of which resemble in their constituents those of the Dead Sea. These volcanic phenomena cease, however, in the zone to the east of Akabah, where rises the great and barren mountain range of Sherá (the "Seir" of the Bible), a system wholly jurassic in its composition, though its strata lie at various and often at abrupt angles.

The plants and animals tenanting this district are, with slight modifications, common to the next, where, however, they in general obtain a fuller development, and under which they may accordingly be more appropriately described.

Physical description of the Hejaz.

The second geographical district is that of the Hejaz, lying between 28° and 21° N. lat. along the eastern shore of the Red Sea, and extending inland for a distance varying from sixty to a hundred and fifty miles. It consists of a continuation of the Sherá mountain range, with a narrow sandy slip of level ground towards the sea, and a hilly plateau on the inland side, broken by bare and fantastic rocks. Its surface is, with few exceptions, barren; stony to the north, sandy to the east and south; what little irrigation it possesses is wholly from wells, deep sunk and brackish; the spring rains supply a few streams that soon dry up in summer. Along its length lie the great Syrian and Egyptian pilgrim-routes, mere camel tracks, of which the direction is determined by the scanty wells and a few villages. In the neighbourhood of Medinah alone, 25° N. lat., and at the station of Kholeys, a few days' journey north of Mecca, is any considerable cultivation to be found, the result of springs; elsewhere all is drought and sterility.

The "Haram" of Mecca.

The southernmost extremity of this region, marked off as the "Haram" or Sacred Territory, but in its physical characteristics identical with the rest, contains the town of Mecca. South-east of this tract rises the upland district called "Jebel Kora," or "Mountain of Villages," fertile and copiously watered; celebrated too for the excellence of its fruits and the salubrity of its climate; whereas the Hejaz, particularly along its western or seaward slope, has the reputation of being unhealthy and feverish. Due south of Mecca the mountains rise still higher, up to the precipitous fastnesses of Jebel Aseer, intersected by countless narrow but fertile valleys.

Geological character.

With Hejaz we may also reckon, topologically speaking, the oases of Jowf and Douma, situated to the north-east, both formed by broad and abrupt depressions in the inland plateau, and surrounded by a wide-spread wilderness of rock and sand. The geological formation of this region is chiefly calcareous and jurassic, though isolated traces of volcanic outbursts are seen near Medinah and Mecca; some also of the wells in the Hejaz—that of Zemzem, for example, at Mecca—are tepid; and one distinct eruption of lava is stated to have occurred in the neighbourhood of Medinah as recently as the middle of the 13th century.

Vegetation.

Of plants there is an endless variety, but insufficiently known, for Arab botany has yet to be investigated. "Samh," a small mesembryanthemum, from the grain of which the Bedouins prepare a sort of porridge that serves them in lieu of bread; "Mesaa," a thorny bush that bears a subacid berry not unlike a currant in appearance and flavour; "Nebek," the *Rhamnus lotus* of botanists; many kinds of euphorbia, absinthium, and the bitter colocynth, used by the Arabs for medicine, grow wild everywhere. The tamarisk or "Talh," the southern larch or "Ithel," the chestnut, the sycamore, and several other trees, the wood of which is, however, too porous and brittle for use as timber, are natives of Hejaz; so also is the wild dwarf date-palm, the almond, the pomegranate, and the "gum arabic" tree, a graceful and delicate acacia. Fine grass, intermingled with various aromatic herbs, springs up in patches between the stones and among the sand; but the want of sufficient rainfall and the dryness of the atmosphere prevent any really profitable vegetation, except in the few oases already mentioned. Taking it as a whole, the Hejaz is, with the exception of the actual and recognised desert alone, the most hopelessly sterile district in the whole Arabian peninsula.

Yemen. Following the Red Sea coast down to its southernmost extremity at Aden, we have in view the third great geographical section, that of Yemen. It includes two regions, sea-shore and inland, the former of which is commonly called the "Tehamah." This is a wide strip of coast left by the mountain chain, which, continuing on from the Hejaz, runs down as far as Aden, but hereabouts recedes somewhat to the east, thus forming an arc, in the curve of which lies the Tehamah. The mountainous district extends far inland, and gives out several minor branches, some of which reach about three hundred miles to the east.

Tehamah. Tehamah is, as might be expected from its topical and geographical conditions, a very hot region; it is one also of but moderate fertility, though the soil, an agglomeration principally of coral debris, is less absolutely barren than that of the Hejaz. The rains here are periodical, their fall coinciding with the epoch of the Indian monsoon; they give rise to numerous torrents, that traverse the plains, and some of which hardly dry up throughout the year. The coast-line is indented by several small harbours and road-steads; intricate coral reefs render the approach everywhere difficult, often dangerous.

Yemen, under which name the whole south-western quarter of the peninsula is popularly included, possesses many advantages, both of climate and soil, denied to the greater portion of Arabia. It is a highland country, formed by a labyrinth of precipitous hills and fertile valleys. The air is pure and even cool; the seasons are as regular as those of eastern India, and succeed each other in much the same order. No accurate survey has yet been made to determine the elevation of its mountains, some of which have been roughly, but perhaps incorrectly, estimated at five thousand feet in height; their general direction is from north-west to south-east. The largest plains, or rather plateaus, inclosed by them are that of Nejran on the north, that of Sanaá to the south, and that of Mareb to the east, on the frontier of the great desert. The oasis of the southern Jowf, a basin-like depression occurring in the sandy waste that reaches inland from the high grounds of Yemen up to Oman, on the other side of Arabia, may also be reckoned as belonging to Yemen.

Geology. Though the mountains are well supplied with water, no considerable rivers or streams find their way from them to the Red Sea, tropical evaporation combining with the light and porous quality of the soil to dry up the torrent beds; nor do any natural lakes exist, though artificial pools and tanks, in which water is preserved all the year round, have been constructed in plenty. Indications of volcanic action, long since extinct, abound throughout Yemen, where basalt formations compose a considerable and the most fertile portion of the coffee-bearing district; in other places jurassic rock predominates, while granite occurs in patches here and there. Spar, agate, onyx, and carnelian are exported from Yemen; silver and gold are reported to have been found on its hills, but on doubtful authority.

Vegetation. It is in this region that Arabian vegetation obtains its most varied, as also its most valuable development. North of Medinah the parched and niggard soil, chiefly composed of marl, flint, and sand, with a supply of rain alike scanty and uncertain, produces little more than varieties of acacia, euphorbias, and thorny shrubs,—a valueless crop. But in the neighbourhood of Medinah commences the great date-palm belt that crosses the peninsula, and extends southward as far as lat. 23° in full vigour. A hundred and more varieties of this tree are said to grow in the immediate vicinity of Medinah alone: the quality of the fruit varies for each kind, as also do its size, colour, and flavour. The poorest of all, the "sihanee" date, a yellow, stringy fruit, is much eaten by the Bedouins; the "birnee" is red and succulent; the "jebelee," an upland date, is a staple article of export.

The date-palm. Nejd is, however, the favoured land of date-palms: every valley that intersects its vast plateaus waves with them; and the fruit, which often attains a length of two inches, with a proportionate thickness, far surpasses the best products of Hejaz in lusciousness as in size. Eaten fresh or stewed with butter, they form the staff of Arab food; and the pulp, after the kernels have been extracted, close-pressed and half dried, is exported under the name of *ajweh* to almost every part of the East. In general a latitude varying from 27° to 22° N., and a sufficient distance from the sea to preclude its atmospheric influences, seem to be the most favourable circumstances for bringing this fruit to perfection; and hence it comes that the produce of the Jowf and of Hareek—which, though inland, lie too far, the one to the north, the other to the south,—of the Hejaz on the Red Sea, and of Rateef on the Persian Gulf coast, is decidedly inferior to that of the inland districts of Kaseem and Nejd. Yet an exception must be made in favour of the "kholas" date, as it is called, that grows in Hasa, an amber-coloured date of exquisite flavour, the king of dates: the tree itself that bears it is readily distinguished from every other species by the delicacy of its stem and foliage. But in the greater number of instances, whatever the variation in the fruit, the palm trees themselves are to an unpractised eye undistinguishable the one from the other.

Other fruit-trees. Besides the date tree, the "doom," a fan-leaved palm bearing a large fibrous and sweetish fruit, is not of uncommon growth in the central and southern districts; while the cocoa-nut and betel are planted, though not to such an extent as to reckon among the articles of ordinary cultivation, along the southern and eastern coast. So are also the banana, the papay, and the Indian fig; but all these are of recent importation from the opposite coast of India.

Vines. Vines are cultivated throughout Arabia, and have been so from time immemorial; and though since the well-known prohibition of the Koran the grapes are no longer pressed for wine, they are in great request as an article of consumption, both fresh and dried. The best fruit is that of Yemen; Oman, where the heat is such that the vintage is gathered in April, comes next, both for the quantity and the quality of its produce.

Other vegetable products. In peaches, apricots, pomegranates, and oranges, the district of Taif, near Mecca, excels all others. Senna, an article much used by the Arabs in their rough medicine, grows in the southern Hejaz and the Tehamah; so also does the balsam tree, the best of which is indigenous to the district of Safra, near Mecca; its gum is sold even within Arabia itself at a high price. The incense tree, said to be a native of Hadramaut, in the extreme south, has, strange to say, never yet been exactly identified, though its gum is a constant article of export; and the henna tree (*Lawsonia inermis*), used in dyeing, grows abundantly on the western coast. The cotton shrub springs up, seemingly wild, in the gullies of Nejd; but owing to the dryness of the soil and climate, does not repay extensive cultivation. Indigo is grown in many places, chiefly in the low districts bordering on the Persian Gulf.

Coffee. But although the Arabs themselves consider the date-palm the special pride and ornament of their country, a more general verdict would probably be given outside of Arabia itself in favour of the coffee plant. This shrub is by some supposed to be indigenous to Abyssinia; it has, however, for several centuries attained its most extensive distribution and its highest standard of produce in Yemen, where it is cultivated throughout about half of the upland district, the best quality of berry being that which ripens on the western slopes of the mountains in the neighbourhood of Sanaá.

The plant itself is too well known to require description; it is enough here to remark that its principal flowering season in Yemen is in March. The first crop of the berries ripens in May; a second and a third crop succeed in the course of the year. The diffused atmospheric heat of an equatorial region is requisite for the growth of the coffee plant; yet it needs also a large supply of moisture, and even of shade, to protect it from the too direct action of the sun. In order to obtain these conditions, large trees are often planted here and there among the shrubs, which are arranged on rock terraces, one above another, amphitheatre-wise, along the slopes, and are densely crowded together. The processes of gathering and drying the berries, of separating the husks, and of picking the kernels, are all performed by manual labour of the simplest kind. How the drink is prepared has been often and minutely described by travellers; the method employed is tedious, but the result infinitely surpasses that obtained in any other country or by any other method. A slightly acid and very refreshing beverage is also made from an infusion of the "kishr" or outer husk. Its use is almost confined to the Yemen; it is esteemed a febrifuge.

Káat shrub.

A small shrub, called "káat," is common throughout the coffee plantations; it resembles verbena in scent and growth; its leaves are chewed by the natives, much as those of tobacco are by some Europeans; the effect is that of a gentle stimulant and anti-narcotic. This plant is only found in the south-western regions, and its use is limited to them.

Hadramaut

Next to Yemen, and lying along the coast of the Indian Ocean, from Aden to Cape Ras-el-Hadd, a distance of 1200 miles, are situated the provinces of Hadramaut and Mahrah, the former mentioned in Genesis under the name of Hazarmaveth, and more celebrated in ancient Arab chronicles, and in the notices of Strabo and Ptolemy, than it has been in later times. This coast has been visited and even partially explored by Captain Wellsted and other navigators. It presents everywhere much the same dreary appearance as that of the Hejaz and Tehamah,—a narrow fringe of sand or of equally sterile shore; beyond this rises a mountain range, varying, so far as any tolerably accurate calculations have been made, from 1000 to 3000 feet in height; its formation appears to be in many places volcanic; behind this comes a second and loftier mountain belt, jurassic in its general character, resembling the highlands of Yemen; while far beyond stretches away the great sandy desert, varied, however, where it approaches the mountain-foot, by oases of considerable fertility, among which that of Wadi Doan is said to be the most extensive. Several barren islands and reefs fringe the waste. The mountains of Hadramaut form one system with those of Yemen, but, unlike the latter, seem to be of an almost monotonous sterility. Torrents descend from them, but no rivers; nor, though lakes are mentioned in the very apocryphal records of the Arabs, has any sign of their existence been verified. The climate is intensely hot, and is said to be unhealthy, at least to strangers; the vegetation is scanty. No part of the peninsula has been less explored than this, even by the Orientals themselves; and European travellers have supplied few reliable data for what regards the physical characteristics of the interior, any more than of its inhabitants and products.

Oman.

From Ras-el-Hadd to the extreme northern limits of Arabia, at the head of the Persian Gulf, the provinces of Oman and Hasa complete the sea-coast. Oman is a mountainous district, its principal range, that of Jebel Akhdar, or the "Green Mountain," so called from the abundant vegetation that covers its sides, reaches an ascertained height of 6000 feet; several other minor chains run parallel with it and with the coast; the plains beneath them are well watered and fertile, though, like every other part of Arabia, destitute of running rivers or streams, the want of which is here atoned by copious wells and springs, running over into large pools, and supplying an extensive system of irrigation. The rocks are chiefly granite on their upper, limestone on their lower level; but here, too, as on the Red Sea coast, indications of volcanic action, though at a comparatively remote period, are frequently to be observed; hot springs, too, such as those known by the title of Imam Alee, near Mascat, are not uncommon. The only good harbour on this part of the coast is that of Mascat, with which the immediately contiguous part of Matrah may be reckoned. By the sea-shore the climate is intensely hot, rivalling in this respect that of Aden, and far from wholesome; among the mountains inland the air is cool and pure.

Coast of the Persian Gulf.

Near Cape Musandam, at about 400 miles north-west of Ras-el-Hadd, the mountains (which, averaging in this promontory from 2000 to 3000 feet in height, come down in precipices to the sea edge), are indented with numerous deep creeks and bays, several of which afford good anchorage and shelter,—only they are cut off by the steepness of the surrounding cliffs from inland communication. West of Musandam, and following the sweep of the great bay of Sharjah and Katar, within the gulf itself, the coast becomes low and sandy, and henceforth offers no harbours, but mere roadsteads, often dangerous of approach by reason of the numerous banks and shoals in the sea. A few palm trees line the shore, which has a desolate appearance. Further still to the north-west, along the region of Hasa, and up to the head of the gulf, the coast continues low, but is enlivened by extensive green tracts of palm-groves and other semi-tropical vegetation. The mountains, situated a good way inland, and not exceeding 3000 feet in their extreme height, are of jurassic formation. Copious springs, some of which are hot and others tepid, break out in many places at their base, but are again absorbed in the sand, or are dissipated by field irrigation before reaching the sea. The extreme northern angle of the gulf is comparatively desert.

Physical character of the coast.

Owing to the rapid interchange of heat and cold occasioned by the peculiar situation of the gulf between the torrid levels of Arabia on the one side, and the high, not unfrequently snow-capped, mountains of Persia on the other, the climate of this coast is remarkably irregular in its seasons, and subject to sudden storms of great violence, with heavy rains. It is also decidedly unhealthy; and low fevers, sometimes of an intermittent, sometimes of a typhoid type, are never absent from the villages.

Indeed the whole of the Arabian sea-shore, which we have now thus summarily surveyed, partakes more or less of the same unhealthy character, one often noticed by travellers, and experienced by some of them with fatal effect. We have seen, too, that in general outline it offers little variety, being mostly mountainous, especially in its southern part, with a narrow and rarely fertile shore-fringe; while the mountains themselves vary in height and extent, being at their loftiest and widest in Yemen and Oman, where their rich vegetation, joined to a pure air, and a climate tempered by the elevation, offers an agreeable contrast to the dissimilar qualities of the coast itself, narrower and more barren elsewhere.

Central Arabia, or Nejd.

We have now to consider the central plateau, or Nejd, an important region, regarded by the Arabs themselves as peculiarly their own—the stronghold of their vigorous nationality, and the birthplace of their most cherished traditions and institutions.

It is girded in on every side by a broad desert belt.

which the traveller must of necessity cross before he reaches the inner region. It is this very desert that, having been often witnessed on its outer rim, but never traversed from one side to the other by Greek or Roman, or even, in the greater number of instances, by modern explorers, has given occasion to the belief that central Arabia was itself little better than an expanse of uninhabitable waste,—an idea expressed by the *Arabia Deserta* of the ancients, and often repeated by later writers.

The northern desert.

This desert, on the north and north-east, where it extends from Syria and the Hejaz inwards, is a region of hard gravelly soil, from which circumstance it has derived the elastic title of "Petræa." It is diversified here and there by belts of sand, with occasional patches of stunted bush and thin grass, indicative of moisture at some depth below; the sand, too, affords roofing for a feathery euphorbia, the "ghada" of the Arabs, a favourite browse of camels. The general height of this tract, backed up as it is by the Syrian plateau on the north, and the Sherá mountains on the west, appears to vary from 1000 to 2000 feet above the sea. Eastward it slowly slopes down to the level of the Persian Gulf. A long serpentine depression, beginning in the Syrian territory near Palmyra, traverses it in a south-easterly direction; this is Wadi Seihan, or the "Valley of the Wolf," leading to the deep oval hollow of Jowf, with its oasis of palms and gardens. A more extensive but shallower depression to the west forms the oasis of Teyma, known to Hebrew chroniclers. South of Jowf and Teyma the desert changes its stony to a sandy character, and its surface is heaped up by the winds into vast ridges, called the Nefood or "passes," not to be crossed without some danger; for, besides the almost absolute want of water, a few scanty and brackish wells of which, separated one from the other by intervals of 60 or more miles, alone exist, it is here that the

The simoom.

"simoom," or poison wind, often blows—a phenomenon entirely distinct from the customary "shelook," or sirocco, of the south, much as a hurricane differs from an ordinary gale, though the two have been occasionally confounded in popular writings. The simoom is a peculiar condition of the atmosphere, resembling in all essential points a cyclone. As in the cyclone, the central space, or the simoom itself, is calm, but is occupied by a gas unfit for respiration; while round this as a centre, slowly travelling on, there eddy violent gusts of heated air, like those of a furnace, though it is not to them, but to the comparative vacuum which they surround, that the simoom owes its suffocating qualities. It approaches slowly amid the whirl of air currents that precede it for some distance; its violet colour announces it when actually near. During its presence the only chance of preserving life till the mephitic vapour has passed over, is found in covering the face with a cloth and lying prone on the sand, thus to inhale what little atmospheric air still exists in the upper ground stratum, and thus to maintain the breath till the period, varying from two to ten minutes, of the poison column be gone by; meanwhile the feeling in the chest is that of suffocation, and that in the limbs as if molten iron were being poured over them. Camels instinctively bury their muzzles in the sand during the simoom; but horses are said not to possess the same preservatory instinct, and to perish in consequence. The precise nature of the phenomenon, and its origin, are subjects of conjecture; but its general character, that of an eddy of heated atmosphere around a central space occupied by a deleterious gas, the whole travelling at a slow rate, and generally from south or east to north and west, is not to be mistaken.

Mountains of Shomer.

South of the Nefood begins a series of granite hills, at first cropping up as mere isolated rocks through the sand, then increasing in extent and height till they coalesce and form the two parallel chains of Jebel Aja and Jebel Solma, both of which cross two-thirds of the peninsula from N.N.E. to S.S.W. The highest peak of either does not seem to exceed 4000 feet above the sea-level. Between them and around their base extend broad and well-peopled valleys. The irrigation is wholly artificial and from wells, which here yield an abundant supply. The water is brought up from an average depth of 20 or 30 feet. The climate of this region, though heated by the neighbouring desert, is remarkably healthy, and the air extremely pure.

The Kaseem.

Passing this mountain-belt, we find a second depression, still following the same general direction, namely, from N.N.E. to S.S.W., wide and fertile, a land of palm-trees, gardens, and wells; the soil is here and there streaked with sand, but no mountains or even rocks of considerable size occur anywhere. Towards the east the level of this region gradually rises upwards to the Toweyk range, by which it is ultimately shut in. Westward it slopes downwards, and at last opens out on the Hejaz near Medinah. The general level is low, not exceeding 1000 feet above the level of the sea, and the temperature hot; it is altogether the most productive, but at the same time the least healthy region of central Arabia. Water abounds throughout the greater part of its extent, at a level of only a few feet below the ground, and occasionally collects on the surface in perennial pools, none of which are, however, large enough to deserve the name of lakes. The most thickly peopled section of this valley is called Kaseem.

Mountain chain of Toweyk

North-east of it rises the mountain chain of Toweyk, running almost due south, and keeping at a distance varying from 100 to 200 miles from the Persian Gulf. This constitutes the backbone of the Arab peninsula, which rises up to it first by a rapid ascent from the coast, and then by a succession of more gently graduated plateaus and valleys from the east and west. Thus the wider half of the peninsula itself lies, not, as has been erroneously stated, to the east, but to the west of the principal watershed. The Toweyk or "complication" chain, so called from the labyrinthine character of its numerous gullies and gorges, is a broad limestone table-land, and at no point exceeds, so far as has been roughly estimated, the limit of 5000 feet in height; it covers an extent of 100 and more miles in width; its upper ledges are clothed with excellent pasturage; and its narrow valleys shelter in their shade rich gardens and plantations, usually irrigated from wells, but occasionally traversed for some short distance by running streams. Except the date-palm, the "ithel" or larch, already described, the "markh," a large-leaved spreading tree, the wood of which is too brittle for constructive purposes, and some varieties of acacia, the plateau produces no trees of considerable size; but of aromatic herbs and bright flowers, among which the red anemone or "shekeek" is conspicuous, this region is wonderfully productive,—so much that Arab writers justly praise the sweet scent no less than the purity and coolness of its breezes. The simoom or poison wind of the low lands and deserts is here unknown; even the sirocco, when it occurs, is comparatively bearable. No signs of volcanic action or hot springs are found within this region, and the mountain strata are ordinarily horizontal; the sides of the plateaus are, however, very abrupt, often forming precipices of 200 to 300 feet in height, cut out in chalky rock. These are due to water action from torrential rains that frequently fall in spring and autumn.

Physical character of the central watershed

Immediately at the foot of the eastern slope, which is much steeper than the western, lies a slip of desert, separating the highlands from the coast regions of Hassa and Kateef. The northerly part of the Toweyk plateau contains the great province of Sedeyr, the healthiest district in all Arabia: the western slope is occupied by the pro vince of Woshem, running down to Kaseem. South of Sedeyr is the province of "Ared" or "The Broad;" it includes the highest and widest table-lands of Toweyk. Thence the range trends away, taking the ordinary S.S.W. direction of the alternate elevations and depressions that furrow the Arab peninsula; here, though keeping the same geographical character, it changes its name into that of "Ared," and, like a long limestone wall, stretches almost to Mecca. Parallel to it, on the south, extends the long and barren valley of Dowasir, ending in the district of Kora, Shahrem, and Soley-yel; broken ground,—the passes of which lead to Nejran and Yemen. The upland labyrinth of Aflaj, south of Ared, forms the extreme elbow of this mountain formation. Just below it, and constituting its south-eastern slope, comes Yemamah, a hot but fertile province, with numerous wells and copious irrigation. Further yet to the south rise the fantastic peaks of the Hareek mountains, granite ridges, not over 2000 feet in height, but making up to the eye for their want of elevation by their strange abruptness: they crop out like the mountains of Shomer on the north, from the first sands of the Great Desert, and form an island, as it were, of irrigation and tillage, though both comparatively scant, and scarcely able to maintain themselves against the excessive heat amid the desolation around.

The great southern desert. Beyond Hareek, or "Burning," as the name means, to the south, as also behind Wadi Dowasir and its neighbourhood, lies the great Arab desert or Dahna, "The Red" as the Arabs call it,—a vast extent of sand, said to cover nearly 50,000 square miles, and only jotted here and there at far intervals by a few clustered bushes or dwarf palms, indicative of moisture below the surface, else wholly desolate. Its surface is ribbed into huge sand waves, the principal ones being from north to south,—that is, at right angles to the prevailing wind, which is here the east; but these main waves are again crossed, intersected, and jumbled with other less regular undulations, the work of more variable breezes.

But neither here nor elsewhere in Arabia do those clouds or columns of moving sand, the terror of caravans, appear, that have been fabled by travellers and poets. Tracks are indeed speedily covered and effaced, to the great annoyance and occasional danger of the wayfarer; but neither he nor his beast run the least risk of being thus buried alive. Hunger, and, still more, thirst, are sufficient guardians of a region, to which, however, Arab fancy has attributed the additional protection of evil spirits and monsters of death.

The Dahna. This greater desert, the "Roba el Khaliyeh" or "Empty Space" of geographers—the "Dahna" or "Crimson" of modern Arabs, so called from the prevailing colour of its heated sands,—extends to Yemen and Hadramaut on the south-west, south, and south-east, and to Oman on the east. It is separated, however, from the northern half of the waste-ring that girdles Nejd by the continuation of Wadi Dowasir and Shahran, up to the mountains of Tayef, near Mecca; and this is the only line by which the plateau of Nejd can be reached from the coast without actually crossing the sandy or stony wilderness. Lying as it does on or within the tropics, the heat of this great desert is said to be fearful by day, and, owing to the general low level, to be scarcely mitigated at night. But it is never traversed in its full width, not even by Bedouins; and little or no credit can be attached to the relations of those who pretend to have explored it, and to have found wonders in its recesses.

The Akhaf. East of Hareek rises a succession of lofty ridges, covered by a deep layer of sand, through which black rock occasionally pierces. This region bears the name of Akhaf, and connects the watershed of Toweyk with the high mountains behind Oman. It is, like the Dahna, unreclaimed desert; but the recesses of its valleys conceal a few wells and springs, so that travellers from Nejd sometimes take this route, the most difficult but the shortest, when on their way to Oman. Immediately north of the Akhaf commences the lesser Dahna, a desert resembling in every way its homonym of the south, only narrower; its breadth in many places not exceeding 50 or 60 miles. This long and dreary strip runs up the whole way along the easterly side of the Toweyk plateau, till it merges in the northern or stony waste land at the head of the Persian Gulf.

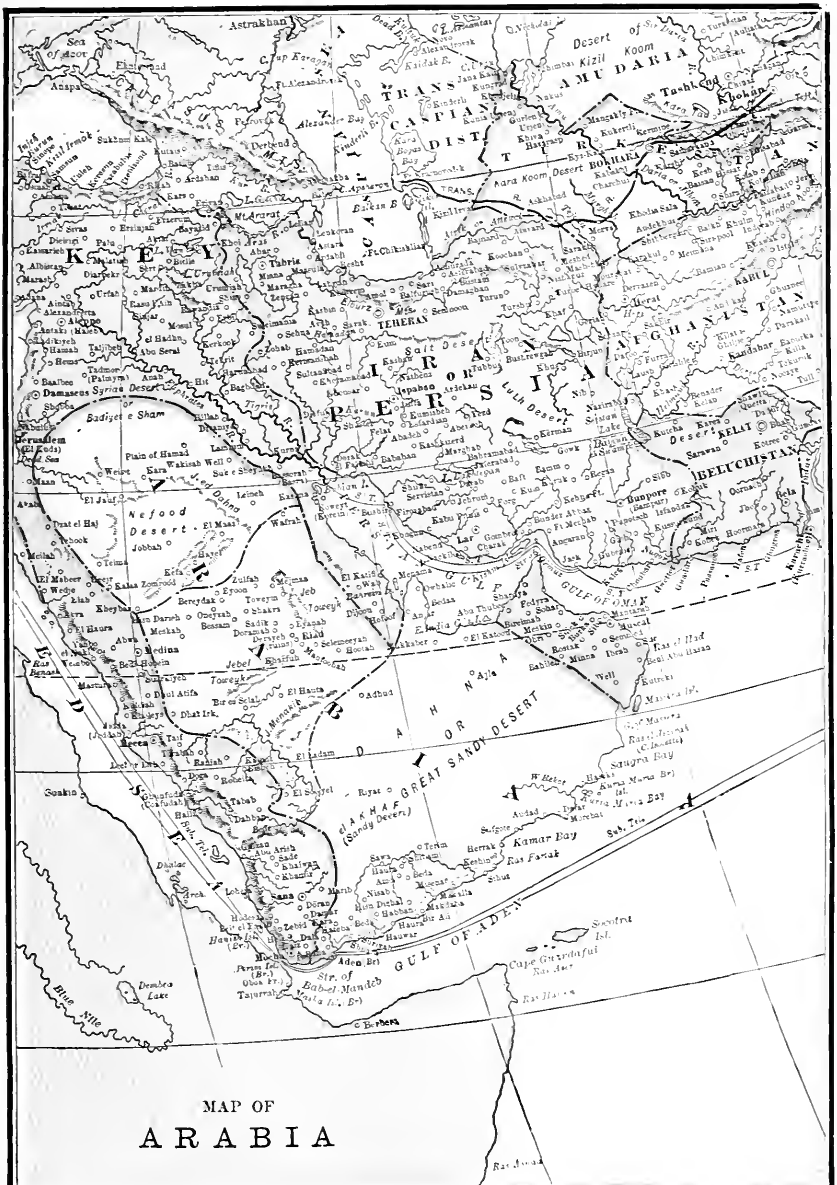
Little Dahna.

Climate of Nejd. Throughout the highlands of Nejd the climate, though often hot by day, is cool and pleasant at night; the spring and the autumn rains seldom fail in their seasons; and the soil, where not artificially irrigated, produces excellent pasture,—where irrigated, it renders very tolerable garden produce and field crops. Storms of thunder and lightning are of rare occurrence, and the tornadoes that from time to time visit the Arabian coasts are here unknown. The prevailing, as also the most refreshing winds, are from the east and north-east; the south and west winds are heated and unwelcome. Epidemic diseases are rare, and only one visitation, and that not a severe one, of cholera is on record within Nejd.

Valley of Aftan. Between Yemamah and Hareek runs the valley called Aftan, which appears in some maps as the bed of an imaginary river flowing nearly across Arabia into the Persian Gulf. But the downward slope of the valley itself is not from west to east, but in the reverse direction, and at a distance of more than 100 miles from the sea it is absolutely closed in by the sand-heaped ridges of Akhaf. Did the mountains of central Arabia furnish a water supply sufficient for a river, large or small, its course would of necessity be directed, not towards the Persian Gulf, but the Red Sea. The copious springs that break out at the foot of the Toweyk mountain range above Hasa, not far from the gulf, are all of subterranean origin; and though they are evidently the off-drainings of the rainfall of Nejd, they have no connection with the very scanty running or standing waters of the surface of the great plateau.

Summary of the geography of Arabia proper. Summing up,—Arabia may roughly be divided, as to its surface extent, into a third of coast-ring and mountains, part barren, part either cultivated or susceptible of being so; another third of central plateau, also tolerably fertile; and a third of desert circle, intervening, with only one gap, that in the latitude of Mecca, between the first and the second. The central space, whether plateau or desert, varying in height from 1000 to 3000 feet above the sea, possesses three important mountain ranges,—two transverse, namely, Jebel Shomer and Jebel Ared, and one vertical, that commences with Toweyk, and is continued by the Akhaf,—these latter being the watershed of the peninsula, the general rise of which is from west to east. The highest mountain peaks—those, namely, of Jebel Akhdar in Oman—do not apparently exceed 6000 feet.

Animals. Horse. In a description of the animals of Arabia the first place is undoubtedly due to the horse, which, though the opinion is unsupported by scientific evidence, has by some been supposed to be indigenous to the peninsula. As a fact, it is here that this animal attains its highest perfection: not, indeed, that of size; for a true Nejdee of the best and purest breed seldom reaches and never perhaps exceeds fifteen hands in height; nor that of mere speed, for a trained European racer would easily distance a thoroughbred Arab on any ordinary course; but for perfection of form, symmetry of limb, cleanness of muscle, beauty of appearance—for endurance of fatigue, for docility, and for speed maintained to distances so long as to appear incredible, the Nejdee horse acknowledges no equal. The



MAP OF

ARABIA

animal is too well known to require minute description on the present occasion; but it is important to have a clear idea of the principal divisions of its race and kind, which have been strangely and even injuriously confused by many writers.

Origin and number. Tradition assigns the origin of the present Arab stock to Yemen, but historical records, dating as far back as the 5th century, show that the best quality and the greatest number of horses were then to be found exactly in the same district where they now exist, namely, in Nejd. Yet, even there a horse is by no means an article of everyday possession, or of ordinary and working use. War and parade are in fact almost the only occasions on which it is employed; and no genuine Arab would ever dream of mounting his horse for a mere peaceful journey, whether for a short or a long distance. Hence horses are the almost exclusive property of the chiefs, who keep them for themselves, and often for the equipment of their armed retainers, and of a few wealthy or distinguished individuals, who regard them as an investment of capital or an ornament of social rank. Thus, no motive tempts the horse-owner to encourage the production of coarse and inferior breeds; while, on the other hand, every circumstance tends to render the greatest purity of blood and perfection of wind desirable; hence it is not strange that the Nejdee horse has to all appearance undergone no degeneration, though he has also probably received no improvement within historic times. Military enterprise and the centralisation of wealth and power enabled the Wahhabee chiefs of recent date to collect and rear a greater number of horses than had perhaps ever before been possessed by a single Arab potentate; and the stables and pastures of the sultan of Derey'seah may well have, as has been stated, contained 10,000 horses, since those of his much-enfeebled successor at Riad are told off at nearly half that amount. But if we allow 20,000 for the total census of pure breeds in Nejd, a full allowance, and assign an equal number to the rest of the peninsula, thus making 40,000 in all, we shall still be rather in danger of an over than of an under statement.

Breed. No distinction of breed is recognised in Nejd itself; each animal is classed according to its individual merits. Nor is a horse, nor, *a fortiori*, a mare, ever disposed of by sale; gift, war-capture, or legacy being the only recognised methods of transfer where a genuine full-blood is concerned. Consequently, no commercial export of Nejdee horses has ever been established; and whoever professes to sell or boasts of having bought one, may be unhesitatingly set down as either deceived or deceiving. In three manners, however—two occasional merely, and one customary—has the Nejdee breed been to a certain extent transplanted beyond the actual limits of Arabia.

The first of the occasional or chance means by which the horses of Nejd have from time to time found their way to foreign stables is the fortune of war. Thus, for instance, Ibraheem Pasha, after overrunning Arabia in 1817, carried away to Egypt with him several hundreds of the best Nejdees, both horses and mares; so that Egypt, though only for a while, became next to Arabia the most fortunate land in this possession; and even now, after the purity of the stock has long since been lost in the Nile valley, the effects of its transitory infusion may be distinctly traced. Next, Ibraheem's vicegerent, Khoorsheed Pasha, followed his master's example; the Ottoman Turks have been, though not often, equally lucky, and the distinctive points of Nejdee blood may now and then be observed in more than one stable at Constantinople.

Secondly, a few thorough-bred Nejdees have crossed the frontier as presents. In this manner, Teysul, the late monarch of Nejd, sent forty head from his own stable as an honorary tribute to the reigning Ottoman sultan, Abd-el-Azeez; and similar offerings have been now and then made, as fear or other motives may have dictated, to different other governments, and even to distinguished individuals. But mares are never given away thus, only stallions.

Mixed breeds. The third and customary method is by admixture of the race. Nejdee stallions are yearly hired out by their owners, and sent into the pastures of Jebel Shomer, of Syria, and even of Mesopotamia, there to breed with the mares of those countries, belonging to the Arabs of Shomer, or to the Anezeh, or the Ru'alah tribes of Syria, and the like. These mares are themselves of Arab though not of Nejdee stock; the proportion of good blood varying in them from a half up to three-fourths nearly, but none are of absolutely pure race. It is to the offspring of such by Nejdee stallions that the divisions of breed much insisted on by several European writers, and actually recognised throughout Mesopotamia and Syria, but almost, often wholly, unknown even by name in Nejd itself, apply. These divisions are principally five,—the Koheylee (said to be the purest of all), the Toweysee, the Manekee, the Saklawee, and the Julfawee; besides which, and branching out from them, there are infinite minor subdivisions. Again, these are the breeds often authenticated for purchase by written pedigrees and witness-papers of descent, as described in books; and which may occasionally be seen in Syria, but never in Arabia, or even elsewhere, when the bargain is to be concluded between two Arabs themselves. The only use of such documents is for strangers. These, too, are the breeds from which European stables, even regal and imperial, have often obtained a supply of noble but never absolutely pure-blooded animals, frequently at prices proportioned to the imagined difficulties of the purchase, or the affected unwillingness of the cunning owner—(Arabs are very cunning)—to part with his beast. The best market for these mixed breeds is at Baghdad; the second is in the neighbourhood of the town of Hama in Syria; inferior animals are sent to the port of Koweyt, on the Persian Gulf, whence they are shipped for India.

Training. To return to the genuine Nejdee. Reared under an open shed, and early habituated to the sight of men, to the sound and glitter of weapons, and to all the accessories of human life, the colt grows up free from vice or timidity, and even acquires a degree of intelligence that surprises a stranger. Barley and dates are the chief stall provender; but the grass of the pasture-grounds, in the selection of which much care is taken, is the ordinary nourishment of an Arab horse. Of water the allowance is always kept purposely scant. A good Nejdee will canter for four-and-twenty hours in summer-time, and eight-and-forty in winter, without once requiring drink. Raw meat, dried is occasionally given in small quantities when extra exertion is required; lucerne grass is employed for lowering the tone. Geldings are very rare. The colour that most frequently occurs is grey; then comes chestnut; then white and sorrel; mottled grey and black are now and then to be found; dark bay never.

Colts are ridden early—too early, indeed—in their third or even second year, and are soon broken in to a steady walk, to a canter, and to the ambling pace which is a special favourite with Arab riders; racing, an Arab amusement from time immemorial, and the game of "jerzed," a kind of tournament or mock fight with blunt palm-sticks, highly popular throughout the peninsula, complete the training both as to wind and pace. Saddles are seldom used in Nejd, and stirrups never, but both are occasionally employed in the Hejaz and Yemen. So it is also with bits, the place of which is taken in Nejd by halter-ropes, the real guidance of the animal being almost wholly effected by the pressure of the rider's leg and knee. Shoes, too, are of rare occurrence, nor are they needed in the light and sand-mixed soil of the central provinces; on the other hand, the hoofs are often rubbed with grease, to counteract the drying effects of the heated ground. Of all niceties of grooming, docking and clipping excepted, Arabs are masters, and their natural kindness to animals, a quality which they share with most Orientals, together with the care which every reasonable man bestows on a valuable article of property, ensures to an Arab horse a good treatment at the hands of his owner. But Arab horses do not commonly enter tents, nor play with women and children, nor, in a general way, do they share family meals, nor are they habitually kissed and cried over, as the imagination or credulity of some narrators has suggested. An Arab, flying for his life, has indeed been known to give the only morsel of dry bread about him to his horse rather than eat it himself,—an act in which self-preservation had probably as large a share as affection. Lastly, the standing prohibition of horse-selling from Nejd has really nothing more romantic in it than a narrow-minded application of the principles of protective monopoly; in other cases, reluctance to conclude a bargain simply indicates that the offer made was considered insufficient.

The camel. Below the horse in popular estimation and market value, but far above him in general utility so far as Arabia is concerned, comes that eminently Arab animal the camel. Of this there are many varieties: the best, swiftest, slimmest in form, and most docile to guidance, is the "hejeen," or dromedary, sometimes also called "delool," or "facile." It is almost exclusively employed for riding, whereas the "ibl," or ordinary camel, readily distinguished from the other by a coarser build, a slower pace, and a less tractable disposition, is a beast of burden, and indeed is employed for all purposes This species is very commonly, too, kept and reared for the sake of its flesh and milk, precisely as horned cattle are elsewhere; in fact, boiled camel's meat is the most ordinary article of animal food throughout the peninsula,—it is a flabby, tasteless dish, not unlike the poorest sort of beef, any flavour that it may possess is musky and disagreeable. The milk, on the contrary, is excellent, equal in quality and in sanitary properties to that of the she-ass, but neither butter nor cheese are made from it. The wool, which in the camels of Nejd and Oman is remarkably soft and fine, serves for making articles of dress, into which it is woven, sometimes alone, sometimes mixed with wool; it is much superior to sheep's wool in every respect. The ordinary colour of the animal in the northern Arab provinces is a reddish brown, but in Nejd and throughout the south, lighter tints, varying from grey to white, are more common; black is extremely rare, and highly esteemed. The least valuable breeds are those of the north and west,—that is, those of the Jowf, of Shomer, of the Hejaz, and of Yemen, in Nejd, which region, from the number of its herds, is sometimes called "Omm-el-Ibl," or "the Mother of Camels," the species improves; but all agree in assigning the palm to the dromedaries of Oman In fine, all over Arabia, whether among the Bedouins or the villagers, camels are the principal staple of traffic, the favourite investment of wealth, and the ordinary standard of property

Qualities of the camel. Camel or dromedary, the Arabian animal has only one hump, which increases or diminishes in size according to the general good or bad condition of the beast On this hump the saddle—called, if a riding one, "ghabeet," if one for baggage, "shedad"—is placed, a halter is the only rein employed, though even this is more commonly dispensed with by the Arabs, who simply direct the animal by a kick of the heel or a blow about the neck with the "mihjan," a small crooked stick carried in the rider's hand. The average travelling pace, an amble, is between five and six miles an hour, and this a good dromedary will continue for fifteen hours out of the twenty-four during a week together Six days in the summer, ten in the winter, form the longest period that the dromedary can continue his pace without a fresh supply of water, and hence an "ashavee" or "tenner" is the title given to the best of the kind. Two hundredweight is the average load of the Arab carrying camel.

No animal puts its owner to less expense for its keep: the thorns of the desert, dry grass, cactuses, euphorbias,—nothing comes amiss to a camel's appetite; a ball of paste weighing about a pound, and made of barley-meal and water, is given every evening when extra work has to be done.

The average duration of a camel's life is thirty years, that of the dromedary somewhat less; the price of either varies from about £4 to £80, according to quality, those of Oman commanding the best market. But although the camel, whether as an article of use or of sale, is far more important to Arabia than the horse, it is in intelligence and docility immeasurably inferior to the latter animal, never becoming attached to, or even, seemingly at least, acquainted with its owner, and never obeying except perforce and under protest.

Sheep. Next to camels, sheep and goats form an important item of Arab wealth. The best sheep are the piebald and large-tailed ones of Yemen; those of Nejd, too, are in great request on account of their flesh, which is excellent, though their wool is confessedly less fine in quality. Some districts of Oman produce a silky-haired breed not unlike that of Angorah. The least esteemed sheep are those of Hejaz and the north, but, in compensation, the goats of these provinces are longer-haired and generally better than those of the south; they are black, with long drooping ears. Spring is the shearing season in Nejd, but the wool is seldom exported, being mostly bought up for local use. From the milk of these animals butter and a white insipid kind of cheese are made: both are articles of daily consumption in Arab households.

Cattle. Cattle are reared throughout Arabia, but owing to the prevailing deficiency of deep and succulent pasturage their number is not so considerable as that of the camel. Cows and oxen, throughout Nejd, Oman, and Yemen, bear on their shoulders a hump analogous to the well-known one of the so-called "Brahminee" bull; the ordinary colour is dun, their legs are slender, the horns short, and the whole stature diminutive. The kine of the northern provinces are stouter and yield more milk; they have no hump. Buffaloes also are kept in the marshy districts that occur in Yemen and Oman. They differ in no respect from the Indian breed; but, unlike oxen, these animals cannot be reckoned in the ordinary list of Arab farm stock, as they exist only under exceptional circumstances, whereas a few kine may be found in almost every village, and the irrigation of the fields and gardens is mostly done by means of oxen.

Asses. Like the horse, the ass attains its greatest excellence in Arabia, where it is more often employed for riding than for loads, indeed, in some provinces, especially in Hasa, it is the usual mount even of the wealthy. The best species is that reared in Hasa and eastern Nejd, where these animals are generally of the purest white in colour, and stand from eleven to thirteen hands high. In pace they scarcely yield to an average horse. They are often exported and sold at high prices in Egypt or at Constantinople, a single animal fetching from £40 to £80. They are ridden in Arabia with side-saddles. Good asses are to be found also in the other districts of Nejd, in

Yemen, even in the Hejaz; their ordinary colour is grey. The same animal runs wild in many of the open and mountainous regions of Arabia, and is hunted for the sake of its skin by the Bedouins, but the onager or zebra of Cutch is not met with in this peninsula.

Mules. Mules and hinnies, common throughout Syria and Mesopotamia, are extremely rare in Arabia proper, where a prejudice exists against their use.

Dogs. The Arab dog differs very little from a jackal in appearance as in habits; its muzzle is pointed, its colour sandy, and its long and somewhat bushy tail is curled over the back. When domesticated, the breed improves, approaching the European wolf-dog; these animals, by training, become very tolerable indoor and out-door guardians, both of flocks and herds and of dwellings, and in this capacity they are to be found everywhere, both in the towns and villages and in the open country, where they are not less useful to their masters than annoying to strangers. Another kind of dog, belonging to the greyhound species, and evidently of exotic origin, is often reared in Arabia; the swiftest and most enduring of this kind are from the province of Hasa. They are in great favour as harriers.

Arab cats differ in no respect from their congeners in Europe except in being rather smaller. The house-mice too are absolutely the same; but the rat is more akin to the old black species of England, now nearly extinct.

Wild animals are not very numerous in any part of Arabia proper, a fact which is sufficiently accounted for by the want of running streams and open pools, as also by the thinness of cover and forest growth; yet the records of the country make mention of the existence of some kinds of beasts which have subsequently disappeared altogether. Thus the long-maned lion, and, it would appear, a large kind of ape resembling the African gorilla, often mentioned by the early writers, are no longer to be found in the peninsula. But a small tiger, formidable from its ferocity even to man, is still met with in the wild hilly regions north of Nejran, and again in the inland recesses of the Oman mountains; while the "fahd," or panther, belongs to no particular province; it haunts the neighbourhood of villages, and devours the smaller stock. Lynxes have been seen in the Hejaz and Nejd; wolves are common in the mountains, and sometimes descend to attack the flocks in the open plains. There are foxes too, but small and greyish in colour. The Arab hyæna is large and fierce; it is said, when pressed with hunger, to be dangerous even to men, and figures in many a story of Arab adventure. Jackals are more numerous in the northern than in the southern districts. Small black-faced long-tailed monkeys are to be met with by herds in Yemen, and even, though less often, in Nejd. A pretty little beast, the "yerbooa," jerboa, or kangaroo-rat, burrows in the sand, and comes out to look with great curiosity on passers-by; its hind legs, long, and provided with equally long feet and toes, are out of all proportion to the shortness of its fore-paws; its motion, especially when pursued, is like that of the kangaroo, and is performed with the help of its long sinewy tail. Its colour, partly fawn, partly white, is very agreeable to the eye. The Arabs eat its flesh, which resembles that of the rabbit.

Of the deer tribe the gazelle is the most common; it abounds not only in the open grounds, but even among the villages and near the towns. It is sometimes, but not often, hunted by the natives. Chase is more often given to the mountain goat, partly on account of its flesh, which is excellent, partly for the sake of its long recurved horns, which are like those of the Alpine steinbock, only larger. But the hare, which is coursed with dogs, and which resembles the European animal in every respect except size, for it is smaller, is the favourite game of the Arabs, who, unlike the Persians and Turks, have no scruple as to the use of the meat.

Birds. The ornithology of Arabia is copious, but has been little studied. Birds of prey, grey eagles, vultures, bustards, and sparrow-hawks, abound in the open lands; while partridges, especially of the mottled kind called "kata," are to be seen crossing the desert in quest of water by flocks; quails frequent the mountain districts in immense numbers, so also do rock-pigeons wood-pigeons, and a species of wild guinea fowl; wild ducks are met with in plenty along the coast. Cranes, larks, sparrows, finches, and the like, frequent the cultivated lands; so also does the hoopoe, a bird held in high honour by the Arabs on account of its traditional services as messenger between Solomon and the Queen of Sheba or Belkeys. A large mottled thrush, also considered to be of good omen, is seen everywhere. Flocks of swallows, the flight of which is invariably from the east, pay annual visits to Arabia, where they are very useful in diminishing the swarms of locusts, their favourite food; one species of this bird appears, however, to be indigenous to Yemen. Peacocks and parrots are also found in the southern provinces, and in Nejd, Hasa, and Oman; hawks are kept by many, and are carefully instructed for the purpose of falconry.

The ostrich. But the most remarkable bird of Arabia, and the only one which forms a regular object of chase among the natives, is the ostrich. Its extreme timidity, joined to the swiftness of its pace—for although it does not fly, it assists its running by the movement of its extended wings—renders it in vain for the hunter to attempt overtaking it on horseback; he therefore seeks to approach it generally when on its nest by artifice, and kills it by a long shot; sometimes he snares it by a running noose. The feathers, the best of which belong to the male bird, are sold at Damascus or Baghdad; the eggs are eaten, and the shells are used for ornament. The finest ostriches are those of the neighbourhood of Shomer and the uplands of Toweyk; they are often to be seen, but at a safe distance, scudding across the sands in a file of twenty or thirty at a time.

Reptiles. Reptiles, except those of the lizard species, are comparatively rare in Arabia, though serpents are occasionally met with; but, except the "afaï" and the "rukta," both snakes of the viper class, the former brown and the latter banded, and considered the deadlier of the two, none are venomous. Boa-constrictors, resembling the Indian rock-snake, have been also seen,—none, however, large enough to warrant the wonderful stories told about them by the Arabs themselves, whose love of the marvellous often leads them beyond the limits of truth.

Insects. Insects are, however, numerous enough: little scorpions, scarce an inch in length, but capable of inflicting by their sting extreme pain, swarm in the desert sands; and large ones, four or even six inches long, infest the houses. Centipedes, too, are common; wasps and wild bees tenant the rocks; flies are troublesome everywhere, and mosquitoes on the coasts; ants of all kinds, some enormous in size and venomous in bite, are to be found here; and a very poisonous spider, called, from its double pincers, "aboo hanekein," inhabits the crevices of old walls on the western coast, and is much dreaded by the natives. Scolopendras, too, are not rare. It is some compensation, however, for these serious yet only occasional inconveniences, that no fleas or bugs exist in any part of Arabia. But—a serious drawback—the "arda," or white ant, the *Termes fatalis* of Linnæus, is hardly less troublesome and destructive in the southern provinces than in India itself. Lastly, vast

Locusts. swarms of locusts, larger and darker in colour than those commonly seen further north, often infest the peninsula, and commit great ravages, especially when, as too frequently happens, their visit is in the spring or early summer. Their course is usually from east to west. However, the Arabs, by converting these insects into an article of food, make up to themselves in some measure for the damage suffered by the crops and pastures; indeed, locusts, boiled and slightly salted, are a favourite article of sale in every Arab market, but particularly in Nejd and the eastern districts.

Soil. The soil of Arabia varies according to the character of its rocky substratum. All round the coast, and to a distance corresponding with the breadth of the girding mountain chain to the interior, it is formed of volcanic and metamorphic detritus, with patches here and there of a calcareous character, due to the upheaval and decomposition of old coral banks. Such a soil cannot but be tolerably fertile, and it would be more so were the scantiness of rain made up for by a more systematic artificial irrigation. A second inconvenience is caused by the encroachments of the sand, which is at times drifted by the winds from the desert inland in such quantities as to become seriously injurious to cultivation. Behind the mountains the surface of the desert to the north and west is that of a gravelly expanse, thickly sown over with flint and quartz; while to the east and south it is an almost unalloyed waste of fine sand. Everywhere the rock underlies it, and there exists, of course, no possibility of utilising a space like this. But the whole of the central plateau—that is, of Nejd, Kaseem, Shomer, Yemamah, and the adjacent lands—is covered with a tolerably deep layer of calcareous earth, mixed with loam, well adapted for cultivation; the best is naturally to be found in the valleys and sheltered spots.

Agriculture. Whether, however, the soil be rich or poor, agriculture is, all over Arabia, very primitive in its conditions, and, above all, in its implements. The plough used by the peasants is wholly of wood and without wheels, an instrument fit for scratching rather than furrowing the ground; while in many places the earth is merely turned over with a pitchfork, which is sometimes worked by two men at a time. More skill is shown in irrigation, for whatever crop is intended, its success cannot be safely entrusted to the uncertain rain supply alone. Accordingly, the slope of the ground, whether field or plantation, is carefully calculated, and the surface divided into compartments and traversed by furrows, each communicating with the other, and all with some large well, or, in favoured situations, cistern; while in still more fortunate but rarer spots a running stream is turned to profit. But in far the greater number of instances the irrigation is from a well, with an orifice varying from six to twenty-five feet in diameter, whence the water is drawn up in large leathern buckets, to which are attached ropes passing over pulleys, and worked by mules or oxen; these buckets, on reaching a cross-beam, turn over and empty their contents into a sloping trough that runs down to the main channel of the field or garden. Green crops, vegetables, and the like, are watered, when it is possible to do so, twice a day; date-palms only once: the porous soil soon absorbs any superfluous liquid that may have overpassed the bounds assigned to it. In ascertaining the right spot for sinking a well, in digging and coating it, as also in the construction of the small cisterns often connected with the source, the Arab peasants have by long practice acquired a not contemptible skill.

Crops. The crops most common in Arabia are, first, the date, a fruit already sufficiently described; it may, however, be remarked here that the fecundation of the female trees from the male is usually perfected by art. The produce is annual: the earliest dates ripen in May, others not till July or even August. This fruit, and the dishes made of it by pressure or with butter, are to the Arabs what corn is to more northern or rice to southern nations. Next in importance, though much more limited in extent, is coffee: very little, and that of inferior quality only, is cultivated out of Yemen. This growth has also been already described in detail. Next come the following:—Wheat, a somewhat rare and not a very remunerative crop; barley, also in small quantity;—these two growths are hardly distinguishable the one from the other by the eye, the colour and shape of the ear and beard being almost identical in each. Millet is, on the contrary, largely sown, and gives an abundant return; there are several species of it; the grain, coarsely ground, is made into a sort of gruel, which appears as a daily dish in Nejd. Rice is looked on as a delicacy: it does not grow in the central uplands, but succeeds well enough in the watered coast districts, especially Hasa, Kateef, and Oman. Beans and pulse are favourite crops; they are reared in almost every part of the peninsula. Other garden plants—melons, gourds, cucumbers, salad, cabbages, onions, garlick, parsley, cumin, and the like,—are cultivated. Orchards are planted and tended in most districts; but of pruning the Arabs have little idea, though they are not unacquainted with grafting.

Husbandry. There being no true winter in any part of Arabia, the crops, such as they are, succeed each other all the year round; many lands bear twice, an early and a latter harvest, though of different produce. Of manuring, of the scientific rotation of crops, of weeding even, and clearing, the Arabs have little knowledge. Reaping is generally done with the sickle,—in some places the ripened grain is torn up by the hand; threshing is performed by oxen,—winnowing by the wind, grinding by the hand-mill. To sum up, though the agriculture of Arabia is sufficient to supply its comparatively scanty population with food, it gives almost no surplus for traffic or exportation, that of coffee and dates alone excepted.

Pasture. In pasture-land Arabia is, on the other hand, singularly fortunate. The very desert supplies through the greater part of its extent sufficient browse for camels; while the pasture-grass for horses, kine, and, above all, for sheep, on the upper hill slopes, and especially in Nejd, is first-rate. The only drawback is the occasional failure of the spring rains and autumn showers; when this occurs great distress is the result, and no commoner cause of contention and bloodshed arises between the Arab shepherds or "Bedouins" than the struggle to obtain, each for his own herd, the use of some yet undried well or exceptional oasis of green pasturage left fresh among the brown and withered herbage around.

Minerals. In mineral products of a valuable description the Arabia of our days is singularly poor, so much so as to suggest the idea that the Arabian gold and jewels, often mentioned by classical writers, must have been brought from Yemen as from a mart or depot, not a place of production. Yet even so late as 600 A.D. the exiled monarch of Sanaa, Seyf of Yezen, could in his interview with the Persian despot Chosroes, describe southern Arabia as "a land the hills of which are of gold and its dust silver." Nowadays nothing is found to justify or even to account for such gorgeous statements. Agates, onyxes, carnelians, and, though rarely, topazes alone are to be met with; of gold mines and precious ores not a trace. Lead is, however, more common. The richest ores of this mineral come from the mountains of Oman; it is brought down to Mascat, and exported thence by sea. A small quantity of silver is also extracted from the same mines. Cinnabar and iron occur in the Sinaitic peninsula, and sulphur has been observed here and there in the long volcanic range that reaches from Palestine to Mecca. Rock-salt is extracted from many parts of the coast range; it exists, too, in the central districts of the peninsula, where of metals, a little iron excepted, not a vestige appears.

The Arab coasts are much frequented by fish, many

Fisheries. of unknown species. Mackerel, mullet, sole, ray, and perch swarm in the Red Sea and Persian Gulf; nor are the sheltered spots on the long line that fronts the Indian Ocean less well provided. Sharks, too, abound along the coast, and are used as food by the poorer classes; crabs and oysters occur almost everywhere. Hence fishing forms the occupation of a large proportion among the littoral population, but ignorance of salting and curing deprives its products of export value.

Pearl fisheries. The pearl fisheries of Arabia alone add to the commercial riches of the country. They commence at the islands of Bahreyn, which lie immediately off the Arab shore, near the centre of the Persian Gulf, and continue east and south along the district of Katar for a distance of nearly 200 miles, after which the banks are lost in deep soundings. The most productive shoals are those between the islands of Halool and the coast of Katar; the fishing season commences with the spring, and lasts all through the summer. Most of the villages along the coast are wholly inhabited by divers, Arabs and negroes, who by long practice can remain under water a space of two minutes at a time; the depth they reach does not exceed fifteen fathoms, and generally falls much short of it. The oysters are opened on shore, and the pearls carefully sorted and counted by officials stationed for the purpose, as a heavy duty, equalling 20 per cent. of their value, is levied on the spot, though no further dues are taken on exportation. Some of the pearls are of great size and value. The total annual produce is roughly estimated at about £250,000, but probably exceeds that sum; a portion goes to India; another portion up gulf to Baghdad, whence it is distributed over Syria, Turkey, and Persia. The divers themselves are the worst off, as their occupation induces various congestive diseases and premature old age.

Pearls are found, too, in other bivalve shells of these seas, and are extensively sold, though at a lower price than those of the oysters. Mother-of-pearl is also common, and is an ordinary article of export, especially to Syria and Egypt; so are also occasionally the corals and ornamental shells with which these seas abound.

In mechanical arts the Arabs are, as a rule, extremely deficient, though favourable exceptions exist in some districts. The Bedouin or pastoral population know little else than the tanning of leather and the weaving of coarse fabrics, such as articles of overdress, tent coverings (which the women generally make of goat-hair), headbands, and the like. In most villages and towns of Nejd, one or more blacksmiths, whose work is of the rudest possible description, are to be found; occasionally an armourer, a few sandal-makers and workers in leather, with several weavers,—none skilled. Throughout the Hejaz these professions exist, but at a still lower standard; but in Yemen greater nicety of workmanship is to be met with; and gold and silver smiths, often, however, not Arabs but strangers by race, get a living in the towns. Formerly Yemen was celebrated for its woven stuffs; this manufacture is now, however, in anything approaching to excellence, the exclusive pride of Oman. In this last-named province, weaving, silk and gold thread embroidery, silver work, gold filigree, and even steel implements, are wrought to a degree of perfection seldom attained by the workmen even of Damascus or Baghdad; and the labours of the Oman loom or forge, when exported, as they are, though not in large quantities, are eagerly purchased abroad. But even here the extreme simplicity, or rather rudeness, of the tools employed, and the deficiency of mechanical contrivance, dwarf the results of patient and otherwise ingenious labour into comparative insignificance.

In wood the Arabs are not unskilful artificers; and their drinking bowls and platters, manufactured chiefly from the "ithel" or larch tree, and studded with small silver knobs, make a good appearance. As masons they deserve little praise; their constructions are clumsy and unstable, the details coarse and ill-fashioned. There is not a single building, public or private, built by the Arabs themselves, of any merit either in regard of utility or of beauty, within the whole of Arabia.

Trade. Backward in manufacture, and even showing, on the whole, little capacity for it, the Arabs are singularly alive to the advantages of commerce and trade, and fond of exercising them. No Arab undertakes a journey, were it only from one village to another, without taking with him some object for exchange or sale; and he will sooner chaffer away the handkerchief on his head or the camel on which he rides, than return without having effected something in the way of business. In this respect, Bedouin and townsman, rich and poor, are all alike; and their history shows that this propensity is no less ancient than universal in the race. Owing, however, to the want of variety in its productions, and the remarkably uniform habits of its inhabitants, combined with the scarcity of local manufactures, the trade of Arabia, whether export or import, is soon catalogued. Camels and sheep, hair and wool, come first on the export list; next coffee; then dates, then horses; a very little rice and a few cloaks from Yemen or Oman close the chapter of commerce so far as land produce is concerned; pearls sum up that of the sea. Nor is the import much more diversified or extensive. Cotton cloth, Indian prints, sugar, a little hardware, a few arms, powder and shot, and trinkets of no great value—such are the customary requisitions of the land. Nor has any single Arab, the Imam or Prince of Mascat alone excepted, sufficient available capital for extensive traffic, out or in; while the Mahometan prohibition of interest, and consequently of credit, joined to the illegality of insurance, would, even in a richer land, restrict enterprise within very unsatisfactory bounds. It is owing, indeed, to these narrow-minded laws, introduced by the Koran and co-existent with its observance, that what commerce exists at the seaports of Hejaz, Tehamah, and Yemen, has mainly fallen into the hands of Jews and Banians—that is, Indian merchants; though in Oman, where a more liberal spirit prevails, Arab merchants of considerable capital and with extensive connections are to be found. The custom-duties in the ports of Oman and the Persian Gulf, whether export or import, are 10 per cent., except on pearls; in the harbours of Yemen they are capricious, and often very high. The shereef or governor of Mecca used formerly to carry on, through Jiddah, a trade hardly inferior to that of the Imam of Mascat himself; but the devastations committed by the Wahhabees, and in later times the oppression of the Egyptian and Turkish governments, have considerably reduced this source of Arab income.

Origin of Arab race. The origin of the Arab race, like that of most others, can only be matter of conjecture; no credit can be attached to the assertions, evidently unbased on historical facts, of those authors who, building on the narrow foundation of Hebrew records, have included the entire nation under the titles of Ishmael and Joktan; and Mahometan testimony on these matters can have no more weight than the Jewish, from which it is evidently derived. Setting, therefore, these vague and half-poetical traditions aside, the first certain fact on which to base our investigations is the ancient and undoubted division of the Arab race into two branches, the "Arab," or pure; and the "Mostareb," or adscititious. The geographical limits of both branches have already been sufficiently indicated. A second fact is, that everything in pre-Islamitic literature and record—the only reliable authorities in such a case, as preserved to us in the *Hamasa*, the *Kitab-el-Aghanee*, the writings of Musáoodee and Abul-

Feda, the stories of Antarah or Mohalhet, and the like—concurs in representing the first settlement of the "pure" Arabs as made on the extreme south-western point of the peninsula, near Aden, and thence spreading northward and eastward over Yemen, Hadramaut, and Oman. A third is the name Himyar, or "dusky," given now to the ruling class, now to the entire nation; a circumstance pointing, like the former, to African origin. A fourth is the Himyaritic language—now, indeed, almost lost, but some words of which have been preserved either in proper names or even in whole sentences handed down. They are African in character, often in identity. Indeed, the dialect commonly used along the south-eastern coast hardly differs from that used by the Somawlee Africans on the opposite shore; but later intermixture of blood and constant intercourse may have much to do with this. Fifthly, it is remarkable that where the grammar of the Arabic, now spoken by the "pure" Arabs, differs from that of the north, it approaches to or coincides with the Abyssinian. Now, it is well known to philologists that grammatical inflections are a much more abiding and intimate test of origin than separate nouns or even verbs. Sixthly, the pre-Islamitic institutions of Yemen and its allied provinces—its monarchies, courts, armies, and serfs—bear a marked resemblance to the historical Africo-Egyptian type, and even to the modern Abyssinian. Seventhly, the physical conformation of the pure-blooded Arab inhabitants of Yemen, Hadramaut, Oman, and the adjoining districts—the shape and size of the head, the slenderness of the lower limbs, the comparative scantiness of hair, and other particulars—point in an African rather than an Asiatic direction. Eighthly, the general habits of the people,—given to sedentary rather than nomade occupations, fond of village life, of society, of dance and music; good cultivators of the soil, tolerable traders, moderate artisans, but averse to pastoral pursuits—have much more in common with the inhabitants of the African than with those of the western Asiatic continent. Lastly, the extreme facility of marriage which exists in all classes of the southern Arabs with the African races; the fecundity of such unions; and the slightness or even absence of any caste feeling between the dusky "pure" Arab and the still darker native of modern Africa—conditions different from those obtaining almost everywhere else—may be regarded as pointing in the direction of a community of origin. Further indications are afforded both by local tradition and actual observation; but they are of a nature to be scarcely appreciable, except by those whom long familiarity has rendered intimate with the races in question; besides, the above are, for average criticism, sufficient.

Origin of Mustareb race.

It is harder to determine with precision the origin of the "adscititious" or "Mustareb" Arabs, and the circumstances under which they first peopled their half of the peninsula. Though in physical, mental, and lingual characteristics they offer too marked an affinity with the Arabs of the south to allow of any supposition except that of ultimate unity, so far as the stock is concerned; yet they present many and important divergences from them, and these divergences, whatever their nature, have all an Asiatic impress of their own. Such are their pastoral tendencies and proneness to nomade life; such the peculiarities of their idiom, drawing near to the Hebrew; such the strong clannish feeling, joined with a constant resistance to anything like regal power or settled comprehensive organisation; such even the outward and physical type. Time after time we may observe—in their history, their literature, their institutions or the absence of them, their past, their present—traits now Hebrew, now Syrian, now Chaldæan, now even Tatar; though the groundwork of the whole is undoubtedly identical with the Arab of the south. The probability, faintly indicated by tradition, is that at an early, indeed an absolutely pre-historic period, this branch of the Arab race, emigrating eastward, passed into Asia—not like their congeners, at the southern, but at the northern or isthmal extremity of the Red Sea; then pursued their inland way to the plains of Mesopotamia and Chaldæa, and perhaps even further; and after a long sojourn in these lands, during which they acquired the modifications, mental and physical, which distinguish them from their southern and more unchanged brethren, returned westward to the land already partly occupied by their kinsmen. This return would not be effected all at once, but by band after band, according to the pressure exercised on them by Iranian or Turanian neighbours, a fact witnessed to by many of the northern pre-Islamitic traditions, as found in Ibn-Atheer, Tabreezee, and others; while the well-known Ishmaelitic mythos, recorded alike in Hebrew and in Arab chronicles, probably points to the last batch of "adscititious" Arab immigrants, the special clan from which the family of Koreysh and the Prophet had origin.

Once established on the same soil, the two branches would naturally early manifest a tendency to unite, sufficient in time to produce a tolerable identity both of language and of usages; while the superinduced modifications of character and manners may well have originated the rivalry and even enmity between the Arabs of the north, or "Keysees," and those of Yemen, which, under various forms, has never ceased down to our own time.

Actual divisions of the Arab race. Bedouins.

At present, however, the most important, as also the best-known division of the Arab race is that which separates them into "Ahl Bedoo," or "dwellers in the open land," whence the common appellation of Bedouin; and "Ahl Hadr," or "dwellers in fixed localities." The former class, living under tents, and occupying the waste country which lies in a vast circle between the coast and the central plateau, while to the north it joins on to the Syrian desert, are the best known to European travellers, with whom they often come in contact, and by whom they have sometimes been described with considerable exaggeration both as to their numbers and in other respects. The most trustworthy authorities regarding them are Niebuhr and Burckhardt.

Mode of life.

The Bedouins, then, are shepherds and herdsmen, reduced to an out-of-doors and roving life, partly by the intrinsic nature of their occupations, partly by the special characteristics of the country they belong to. For, while land, unsuited to all purposes except pasture, forms an unusually large proportion of the surface in the Arabian territory, the prolonged droughts of summer render considerable portions of it unfit even for that, and thus continually oblige the herdsmen to migrate from one spot to another in search of sufficient herbage and water for their beasts. The same causes also involve the Bedouins in frequent quarrels with each other regarding the use of some particular well or pasture-ground, besides reducing them not unfrequently to extreme want, and thus making them plunderers of others in self-support. Lastly, the loneliness of the desert, far removed from the vigilant control of fixed law, order, or police, has, combined with the other circumstances, continued during generation after generation to leave a peculiar impress on a naturally bold, hardy, and enterprising race, till the terms Bedouin and brigand have, in the opinion of many, become synonymous.

Habits.

This opinion is, however, unjust. Professionally, and in the ordinary course of their lives, Bedouins are only shepherds and herdsmen: their raids on each other, or their exploits in despoiling travellers and caravans, are but occasional, though welcome and even exciting, exceptions to the common routine. Besides, their wars or forays among themselves,—for they very rarely venture on a conflict with the better armed and better organised sedentary population,—are rarely bloody; the object being most often with the one party to carry off, and with the other to protect, a flock of sheep or a herd of camels: booty is aimed at, not slaughter. If positive hatred or a desire to kill exist, such feelings are usually limited to two or three individuals at most, one of whom has perhaps been ridiculed in satirical verse, to which they are very sensitive, or had a distant relation killed in some previous fray. Bloodshed, too, is expensive, as it must be made up for either by more bloodshed or by paying the price,—the "deeah," as it is called, and which varies, according to the importance of the person killed, from ten to fifty camels, or even more. Previous to Mahomet's time it was left optional to the injured tribe either to accept this kind of compensation or to insist on blood for blood; but the Prophet, though by his own account despairing of ever reducing the nomade portion of his countrymen to any fixed observances, succeeded on this point in establishing among them the rule, that a fair "deeah," if offered, must of necessity be accepted: a merciful regulation, tending to cut short otherwise interminable feuds.

Instances are, however, not wanting in Arab history of fiercer and more general Bedouin conflicts, in which the destruction, or at least the complete subjugation, of one tribe has been aimed at by another, and when great slaughter has accordingly taken place. Such were the wars of Pekr and Thagleb in the 6th century, of Kelb and Howazin in the 8th, of Harb and Oteybah in the 18th, with others. But these are comparatively rare events.

Brigandage. The Bedouins regard the plundering of caravans or travellers, whether on business or otherwise, simply as a supplementary measure that takes the place of passports or custom dues exacted elsewhere. The land is theirs, they say, and trespassers on it without leave must pay the forfeit. Hence whoever can show anything equivalent to a permission of entrance into their territory, has, in the regular course of things, nothing to fear. This permission is obtained by securing the protection of the nearest Bedouin sheykh, who, for a politely-worded request and a small sum of money, will readily grant the pass, in the shape of one or two or more men of his tribe, who accompany the wayfarers as far as the next encampment on their road, where they hand their charge over to fresh guides, equally bound to afford the desired safeguard. In the interior of the peninsula the passport is given in writing by one of the local town governors, and is respected by the Bedouins of the district; for, however impudent and unamenable to law these nomades may be on the frontiers of the impotent Ottoman government in Syria or the Hejaz, they are quiet and submissive enough in other and Arab-governed regions of the peninsula. But the rash traveller who ventures on the desert strip without the precautions above mentioned is likely enough to atone for his negligence by the loss of his luggage; and should he resist, perhaps his life also.

Tribes. Utterly ignorant of writing and unacquainted with books, the Bedouins trust to their memory for everything; where memory fails, they readily eke it out with imagination. Hence their own assertions regarding the antiquity, numbers, strength, &c., of their clans are of little real worth; even their genealogies, in which they pretend to be eminently versed, are not to be much depended on; the more so that their own family names hardly ever exceed the limits of a patronymic, whilst the constantly renewed subdivisions of a tribe, and the temporary increase of one branch and decrease of another, tend to efface the original name of the clan. Few tribes, accordingly, now preserve their ancient, or at least their historical titles; and the mass of the Bedouin multitude resembles in this respect a troubled sea, of which the substance is indeed always the same, but the surface is continually shifting and changing. As, however, no social basis or ties are acknowledged among them except those of blood and race, certain broad divisions are tolerably accurately kept up, the wider and more important of which may here be noted.

Anezah. First, the Anezah clan, whose pasture-grounds extend from Syria southward to the limits of Jebel Shomer. It is numerous, and, for a Bedouin tribe, well armed. Two-thirds of the Arab horse trade, besides a large traffic in sheep, camels, wool, and similar articles, are in the hands of these Anezah Bedouins. Their principal subdivisions are the Sebaá on the north, the Woold-Alee on the west, and the Ruála on the south; these are generally on bad terms with each other. If united, they could muster, it is supposed, about 30,000 lances. They claim descent from Rabeeah. Shomer. Second, the Shomer Bedouins, whose pasturages lie conterminous to those of the Anezah on the east. Their numbers are about the same. Howeytat. Thirdly, in the northern desert, the Howeytat and Sherarat, comparatively small and savage tribes. Also the Soleebee clan, which, however, is disowned by the Arabs, and seems to be of gipsy origin. Harb. Next follow, in the western desert, the Benoo-Harb, a powerful tribe, supposed to muster about 20,000 lances. Their origin is from Keys-Eylan. They are often troublesome to the Meccan pilgrims. Moteyr. In the eastern desert are the Moteyr, the Benoo-Khalid, and the Ajmans, all numerous clans, often at war with each other. Others. To the south, in Nejd itself or on its frontiers, are the Hodeyl, Oteybah, and others. These all belong to the "Mustareb," or northern Arabs.

Southern Bedouins. The Bedouins of southern or "pure Arab" origin are comparatively few in number, and are, it seems, with few exceptions, even poorer and more savage than their northern brethren. Al-Morrah, on the confines of Oman, Al-Yam and Kahtan, near Yemen, and Benoo-Yas, between Hareek and the Persian Gulf, are the best known. The total number of the Bedouin or pastoral population throughout Arabia appears, including men, women, and children, not to exceed a million and a half—it may even fall short of it.

Organisation. Whatever be the clan, the only authority it submits to is that of its "elder," or "sheykh," a title which, however, does not necessarily imply advanced age, but is given to any one who, on account of birth, courage, wealth, liberality, skill, prudence, or some other fortunate quality or accident, has been chosen to the leadership. Descent has something to do with rank, but not much, as every individual of the tribe considers himself equal to the others; nor are the distinctions of relative riches and poverty greatly taken into account. This is natural in a state of things where property itself, consisting almost wholly of live stock, is of an essentially uncertain and fluctuating character, and the Bedouins have no other. To the "sheykh" all disputes are referred; he is consulted, though not necessarily obeyed, on every question which regards the general affairs of the tribe, whether in peace or war; there is no other magistrate, and no law except what he and the other chief men of the clan may consider proper. But in fact, for most personal and private affairs, every man does pretty much what is right in his own eyes.

Religion. Nominally Mahometan, most of the Bedouins pay slight attention to the ceremonial precepts of the Koran; the five daily prayers and the annual fast of Ramadhan are not much in favour among them; and however near a tribe may be to Mecca, few of them visit it as pilgrims. Wahhabee influence exercised, sword in hand, has, however, of late enforced some degree of Islamitic observance among the Bedouins of Nejd and the adjoining districts: elsewhere nomade Mahometanism is pretty nearly confined to the profession of the Divine Unity; among the remoter and wilder tribes sun-worship, tree-worship, and no worship at all, are not uncommon. Some clans even omit the rite of circumcision altogether; others, like the tribe of Hodeyl, south of Mecca, perform it after a fashion peculiar to themselves.

Morals.

Nor are the social and moral injunctions of Islam better observed. Marriages are contracted without any legal intervention or guarantee; the consent of the parties, and the oral testimony of a couple of witnesses, should such be at hand, are all that are required; and divorce is equally facile. Nor is mutual constancy much expected or observed either by men or women; and the husband is rarely strict in exacting from the wife a fidelity that he himself has no idea of observing. Jealousy may indeed occasionally bring about tragic results, but this rarely occurs except where publicity, to which the Bedouins, like all other Arabs, are very sensitive, is involved. A maiden's honour is, on the other hand, severely guarded; and even too openly avowed a courtship, though with the most honourable intentions, is ill looked on. But marriage, if indeed so slight and temporary a connection as it is among Bedouins deserves the name, is often merely a passport for mutual licence. In other respects, Bedouin morality, like that of most half-savage races, depends on custom and public feeling rather than on any fixed code or trained conscience, and hence admits of the strangest contradictions. Not only are lying and exaggeration no reproach in ordinary discourse, but even deliberate perjury and violation of the most solemn engagements are frequent occurrences. Not less frequent, however, are instances of prolonged fidelity and observance of promise carried to the limits of romance. "The wind," "the wood," and "the honour of the Arabs," are the most ordinary oaths in serious matters; but even these do not give absolute security, while a simple verbal engagement will at other times prove an inviolable guarantee. Thus, too, the extreme abstemiousness of a Bedouin alternates with excessive gorgings; and, while the name and deeds of "robber" are hardly a reproach, those of "thief" are marked by abhorrence and contempt. Patience, or rather endurance, both physical and moral, few Bedouins are deficient in; wariness is another quality universally developed by their mode of life. And in spite of an excessive coarseness of language, and often of action, gross vice, at least of the more debasing sorts that dishonour the East, is rare among them. Of their hospitality, as also of many other points common between them and the town Arabs, we shall speak further on.

Personal appearance. In person most Bedouins, men or women, are rather undersized, the result probably of hardships endured through uncounted generations; their complexion, especially in the south, is dark; their hair coarse, copious, and black; their eyes dark and oval, the nose is commonly aquiline, and the features well formed; beard and moustache are apt to be somewhat scanty. The men are active, but not strong; the women, rarely otherwise than plain.

Dress. Their dress is simple enough; that of the men consisting in a long cotton shirt, open at the breast, and often girt with a leathern girdle; a black or striped cloak of hair is sometimes thrown over the shoulders; a handkerchief, folded but once, and generally black, more seldom striped yellow and red, covers the head, round which it is kept in its place by a piece of twine or a twisted hairband. To this costume a pair of open sandals is sometimes added. No other article of dress is worn,—neither trousers nor turban, but under the shirt, round the naked waist, a thin strip of leather plait is wound several times, not for any special object, but merely out of custom. In his hand a Bedouin almost always carries a slight crooked wand, commonly of almond-wood; with this he guides his camel when on the road, and amuses himself by playing with it at other times. Among the Bedouins of the south a light wrapper takes the place of the handkerchief on the head, and a loin-cloth that of the shirt.

Women's dress. A woman's attire is hardly more complicated; wide loose drawers, though these are sometimes dispensed with; next a long shirt, and over it a wide piece of dark blue cloth enveloping the whole figure, the head included, and trailing on the ground behind. Very rarely does a Bedouin woman wear a veil, or even cover her face with her overcloak, contenting herself with narrowing the folds of the latter over her head on the approach of a stranger. Her wrists and ankles are generally adorned with bracelets and rings of blue glass or copper or iron, very rarely of silver; her neck with glass beads; earrings are rare, and noserings rarer. A few comparatively rich women indulge in more elegant ornaments and fuller dress. Boys, till near puberty, usually go stark naked; girls up to six or seven.

Weapons. On a journey a Bedouin invariably bears with him a light sharp-pointed lance, the stem of which is made of Persian or African cane; the manner in which this is carried or trailed often indicates the tribe of the owner. The lance is the favourite and characteristic weapon of the Arab nomade, and the one in the use of which he shows the greatest skill, throwing it, at need, to a considerable distance with unerring aim. Frequently, too, he girds on, or rather suspends from a kind of shoulder-belt, a sword, straight or crooked as may be; the blade is often of little value, rusty, and not over sharp; the scabbard of wood. The weapon which comes third in frequency is a gun; this is still in almost every instance a matchlock, clumsy and foul, taking from five to ten minutes to load and fire, when, indeed, it can be fired at all, which is not always the case. Yet with such wretched implements at his disposal, a Bedouin is seldom other than a good marksman. Flint-guns may here and there be met with now-a-days; but percussion or breech-loaders never. Nor are pistols any part of a Bedouin's war equipment. But whether in peace or war, he is seldom without a knife: this in the north is only a large clumsy clasp or sheath knife; but in Yemen, Oman, and the intervening regions it develops into a broad and crooked dagger, a truly formidable weapon, on the ornamentation of which the Bedouin of the south bestows what skill or wealth he may happen to possess.

Armour. For defensive armour a Bedouin on a foray, or preparing for a serious engagement, sometimes puts on a coat of mail, the manufacture of Yemen or Baghdad; its links are thin, but closely plaited, and often are two or even three deep. To this he adds a helmet, a mere iron head-piece, without visor or crest. Pennons and banners are rarely used by the nomades, whose chief tactics consist in surprise, as their main object is plunder, both of which require, not display, but secrecy. For though the Bedouins are undoubtedly brave and reckless enough of life, their own as well as that of others, where a cause requires it, they have the good sense never to venture blood unnecessarily or on insufficient grounds. Indeed on all points and in all their dealings, shrewd, calm, good sense, joined with a humorous and sarcastic turn of mind, may be said to be the base of their character, their passions, strong and lasting, are kept in habitual control; and in these regards, as in a lively and poetical imagination, and a wonderful power of untaught eloquence, they resemble their more settled countrymen of the towns and villages. In their principal faults, too—instability, restlessness, envy, rancour, untruthfulness, and sensuality—they resemble them also.

Independence Much has been said and written of the independence of the Bedouins, and of their having never submitted themselves to a foreign yoke; and prophecy has been called in to explain a fact which a little reflection would have shown to imply nothing marvellous or exceptional whatever, but to be merely the natural result of condition and circumstances. A nomade population, thinly scattered over a large and open space of meagre pasture-land, will always be unconquerable, because it offers next to nothing to conquer. When in camp, a Bedouin's tent consists of a few coverings of the coarsest goat-hair, dyed black, and spread over two or more small poles, in height from 8 to 9 feet, gipsy fashion. If it be the tent of a sheykh or man of consequence, its total length may be from 30 to 40 feet; if of an ordinary person, it will oftener fall short of 20. Sometimes a partition separates the quarters allotted to the women and children; sometimes they are housed under a lower and narrower covering. A piece of rough carpet or an old mat may or may not be spread on the sandy floor; while camel-saddles, ropes, halters, and the like, constitute the entire furniture of the dwelling; ornament there is none. To the list two or three cauldrons for cooking, one or two platters, and a wooden drinking bowl, must be added; and with these, including the master's arms in one side of the tent, and his spear stuck in the ground at the door, the household valuables are complete. When the time comes for moving, all these several articles are easily fastened in bundles on the backs of one or more camels; the men mount their saddles, the women their litters; and in an hour the blackened stones that served for a cooking hearth remain as almost the only sign where the encampment has been. When the tribe is once on its way across the desert, pursuit is difficult; and were the fugitives overtaken, they would offer nothing to repay the trouble of their pursuers. It may be worth the while of nomades such as these occasionally to plunder each other, but it can hardly be worth the while of any foreign power to plunder, still less to attempt to subdue them, and in this lies the whole secret of their imagined independence.

Settled Arabs

From the Bedouins, or "Ahl Bedoo," we now turn to the "Ahl Hadr," or the dwellers in fixed abodes. These constitute about six-sevenths of the population of Arabia proper, and it is from them alone that a just appreciation of the Arab character and customs can be formed.

Family divisions.

Though the clan and the family form the basis and are the ultimate expression of the civilised Arab society, they do not, as is the case among the Bedouins, sum it up altogether; local feelings and duties, the consequences of settled life having deeply modified the character alike of the individuals and the race among all Arabs, town or country. Still, blood is the first thing taken into account; and, indeed, the possession of written records, and habits of order and reflection, enable the settled Arabs to acquire and retain a more accurate knowledge and nicer distinction of pedigree and race than could be expected or found among the unreflecting and half-barbarous Bedouins.

Koreysh.

Throughout the peninsula, but especially on the western side, the family of Koreysh is even yet regarded as the noblest of Arab races, indeed of the world; and its members, on the strength of their connection with the Prophet, all bear the title of "Shereef," sometimes also, as in Yemen, that of "Seyyid," or "lord." Besides the advantages which naturally follow popular respect, they hold in several districts of Arabia—in Mecca itself, for example, in Aboo-Areesh, and in some parts of Yemen—the positions and emoluments of local hereditary governors. But they do not assume any regular distinctive mark, like the green turban so often worn in Turkey or Persia; nor in private life do they enjoy any immunity, either explicit or prescriptive, from the ordinary obligations of law.

Titles of rank—Sheykh.

"Sheykh," or elder, "Emeer," or ruler, "Imam," or preceder, and "Sultan," or monarch, are personal and often, though not necessarily, hereditary titles of rank. "Walee," or governor, is a word the use of which is limited to Yemen and Oman. "Sheykh," on the contrary, is universal; every village, however small, every separate quarter of a town, has a "sheykh," in whom is lodged the executive power of government—a power loosely defined, and of more or less extent according to the personal character and means of the individual who wields it. A village "sheykh" is a sort of head magistrate and chief of police, or like a sheriff of old times. His power is, however, occasionally limited, particularly in towns, by that of the "kadee," or "judge," whose duty consists in the official, though rather arbitrary, interpretation of the law, and whose sentence ought, in theory at least, to precede the action of the sheykh. But as the Koran, the sole authentic authority in all matters, legal or civil, throughout Arabia, never accurately distinguished between the two classes, and its phrases, besides, are vague and capable of admitting different and even opposite interpretations, the administration of law and justice has in consequence always remained extremely irregular, and dependent much more on the personal good sense and integrity of the officials, or too often on their want of those desirable qualities, than on any methodised system. The sheykh has no fixed income; he is usually a landed proprietor, sometimes a merchant; many sheykhs, however, abuse their power for their own private advantage. Nor is his office strictly hereditary, though it may become accidentally so.

Emeer

Emeer is a higher title, restricted to a governor of a district or province especially in Shomer, Nejd, and the rest of the central region. An emeer is in most respects nothing but a magnified sheykh; he has, however, the advantage of drawing a considerable portion of his income from the country he administers. Thus in Nejd the emeers receive and retain, partially in Wahhabee governments, wholly in others, the "zekat," or tithes, varying from one-twentieth up to one-fifth of the value of property, besides other occasional dues, fines, &c.; in Hasa, Bahreyn, Katar, Mahrah, and Hadramaut the emeer can also claim the fishery tax and customs. Beyond Wahhabee limits he has the ordinary, within them the extraordinary, power of life and death; in all cases he can punish by imprisonment and fine. Part of his office is to hold public audiences daily, on which occasions every one who chooses, of whatever rank or condition, has the right of coming forward and of presenting any complaint or petition. Sometimes the emeer takes the matter thus brought before him into his own hands at once; sometimes he refers it to the radee, or to the elder and more respectable inhabitants, who in these meetings take seat near the emeer, and form a kind of improvised council. The emeer himself wears about him no distinctive badge of office; nor is he approached with any ceremony beyond that of ordinary Arab politeness. In the Wahhabee provinces, or those where Wahhabeeism, though no longer dominant, has made a permanent impression, as in Shomer for instance, the emeer commonly takes on himself the duties of the Friday "imam," not unlike those of precentor in Presbyterian worship, in the public mosque; now and then he preaches a sermon. His position is generally hereditary, but not always in direct line.

Sultan.

The title of "sultan," or king, one of doubtful antiquity, has been assumed by the hereditary Wahhabee ruler of Riad, the capital of Nejd; it is also often applied to the sovereign of Oman, and to some petty princes in the south of the peninsula. In practice it adds little or nothing to the dignity of emeer, but implies a larger territorial range of authority.

Religion.

Where the Wahhabee doctrines have definitely established themselves, as in Nejd, Yemameh, Hareek, Aflaj, and Jebel Aseer, the Mahometan code, as laid down in the Koran, is observed more strictly perhaps than in any other part of the Eastern World. Besides the principal mosque, or "jamiá," for Friday prayers, indispensable in every town or village, smaller praying-places, or mesjids, are erected in every quarter. These buildings are mere oblong rooms, flat-roofed, supported on numerous rough pillars placed close to each other, and with no architectural or decorative beauty whatever; but are kept scrupulously clean, and laid down partly with mats, partly gravel. In most cases there is no minaret attached, the times of prayer being merely announced by the "múeddin," or crier, from the roof itself. Punctuality in attendance is enforced by the "mutowwás," or "compellers" of "obedience," a set of self-elected zealots, who parade the towns and villages with sticks in their hands, take note of the defaulters from prayers, or transgressors otherwise of the letter of the law, and punish them with reproaches or even blows. Marriage, divorce, inheritance, purchase, every detail of life is regulated in exact accordance with the Koran; even conversation is liable to censure unless thickly interlarded with words of religious import; while after night-prayers talking is a luxury prohibited altogether. Yet, though these Wahhabee Arabs are bigoted even to fanaticism among themselves and with their fellow-countrymen, they are remarkably tolerant towards strangers, and often unite with the extreme of theoretical exclusiveness a good deal of the practical scepticism and indifference common to their race.

Orthodox sects. These Wahhabees all belong to the orthodox sect of Ebn-Hanbal, and are in fact its most exaggerated expression. In the eastern provinces, Hasa, Katee, Bahreyn, and Katar, the Malikee sect is more common; as also, it is said, in Hadramaut, and in some parts of Yemen. But in Yemen generally, and throughout the Hejaz, the Shaféyee sect, orthodox like the two others, predominates. There are no Hanefees in Arabia, except a few Turks or Indians settled on the western coast. "Sheéah," too, or votaries of Ali and his family, in the Persian sense of the word, are by no means common in the peninsula, and where found are often of foreign origin.

Khowarij. But all along the Persian Gulf, in Hasa, Bahreyn, and Katar, a considerable proportion of the inhabitants are not Mahometans at all, that is, in the ordinary acceptation of the word, but "Khowarij," or "seceders," belonging to the Karmathian school already mentioned; while in Oman, the little peninsula or cape of Ras-el-Rheymah excepted, where Wahhabeeism has made good its footing, the bulk of the people belong to the Beyadee or Abadee sect, a Karmathian offshoot nearly allied in doctrines and in practice to the "Ismaileeyah" of Syria. For a detailed account of either the reader may with advantage consult Silvestre de Sacy's admirable treatise on the "Batineeyah," or secret sects of the Mahometan East, prefixed to his History of the Druses. Somewhat akin to these, but of a less marked divergence from orthodox Islam, are the Zeydees, of whom great numbers exist in Yemen. Lastly, paganism, or rather the fetichism that takes for its scope a stone, tree, or some other natural object, appears to exist in Mahrah, in the southern Jowf, and in various small half-isolated spots on the borders of the great desert, or Dahna. Vestiges of Sabaism, or the worship of the heavenly bodies, are said to linger among the wilder Bedouin tribes, who even yet compute the year from the rising of Soheyl or Canopus, and prostrate themselves to the morning sun. It is also noticeable that even such of the southern Arabs as are professedly Mahometan, are far less zealous and much laxer in their ways than the Arabs of the north; in fact, the Islam of the latter was indigenous, that of the former acquired or compulsory.

Except in a few places on the west coast long exposed to Egyptian, Turkish, and Indian influences, no dervishes are to be met with, or are even tolerated, in Arabia proper. The Wahhabees all hold them in the utmost contempt and abhorrence. Nor are Arabs, generally speaking, superstitious in other respects: of dreams and omens they make little account; nor does the apprehension of ghosts, spectres, apparitions, demons, and the like often disquiet their hours of loneliness or darkness; stories of such a character, though embodied here and there in Arab literature, in the *Thousand and One Nights* for example, are less frequently of Arab than of foreign origin, generally Persian. Nor do Arabs often seek to convert others, except it be their own purchased negro slaves, a facile acquisition, to Mahometanism, or molest those of other religions. Jews exist undisturbed in great numbers near Teyma and in the south; Hindoos worship cows and burn their dead without interference in Oman; only old custom, it would seem, and the memory of long and bitter wars, prohibits the practice of the Christian religion in Arabia proper,—Aden alone, of course, where the British flag proclaims absolute tolerance, excepted. Absence of superstition.

Slavery is still, as of old times, a recognised institution throughout Arabia; and an active traffic in blacks is carried on along the coasts of the Persian Gulf and the Red Sea, but especially the former. Slavery.

The slaves themselves are chiefly brought from the east African coast districts down as far as Zanzibar, and from the Galla tribes in the interior; a few Abyssinians, too, are sometimes imported. Slaves are usually employed in Arabia as herdsmen or as domestic servants, rarely in agricultural works; they also form a considerable portion of the body-guards with which Eastern greatness loves to surround itself. Like their countrymen elsewhere, they readily embrace the religion of their masters, and become zealous Mahometans, though rarely according to knowledge. Arab custom enfranchises a slave who has accepted Islam at the end of seven years of bondage; and when that period has arrived, the master, instead of exacting from his slave the price of freedom, generally, on giving him his liberty, adds the requisite means for supporting himself and a family in comfort. Further, on every important occasion, such as a birth, circumcision, a marriage, or a death, one or more of the household slaves are sure of acquiring their freedom. Hence it comes that Arabia is densely sprinkled with a free black population; and these again, by intermarriage with the whites around, have filled the land with a mulatto breed of every shade, till, in the eastern and southern provinces especially, a white skin is almost an exception. This has taken place all the more readily that in Arabia there exists no prejudice against negro alliances; no social or political line separates the African from the Arab. A negro may become a sheykh, a kadee, an emeer, or whatever his industry and his talents may render him capable of being. This occurs frequently, particularly in Nejd, Yemen, and Hadramaut; in the Hejaz and the north, on the contrary, a faint line of demarcation may be observed between the races.

Both town and village Arabs are, as a rule, serious in gait and demeanour, and very observant of politeness, not only in the manner, but even in the substance of their conversation. In temper, or at least in the manifestation of it, they are studiously calm; and an Arab rarely so much as raises his voice in a dispute. He prides himself on an unruffled exterior, and will bear much with careful seeming calm that would drive a European to the extreme of impatience and rage. But this outward tranquillity covers feelings alike keen and permanent; and the remembrance of a rash jest or injurious word, uttered years before, is too often the cause of violence and bloodshed. Character.

Besides, however, the individual shades of character, there exist marked tribal or almost semi-national diversities, among the Arabs. Thus, the inhabitants of Hejaz are noted for courtesy and blamed for fickleness; those of Nejd are distinguished by their stern tenacity and dignity of deportment; the nations of Yemen are gentle and pliant, but revengeful; those of Hasa and Oman cheerful and fond of sport, though at the same time turbulent and unsteady. Anything approaching to a game is rare in Nejd, and in the Hejaz religion and the yearly occurrence of the pilgrim ceremonies almost exclude all public diversions; but in Yemen the well-known game of the "jereed," or palm-stick, with dances and music—the latter very barbarous, it must be allowed—is not rare. In Oman such amusements are still more frequent. Again, in Yemen and Oman, coffee-houses, where people can resort for conversation, and where public recitals, songs, and other diversions are to be met with, stand open all day; while nothing of the sort is tolerated in Nejd. So it is also with the ceremonies observed on occasion of circumcision or marriage—occasions of gaiety and pastime on the coast, but passed over with little of the like observance in the central provinces.

Arab towns. An Arab town, or even village, except it be the merest hamlet, is invariably walled round; but the ramparts are low, and seldom of any stronger material than dried earth; they are occasionally flanked by towers of like construction, such as befit a country where cannon are unknown and fire-arms are yet at the matchlock stage. A dry-ditch often surrounds the whole. The streets are utterly irregular—some broad, some narrow, all tortuous; the houses are of one or two storeys, very rarely of three, with flat mud roofs, little windows, and no external ornament. If the town be large, the expansion of one or two streets becomes a market-place, where are ranged a few shops of eatables, drugs, coffee, and, very rarely, cottons or other goods. Many of these shops are kept by women. The chief mosque is always near the market-place; so is also the governor's residence, which, except in size and in being more or less fortified Arab fashion, does not differ from a private house. Drainage is unthought of; but the extreme dryness of the air obviates the inconvenience and disease that under other skies could not fail to ensue, and which in the damper climates of the coast make themselves seriously felt. But the streets are roughly swept every day, each householder taking care of what lies before his own door. Whitewash and colour are occasionally used in Yemen, Hejaz, and Oman; elsewhere a light ochre tint, the colour of the sun-dried bricks, predominates in an Arab town or village, which looks at a distance like a large dust-heap in the centre of the bright green ring of gardens and palm-groves all around. Baked bricks are unknown in Arabia, and stone buildings are rare, especially in Nejd. Palm branches and the like, woven in wattles, form the dwellings of the poorer classes in the southern districts. Many Arab towns possess watch-towers, like huge round factory chimneys in appearance, built of sun-dried bricks, and varying in height from 50 to 100 feet, or even more. Indeed, two of these constructions at the town of Birket-el-Mawj, in Oman, are said to be each of 170 feet in height, and that of Nezwah, in the same province, is reckoned at 140; but these are of stone. Some of these watch-towers are so built as to serve also for citadels or places of refuge; but none could offer a minute's resistance to any kind of artillery, though formidable obstacles to men whose only means of attack are lances and matchlocks.

Interior of an Arab dwelling. The principal feature in the interior of an Arab house is the "kahwah," or coffee-room, as from its destination it is commonly called. It is a large apartment spread with mats, and sometimes furnished with carpets and a few cushions. At one extremity is a small furnace or fire-place, for preparing coffee. In this room the men congregate; here guests are received, and even lodged; women rarely enter it, except at times when strangers are unlikely to be present. Some of these apartments are very spacious, and supported by pillars; one wall is usually built transversely to the compass direction of the káabeh; it serves to facilitate the performance of prayer by those who may happen to be in the kahwah at the appointed times. The other rooms are ordinarily small, and appropriated to the use of the females of the family and to domestic life.

Hospitality. In hospitality the Arabs of our time have in no degree degenerated from their former reputation, though Shomer, Nejd, Yemamah, and Hasa excel in this respect the other provinces. A stranger's arrival is often the occasion of an amicable dispute among the wealthier inhabitants as to who shall have the privilege of receiving him; and though three days are often popularly spoken of as the limit of such entertainment, practice sets no precise bounds to its length; and an Arab host always carefully abstains from putting any question to his guest as to when he is going, or where. Indeed, if the guest be discreet and acceptable in his manners, he will soon find himself on the footing of one of the family; and even the women of the house will come in to sit and converse with him not less freely than they would with their own relations.

Cookery. Arab cookery is of the simplest. Roughly-ground wheat cooked with butter; bread, in thin cakes, prepared on a heated iron plate or against the walls of an open oven; a few vegetables, generally of the leguminous kinds; boiled mutton or camel's flesh, if the circumstances of the host allow of such luxuries; dates and fruits,—this is the *menu* of an ordinary meal. Roast meat, fried, stewed—in a word, anything but boiled—is rarely seen, such dishes exceeding the skill of the cooks, who, as a rule, are the women of the household. Rice is eaten in wealthy houses, and fish is common on the coasts. Among the Bedouins, millet-cakes, half-cooked in ashes, or a broth prepared from the gritty seeds of the "samh" (a species of *Mesembryanthemum*), often take the place of bread; and their meat cookery is equally wretched. Game, such as venison, partridge, and hare, is served up on rare occasions. Camel meat is a favourite, but to a stranger a very insipid dish, in southern Nejd, Yemamah, Hareek, and Aflaj. Spices are freely employed in town cookery; butter much too largely for a European taste.

Entertainment. After eating, the hands are always washed with soap, or some substitute for it, commonly the ashes of an alkaline plant. A covered censer with burning incense is then passed round, and each guest perfumes his hands, face, and sometimes his clothes; this censer serves also on first receptions, and whenever special honour is intended. In Yemen and Oman scented water often does duty for it. Coffee, without milk or sugar, but flavoured with an aromatic seed brought from India, is served to all. This, too, is done on the occasion of a first welcome, when the cups often make two or three successive rounds; but, in fact, coffee is made and drunk at any time, as frequently as the desire for it may suggest itself; and each time fresh grains are sifted, roasted, pounded, and boiled—a very laborious process, and one that requires in the better sort of establishments a special servant or slave for the work. Among the Bedouins the use of coffee is rare, though they are fond of it when they can get it. Arabs in general make only one solid meal a-day—that of supper, soon after sunset; nor even then do they eat much, gluttony being rare among them, and even daintiness esteemed disgraceful. Wine, like other fermented drinks, is prohibited by the Koran, and is, in fact, very rarely to be met with, though the inhabitants of the mountains of Oman are said to indulge in it. On the coast spirits of the worst quality are sometimes procured; opium and hasheesh have also but few votaries in Arabia. On the other hand, wherever Wahhabeeism has left freedom of action, tobacco-smoking prevails, the manner of smoking varying considerably, according to the district. Among the Bedouins and the poorer classes of the upland regions a short pipe of clay, called a "sebeel," red or black, is in vogue. The wealthier townsmen prefer long pipes with large open bowls; but the most frequent use is made of the water-pipe, or "narghileh," of which implement every form, kind, and dimension imaginable may be found in Arabia. The tobacco smoked is generally strong, and is either brought from the neighbourhood of Baghdad or grown in the country itself. The strongest quality is that of Oman; the leaf is broad and coarse, and retains its green colour even when dried; a few whiffs have been known to produce absolute stupor. The aversion of the Wahhabees to tobacco is well known; they entitle it "mukhzee," or "the shameful," and its use is punished with blows, as the public use of wine would be elsewhere.

Smoking.

Dress. In dress much variety prevails. The loose cotton drawers, girded at the waist, which in hot climates do duty for trousers, are not often worn, even by the upper classes, in Nejd or Yemamah, where a kind of silk dressing-gown is thrown over the long shirt; frequently, too, a brown or black cloak distinguishes the wealthier citizen; his head-dress is in its character the same as that of the Bedouins — namely, a handkerchief fastened round the head by a band—only of better materials. But in Hejaz, Yemen, and Oman, turbans are by no means uncommon; the ordinary colour is white; they are worn over one or more skull-caps—sometimes fifteen—till the head is rather burdened than protected. Trousers also form part of the dress in the two former of these districts; and a voluminous sash, in which a dagger or an inkstand is stuck, is wrapped round the waist. Meanwhile the poorer folk and the villagers often content themselves with a broad piece of cloth round the loins, and another across the shoulders. In Oman trousers are rare, but over the shirt a long gown, of peculiar and somewhat close-fitting cut, dyed yellow, is often worn. The women in these provinces commonly put on loose drawers, and some add veils to their head-dresses; they are fond of ornaments (gold and silver), and overcharge themselves with them; their hair is generally arranged in a long plait hanging down behind. All men allow their beards, whiskers, and moustaches full growth, though none of these are much to speak of, particularly among the Arabs of the south, who are a thin-haired race. Most shave their heads, and indeed all, strictly speaking, ought by Mahometan custom to do so; but many, peasants especially, Bedouins, and the like, neglect it. An Arab seldom or never dyes his hair. Sandals are worn more often than shoes, but the heat of the ground in the day-time allows none except the very poorest to go wholly barefoot. Lastly, though no class or occupation lays claim to any particular style or article of dress, legists, writers, imams, and others connected with the service of the mosques, generally affect greater amplitude and less variety of colour in their turbans and vestments than other people.

Personal appearance and qualities. In person the Arabs are a remarkably handsome race,—tall, lithe, well-formed, dark-eyed, and dark-haired. Deformed individuals or dwarfs are rare among them; nor, except leprosy, of which frequent instances may be met with throughout the peninsula, does any disease seem to be hereditary among them. The frequency of ophthalmia, though not in the virulent Egyptian form, is evidently attributable to the nature of the soil and the climate. They are scrupulously clean in their persons, adding to the prescribed ablutions of the Mahometan code frequent supererogatory washings of their own; and take special care of their teeth, which are generally fine, though toothache is by no means unknown in Arabia. Simple and abstemious in their habits, they often reach an extreme yet healthy old age; nor is it common among them for the faculties of the mind to give way sooner than those of the body. To sum up, physically and morally they yield to few races, if any, of mankind; mentally, they surpass most, and are only kept back in the march of common progress by the remarkable defect of organising power and incapacity for combined action which they share with many other nations of the East, and some, it would seem, of the West also. Lax and imperfect as are their forms of government, it is with impatience that even these are borne; and we have already seen that of the four caliphs who alone reigned—if reign theirs could be called—in Arabia proper, three died a violent death; and of the Wahhabee princes, the most genuine representatives in later times of pure Arab rule, almost all have met the same fate.

Revenues. Of the revenues of Arabia it would be difficult to form anything like a correct estimate. Palgrave has stated the yearly receipts of the Nejdean treasury, inclusive of the tribute then (1862) paid into it by Bahreyn and the west of Oman, to be nearly £106,000 sterling—no very large sum.

The revenues of Oman itself, then in a comparatively prosperous condition, are estimated by the same author at nearly ten times the amount, but may possibly have been overrated by him, as those of Yemen were perhaps by Niebuhr. Certainly the general condition of these provinces—the restricted character of the cultivation and the evident poverty (not absolute want, indeed, for that is rare) of the greater number of the inhabitants—do not convey to the visitor the idea of large national wealth or extensive resources. There can, however, be no doubt that both the coast districts of Arabia, in their varied and valuable products, and the central plateau, with its palm-groves, well irrigation, and wide pasture-lands, might, under a judicious administration, become the sources of much greater revenues, both public and private, than is now the case. The mines, too, in the metamorphic districts of Yemen and Oman, remain yet to be properly worked. As for the desert proper, which, as we have seen, occupies about one-third of the peninsula, it must, like the ocean of *Childe Harold*, remain what it is to the end of time.

Defence. In the 7th century Arabia sent forth armies that attacked and conquered nearly half the then known world. But the secret of her conquests lay not in the number of her warriors, but in a resolute purpose, a unity of aim, and an enthusiasm which concentrated in itself and intensified every motive of human action. In later ages she has been reduced to the defensive, and has shown herself not always equal even to that: witness her conquest by the Turks in the 16th, and by the Egyptians in the present century. Once only, at the moment when Wahhabee union and zeal half restored for a few years the energy of early Islam, did her armies go forth to invade the neighbouring territories of Mesopotamia and Syria; but it was to plunder rather than to conquer, and the results lasted no longer than the invasions themselves.

Yet on the defensive Arabia had much in her favour, and that from many causes. The first is, that there is little to defend, since, the coast of Yemen and the districts of Bahreyn and Oman excepted, there is very little to excite the cupidity of an invading, and nothing to satisfy the exigencies of an occupying force. The second is, that the mountainous nature of Yemen and Oman themselves, and the narrowness of their labyrinthine defiles, added to the extreme heat of the climate, and the scarcity of available provisions, would make even those provinces hard to attack, harder to retain. A third cause is in the broad strips of desert that gird the central districts as with a moat of sand, and send long arms of barrenness here and there into the heart of the cultivated or pastoral regions, so as to render military operations on a large scale in the interior almost impossible. A fourth and a very serious obstacle to invasion is the character of the inhabitants. Personal courage, wonderful endurance of privation, fixity of purpose, and a contempt of death rare even in the bravest Europeans, are qualities common to almost every race, tribe, and clan that compose the Arab nation; and though their undisciplined troops are unfitted to meet a better trained enemy in a regular battle, in skirmishing and harassing they have few equals, while at close quarters their individual impetuosity often disconcerts the more mechanical fortitude of organised regiments. To this our own troops gave testimony in the engagements of Shenaz, 1810, and of Ras-el-Hadd, 1819 and 1820, when, with swords and spears alone, the Arabs of Oman maintained a desperate struggle against guns and bayonets, neither giving nor receiving quarter. **Military tactics.** Nor are they wholly ignorant of tactics, their armies, when engaged in regular war, being divided into centre and wings, with skirmishers in front, and a reserve behind, often screened at the outset of the engagement by the camels of the expedition. These animals, kneeling, and ranged in long parallel rows, form a sort of entrenchment, from behind which the soldiers of the main body fire their matchlocks, while the front divisions, opening out, act on either flank of the enemy. This arrangement of troops may be traced in Arab records as far back as the 5th century, and has often been exemplified during the Wahhabee wars in our own day.

Military force. The military contingent of Nejd, including that of all the adjoining provinces that constitute central Arabia, Jebel Shomer excepted, is reckoned by Palgrave at 47,300 from among the settled, and at about 8000 from among the nomade inhabitants. That of Shomer is estimated by the same authority at 14,000 of the first, and at about 16,000 of the second category. Oman, including the neighbouring and allied districts, is said to supply about 112,000, all from towns or villages.

We thus obtain a total of about 197,300 fighting men for what represents a full half of the Arab peninsula. If, therefore, we calculate the entire military force of the land from Suez to Aden, and from the Red Sea to the Indian Ocean, at 400,000 fighting men, we shall probably be not far from the truth. But while remembering, on the one hand, that this is no standing army, nor composed of regular and disciplined soldiers, it should not be forgotten that, in case of invasion, their energy, and, it may be, their numbers, would be doubled by the enthusiasm of patriotism; and that not every male only, but every woman would, in the excitement of the struggle, take part in the national defence.

Courage of Arab women. Indeed, at all times Arab women have distinguished themselves by their bravery hardly less than Arab men. Records of armed heroines occur frequently in the chronicles or myths of the pre-Islamitic time; and in authentic history the Battle of the Camel, 656 A.D., where Ayeshah, the wife of Mahomet, headed the charge, is only the first of a number of instances in which Arab amazons have taken, sword in hand, no inconsiderable share in the wars and victories of Islam. Even now it is the custom for an Arab force to be always accompanied by some courageous maiden, who, mounted on a blackened camel, leads the onslaught, singing verses of encouragement for her own, of insult for the opposing tribe. Round her litter the fiercest of the battle rages, and her capture or death is the signal of utter rout; it is hers also to head the triumph after the victory of her clan.

Education. There is little education, in our sense of the word, in Arabia. Among the Bedouins there are, of course, no schools, and few, even of the most elementary character, in the towns or villages. Where they exist, little beyond the mechanical reading of the Koran, and the equally mechanical learning of it by rote, is taught. On the other hand, Arab male children, brought up from early years among the grown-up men of the house or tent, learn more from their own parents and at home than is common in other countries; reading and writing are in most instances thus acquired, or rather transmitted; besides such general principles of grammar and eloquence, often of poetry and history, as the elders themselves may be able to impart. To this family schooling too are due the good manners, politeness, and self-restraint that early distinguish Arab children. In the very few instances where a public school of a higher class exists, writing, grammar, and rhetoric sum up its teachings. Law and theology in the narrow sense that both these words have in the Islamitic system, are explained in afternoon lectures given in most mosques; and some verses of the Koran, with one of the accepted commentaries, that of El-Beidawee for example, form the basis of the instruction.

Dialects. Great attention is paid to accuracy of grammar and purity of diction throughout Arabia; yet something of a dialectic difference may be observed in the various districts. The purest Arabic, that which is as nearly as possible identical in the choice of words and in its inflections with the language of the Koran, is spoken in Nejd, and the best again of that in the province of Sedeyr. Next in purity comes the Arabic of Shomer. Throughout the Hejaz in general, the language, though extremely elegant, is not equally correct; in Hasa, Bahreyn, and Oman, it is decidedly influenced by the foreign element called Nabathæan, that removes it still further from its original character. In Yemen, as in other southern districts of the peninsula, Arabic merges by insensible degrees into the Himyaritic or African dialect of Hadramaut and Mahrah. The Arabic spoken by the nomade or Bedouin tribes, especially those of the north, is tolerably correct, but the pronunciation is often inexact.

Territorial divisions. The principal territorial divisions of Arabia have been already indicated, but a detailed list may here not be out of place. They are, accordingly, on the western side—

Hejaz. The Hejaz, subject in great measure to Ottoman authority, and extending from 28° to 21° N. lat. Its principal towns are YAMBO and JIDDAH on the sea-coast, MEDINAH and MECCA in the interior; all of which are separately described in the articles under these headings. The inhabitants are partly nomade, partly settled, in about equal proportions. The Hejaz includes the Beled-el-Haram, of sacred territory, immediately adjoining Mecca; and the Táif, a mountainous but fertile district to the S.E. of that town.

Jebel Aseer. Jebel Aseer, a mountainous tract along the coast immediately south of the Hejaz. Its inhabitants are of the Wahhabee sect, and are governed by their own sheykhs, with an emeer residing at Kolakh, the principal town or rather village of the region. The Turks have lately invaded it, but to no great purpose.

Aboo Areesh. Aboo Areesh, along the coast, from 17° 40′ to 15° 50′ N. lat. This district, now occupied by the Turks, detached itself from Yemen about a century ago. Its inhabitants live in villages: the soil is poor, but the fisheries abundant.

Tehamah. Tehamah. This name is given to the shore strip from 15° 50′ to Aden, 12° 47′ N. lat. Its principal towns are Loheya, Hodeydeh, and Mokha; the two former of these are seaports, of 4000 or 5000 souls each; the last is celebrated for its export of coffee, but its population does not exceed 8000 souls at most. There are numerous fishing villages along the coast, and some inland hamlets; the district is now partially occupied by the Turks.

Yemen. Yemen. Under this title are included thirty mountain districts, dependent on the "imam" or prince of Yemen, who resides at Sanaá, the capital, a town which is said, in the extent of its edifices and gardens, to have once rivalled Damascus, but which at present scarcely contains 20,000 inhabitants. It is surrounded by turreted walls, with seven gates: the mosques, public baths, and market place are all modern. Inland there are several small independent states, accurately enumerated by Niebuhr, the best, or rather the only authority for what regards this part of Arabia. In extent Yemen constitutes about one-tenth of the superficies of the peninsula. It is thickly peopled throughout, with countless villages; the nomades are few in number. It has been recently invaded by the Turks.

Jowf, a large oasis in the desert, adjoining Yemen on the east. It contains the ancient capital of south Arabia, Mareb, with the ruins of the famous dyke that bears its name, besides many villages. The inhabitants are warlike; the country is said to be fruitful, but little is known of it with certainty, nor has any European ever visited it.

Nejran. Nejran, an independent province on the north-east of Yemen. It is fertile and thickly peopled; the inhabitants are mostly villagers, and belong to a sect allied to that of the Beyadees in Oman. The principal town, situated on the highroad of Sanaá, bears the same name as the district.

Adjacent districts. Kaláat-Bisha, Shahran, Kahtan, Taslees, Belad-el-Kobeyel, and others—small districts, each governed by its own sheykh, except the last named, of which the inhabitants are chiefly nomade; the others are agricultural. They are situated to the east and north of Yemen, on the confines of Nejd.

Hadramaut. Hadramaut, an extensive region, occupying the south-east coast and inland. Niebuhr, our best authority for this part of Arabia, as for Yemen, describes it as being divided into several small principalities, of which Shibam on the south, and Ainad further north, are the chief. The only towns really known are Dafar and Kesheen, ports of the coast; they are both small and unimportant. The inhabitants are all governed by their own chiefs. Of their race and language mention has been made before; their mode of life is partly nomade, partly settled.

Mahrah. Mahrah, a continuation of Hadramaut northwards, up to Ras-el-Hadd. Its inhabitants, who appear to be the least civilised among all the Arab races, pay an irregular allegiance to the sultan of Oman. The country is said to be sandy, and thinly peopled; the Bedouin tribes of Al-Morrah and Aboo-Alse frequent its pasturages.

Northern. Returning inland, we find the north and centre of Arabia thus divided:—

Jowf. Jowf, an oasis south of the Syrian frontier. It contains seven principal and some smaller villages. The population is set down at 40,000 souls; they are governed by an emeer, who depends on the prince of Shomer.

Teyma. Teyma, a thinly-peopled district west of Jowf. Its inhabitants are mostly Bedouin, and each clan obeys its own sheykh. The total population is 12,000.

Kheybar. Kheybar, a collection of small villages and encampments on the north-west of the Hejaz; several of the tribes inhabiting it are of Jewish origin. The population is given at 25,000.

Jebel Shomer. Jebel Shomer, an important province, including the mountain ranges of Aja and Solma south of Jowf. Its capital, Hayel, stands on the highroad between Bosrah and Medinah; it possesses a public market-place, and may contain about 15,000 or 16,000 souls. The villages of the province are forty; the total population 162,000, who are given to agricultural and pastoral pursuits in about equal proportions. The emeer or prince is hereditary, and allied with, though not dependent on, the government of Nejd.

Upper Kaseem. Upper Kaseem, an oblong strip of land, lying between the mountains of Shomer and the valley of Lower Kaseem, which latter belongs to Nejd. The soil is sandy, but not unfertile. It contains about twenty villages, besides many hamlets. The population is stated at 35,000. This district is subject to the emeer of Shomer.

Bedouins. The principal Bedouin tribes of this part of Arabia are the Shomer, who indeed have given their name to the province; the Shcrarat; the Howeytat; the Benoo-Ateeyah; the Máaz; the Téy, a very ancient and famous tribe, of southern origin, whose emigration hither dates from many centuries before Mahomet; and the Wahhideyah. The total population is estimated at 166,000 souls; but this does not include the Bedouins of Teyma and Kheybar, who together, it is said, muster an equal number.

There remains Nejd, a name including the whole central inhabitable district of Arabia, and which is divided into nine provinces. They are as follows:—

Ared, the centre province, in which the present Wahhabee capital, Riad, is situated. The town is very ancient, and has a population of 30,000. It possesses a palace, where the sultan of Nejd resides, and many other considerable buildings. The fortifications are extensive, but of unbaked brick only, as are also the dwellings of the town; near Riad may still be seen the ruins of the ancient capital, Dereyéeah, demolished by Ibrahim Pasha in 1817. Besides Riad, Ared contains many villages so large as to merit the name of towns; the land is generally fertile, cultivation abounds, and the total population exceeds, it is said, 100,000.

Sedeyr, an extensive province, north of Ared, and situated in the highlands of the Toweyk mountain chain. Its principal town, Mejmaá, is fortified, Arab fashion; the ancient towns, Jelajib, Toweym, and others are situated here. The number of large villages is twenty-five; the entire population is 140,000. They are a brave and intelligent race, and furnish the choicest contingent to the Wahhabee armies.

Yemamah. Yemamah, a fertile district, south of Ared, celebrated in all ages of Arab history for the bravery of its men and the beauty of its women. It forms an important part of the Wahhabee empire. Its principal town is Manfoohah; but it includes many others, such as Khorj, the neighbourhood of which, from its fertility, is called the paradise of Nejd; the number of inhabitants is said to equal that of Sedeyr.

Hareek. Hareek, a mountainous oasis on the extreme southern verge of Nejd, at the commencement of the great desert, or Dahná. Principal town, Hootah. The inhabitants are all zealous Wahhabees; their number is stated at 14,000. The villages are 16 in number.

Aflaj. Aflaj, a small and hilly district south-west of Ared. The inhabitants are Wahhabees, and number 16,000; the villages, of which Kharfah is the chief, are twelve in all.

Wadi Dowasir. Wadi Dowasir, a long shallow valley, reaching down from Aflaj in the direction of Yemen; the soil is sandy and unproductive. It contains fifty small villages, besides hamlets, and the population is estimated at 100,000, all Wahhabees. They have a bad reputation for illiberality and meanness of disposition.

Soleyel. Soleyel, also a Wahhabee province. It forms the junction between Wadi Dowasir and Yemen; its principal town bears the same name as the district. Its villages are given at twenty-five, its inhabitants at 30,000.

Woshem. Woshem, a small, compact, but important district west of Ared, of which it is the key. Its principal town, Doramah, offered a determined resistance to Ibraham Pasha in 1817. Here, too, is Shakrah, a large commercial centre; Kowéy, near which was fought the decisive battle between the Egyptian and Wahhabee troops; and other villages, twenty in all. Inhabitants, 80,000, all Wahhabees. The country is well supplied with water, and the ground productive.

Kaseem. Kaseem, a wide fertile valley west of Woshem, and belonging to the Wahhabee government. It possesses three large towns—Onezzah, Bereydah, and Rass—besides about 60 villages and numerous hamlets. The inhabitants are a busy and thriving, but not a very warlike race; they are computed at 300,000. These districts constitute Nejd proper, and form the bulk of the present Wahhabee monarchy.

Hasa. Coming now to the east coast, we find Hasa, a large province occupying almost the whole region conterminous with the upper half of the Persian Gulf. Its principal town, Hofhoof, possesses a remarkable fortress, said to be of Karmathian construction, besides a large market-place and several handsome buildings. Close by is the more modern town of Mebarrez, almost equalling the capital itself in size. The province is in general well-watered and fertile; the number of villages about fifty, that of the population 160,000. This region belongs to the Wahhabee government, but has lately been occupied by the Turks.

Kateef. Kateef, a small, marshy, but fertile district on the shores of the Persian Gulf, directly opposite to Bahreyn. It belongs, like Hasa, to the Wahhabees; the principal town, also called Kateef, was once the residence of the dreaded Karmathian princes. The climate is unhealthy; the population is estimated at about 100,000 souls.

Bedouins. The most considerable nomade tribes in this district are the Ajman, Benoo-Hajr, Benoo-Khalid, Méteyr, Oteybah, Sebaá, Kahtan, Harb (a numerous and warlike clan), Anezeh, and Al-morrah. Their whole number does not probably exceed 80,000; the nomade population of central Arabia bearing no proportion to the settled, whereas a reverse condition exists on the northern frontier, and above all in the Syrian desert.

Continuing our review of the eastern districts, we next find—

Bahreyn. Bahreyn, a name given to the two large islands of Menameh and Moharrek, both celebrated for pearl fisheries off their shores. They are governed by a chief of their own, of the family name of Khaleefah; but pay an uncertain allegiance, sometimes to the government of Baghdad, sometimes to that of Oman. Numerous villages cover the islands, of which the soil is fertile; but the chief resources of the inhabitants are maritime and commercial. Population, 70,000.

Katar. Katar, the pearl-fishery coast east of Hasa. Its inhabitants, said to be 135,000 in number, find an almost exclusive occupation in the pearl trade; inland the region is barren and desert. This province depends on the chiefs of Bahreyn, but it also pays tribute to Oman.

Sharjah. Sharjah, a coast strip, with a seaport of the same name, east of Katar. It belongs to Oman, but has been often occupied by the Wahhabees. Sharjah is a great depot for slaves brought from the east African coast; the inhabitants are mostly concerned in the trade. The province counts thirty-five villages and 85,000 inhabitants. The present governor, Khalid-ebn-Sakar, whose authority also extends over the two next districts, is almost independent of the sultan of Mascat.

Roos-el-Jebal. Roos-el-Jebal, also known as the Jowasimah, or Private Coast. The chief village, Rás-el-Kheymáh, was destroyed by the English in 1810, and again in 1819; although since rebuilt, it has ceased to be a nest of robbers. This coast is very mountainous, and the inhabitants, mostly Wahhabees, are savage in the extreme. Their number is said not to exceed 10,000; they speak a dialect of their own, almost unintelligible to the Arabs of the neighbourhood.

Kalhat. Kalhat, the coast region east of Cape Mesandom. Its principal village is the small seaport of Leemah; the other hamlets are about forty in number. The population, a rough seafaring set, is stated at 60,000.

Batineh. Batineh. This district includes the whole plain between the mountains of Oman and the sea-coast as far as Ras-Heyran, east of Mascat. It is the richest, best-watered, and most thickly populated in all Arabia, and contains several considerable towns, of which Mascat is the chief; and where the sultan, or, as he is sometimes called, imam, of Oman resides. The other principal towns are Matrah, Barkah, Sohar, and Shenaz, all seaports of some activity along the coast; more than seventy other small towns and villages are reported to be scattered through the interior. The population, all Biadeeyah, and mortal-enemies of the Arabs of Nejd, is said to be 700,000.

Dahirah, the north-western province of Oman, having for its principal town that of Bereymah, besides several places of less importance. It is the only district where the nomade population bears any proportion to the settled: the total population is given at 80,000. The Wahhabees of Nejd have often occupied and still continue to harass this part of the country.

Jebel Akhdar. Jebel Akhdar. This province, including the great fertile and well-peopled chain of the "Green Mountains," is to the kingdom of Oman what the province of Ared is to that of Nejd, the backbone of the land. Here are the two towns of Nejwah and Bahhileh, formerly residences of the sultan; besides Zekee, Minah, and about seventy villages. The inhabitants are warlike, the women stately and beautiful; all belong to the sect of the Biadeeyah. The population is stated at about 600,000.

Belad Soor. Belad Soor, a coast district, said to be moderately fertile from Mascat to Ras-el-Hadd. The port of Soor is the only place of any note, but several small villages are said to exist near the coast. Population about 100,000; among them are the Benoo Aboo-Alee Arabs, famous for their brave resistance to our own troops in 1819-20.

Jaylan. Lastly, Jaylan, a wild region of which little is known, except that the inhabitants are uncivilised, and resemble in all respects those of Mahrah, with which province theirs is conterminous.

Population. The entire population of Arabia proper has been variously estimated; some authors make it reach 12,000,000, others reduce it to 7,000,000. Taking the approximate statistics above given, we find for the whole of central Arabia, including Jowf, Shomer, and Nejd, about 1,500,000 settled inhabitants, with 500,000 Bedouins or nomades; thus 2,000,000 may perhaps fairly represent the complete number. The east coast—Hasa, Bahreyn, Oman, and their adjoining districts—furnishes 2,500,000 more. Yemen is said to contain over 1,000,000: Hadramaut and Mahrah cannot be very populous: the Hejaz certainly is not. 3,000,000 is the maximum estimate of both taken together, nomades or villagers. To these must be added the tribes of the Sinaitic peninsula, and of the northern frontier. These may possibly bring the sum of the Arab population to 8,500,000, or even 9,000,000, with a quota of about one-fifth Bedouin to four-fifths of settled Arabs; to such small numerical proportions has the nation shrunk that once ruled by land and sea from the Indus to the Atlantic, and that even now, by its religion and institutions, gives the law to one-eighth of the human race.

History. The history of Arabia and its inhabitants naturally divides itself into two distinct and even dissimilar periods, that, namely, which preceded the era of Mahomet, and that which followed it. Each of these two periods, though comprising in its extent several minor phases and fluctuations, now of advance, now of retrogression, bears, however, a well-marked general character of its own. The first of the two periods is distinguished as one of local monarchies and federal governments; the latter commences with theocratic centralisation dissolving into general anarchy.

Prehistoric myths. The unrestrained imagination of Arab chroniclers has indeed added to their annals a third or pre-historic tract, peopled with heroes and giants, men of renown, sons of Anak, much resembling those who figure in early Jewish records, and, it may be not unfairly presumed, of analogous authenticity. To such belong the fabulous tribes of 'Ad in the south, of Thamood in the north, and of Tasm and Jadis in the centre of the peninsula. Very gorgeous are the descriptions given of "Irem," the "city of pillars," as the Koran styles it, supposed to have been erected by Shedad, the latest despot of 'Ad, in the regions of Hadramaut; and which yet, after the annihilation of its tenants, remains entire, so Arabs say, invisible to ordinary eyes, but occasionally, and at rare intervals, revealed to some heaven-favoured traveller. Vague reports of the colossal ruins of Egyptian Thebes and Karnak probably originated the fancy. To Thamood are ascribed the more substantial traces of rock excavations in the north-western Hejaz; while Tasm and Jadis are described as more scenite or Bedouin-like in their manners and mode of living. Mahometan tradition, a mere travestie of the Jewish, and mostly derived from rabbinical sources, has attempted to construct a pseudo-genealogy of a Noachian character for every one of these imaginary or vanished clans. Further yet, it has, in its eagerness to find a confirmation of its own central idea, everywhere ascribed their extinction to supernatural wrath, brought down on them, now by the rejection of some apocryphal prophet of the Divine Unity, now by atrocious misdeeds like those recorded of the inhabitants of Canaan or the Cities of the Plain. The sober historian, however, will, in the absence of any reliable evidence, documentary or monumental, abstain from pronouncing either on the character of these aboriginal tribes, or on the manner and causes of their disappearance.

Old Arab monarchies. The first dawning gleams of anything that deserves to be called history disclose Arabia wholly, or nearly so, under the rule of a race of southern origin; the genuine, or, as they are sometimes termed from a mythical ancestor Kahtan, the Kahtanee Arabs. These, again, we find subdivided into several aristocratic monarchical governments, arranged so as to form a broad framework or rim round the central wilds of the peninsula.

Kingdom of Yemen. Oldest and chiefest among the Arab monarchies was that of Yemen; its regal residence is said to have been in the now abandoned town of Mareb, in the extreme south. After a devastating inundation, referred with some probability to the first century of the Christian era, the seat of government was removed from the ruins of Mareb to Sanaá, a city which has continued the metropolis of Yemen to the present day. The Yemenite kings, descendants of Kahtan and Himyar "the dusky," a name denoting African origin, and each adorned with the reiterated surname of "Tobba," a word of African etymology, and signifying "powerful," are said to have reigned, with a few dynastic interruptions and palace revolutions, for about 2500 years; during which long period they commanded the direct obedience of the entire southern half of the peninsula; while, by their tribute-collectors, and by chiefs of kindred or delegated authority, they indirectly governed the northern. One of these monarchs is asserted, though historical criticism will hardly admit the assertion for fact, to have subdued the whole of central Asia, and even to have reached the boundaries of China; while another anticipated, so runs the story, the later and more authentic conquests of his race on the north African continent. In both these cases Arab chroniclers seem to have appropriated for their own rulers, not without some additional exaggerations, the glories and exploits of the Egyptian kings. But that theirs was a vigorous and in some respects a civilised government, is attested alike by the literary and architectural relics of their time. Their sovereignty was at last overthrown, 529 A.D., by an Abyssinian invasion, and was re-established 603 A.D. as a dependency of the Persian empire, till in the year 634 it was finally absorbed by Mahometan conquest.

Kingdom of Hira. Next in importance to the kingdom of Yemen came the subsidiary monarchy of Hira, or, more correctly, Heerah, situated in the north-easterly province of Arabian Irak. Its kings, a collateral branch of the royal race of Sanaá, governed the western shore of the lower Euphrates, from the neighbourhood of Babylon down to the confines of Nejd, and along the coast of the Persian Gulf. The duration of their empire, founded in the second century after Christ, was 424 years. This kingdom paid an uncertain allegiance to their more powerful neighbours, the Persian despots; and from time to time exercised considerable influence over the turbulent tribes of Central Arabia, till, like Yemen, it sank before the rising fortunes of Mahomet and his followers.

Kingdom of Ghassan. A third monarchy, that of Ghassan, lorded it on the north-west over lower Syria and the Hejaz: its independence was somewhat tempered by unequal alliances with the Roman, and subsequently the Byzantine empire. It was founded in the first century of the Christian era, shortly after the flood of Mareb; and its duration, till subdued by the all-conquering prophet, exceeded 600 years.

Kingdom of Kindeh. A fourth government, that of Kindeh, detached itself from Irak early in the fifth century, and united under its sceptre the tribes of northerly Nejd and even those of Oman, for about 160 years. Its kings were, like those before mentioned, of Yemenite origin; but their rule was weak and disturbed by frequent wars.

Flood of Arem. Much has been written by Arab authors regarding the great inundation, as they term it, of Arem or Mareb, possibly a tropical cyclone of more than ordinary destructiveness, like that of 1867 in the West Indies; and this event they love to assign as the proximate cause which dispersed the families of Yemen over northern Arabia, and led to the foundation of the kingdoms of Irak and Ghassan. But the reality of the events, physical or political, symbolised by the "flood of Arem," a counterpart, after its fashion, of the biblical flood, cannot now be well deciphered.

Prosperity of Yemen.

This is, however, certain, that the Yemenite Arabs, and especially those who tenanted the south of the peninsula, had during the period now cursorily sketched, attained a very fair degree of civilisation; that arts and commerce flourished, that wealth was accumulated, literature cultivated, and talent held in esteem. On all these points we have not only the uncertain and distorted testimony of foreign authors, such as Strabo, Pliny, Diodorus, Ptolemy, and the like, but the more positive though fragmentary evidence afforded by the national writings, chiefly verse, that have survived to our day. In its general character and institutions the kingdom of Yemen seems to have borne a considerable resemblance to the neighbouring one of the Nile valley, on the other side of the Red Sea, and, like it, to have reached at a very early epoch a relatively high degree of prosperity and social culture, from which, however, it had long declined before its final extinction in the 7th century. But the daughter-kingdom of Hira had, as was natural, something of a Persian tinge; while that of Ghassan took a more Byzantine colouring. Lastly, the nomadic element predominated in the ill-cemented monarchy of Kindeh.

The "Mustareb" or northern Arabs.

But while the sceptre of Yemen was yet, in one form or other, outstretched over the length and breadth of the land, and its children, the genuine or African Arabs, formed a complete and dense circle of population all around, the centre of Arabia remained the stronghold of a different though kindred race, composed of tribes almost wholly scenite, in their mode of living wild and ferocious; less susceptible of culture, but gifted with greater energy and concentration of purpose than their southern cousins. The latest recorded emigration of this branch of the Arab-stock had been not from the south but the north; and instead of the mythical Kahtan, they claimed a no less mythical Adnan, or his supposed grandson Nezar, for their ancestor; their language, though radically identical with that spoken by the genuine Arabs, was yet dialectically different in several respects, and nearer to the Syriac or Hebrew. Lastly, unlike the Arabs of the south, they had little disposition for agriculture, and even less for architecture and the fine arts; their instincts leading them to a pastoral and consequently a nomade life. The almost infinite ramifications of these "Mustareb" or "adscititious Arab" tribes lead ultimately up to five principal stocks. These were Rabeéah, which, however, laid some claim to a Yemenite kinsmanship in the east centre of the peninsula; Koreysh, on the west; Keys, or Keys-Eylan, and Hawazin, on the north; and Tameem in the middle.

Revolt of the northern Arabs.

History has left unrecorded the exact date of their arrival in Arabia; nor has she defined the period during which they remained tributaries, though often refractory, of the kings of Yemen. But in the 5th century of the Christian era there appeared among the Mustareb tribes a leader of extraordinary talent and energy named Koleyb, sprung from the tribe of Rabeéah, who having, in the fashion of William Tell, slain with his own hand the insolent and licentious tax-gatherer sent them from Sanaá, raised the banner of general revolt in Nejd; and, in the battle of Hazaz, 500 A.D., broke for ever the bonds of Yemen from off the neck of the northern or scenite Arabs. This done, Koleyb aspired to unite his countrymen into one vast confederacy, over which he himself exercised for a time an almost kingly power; but the scheme was prematurely broken off by his own assassination. Left now without a master, but also without a ruler, the "Mustareb" tribes found themselves involved in a series of wars that lasted during the whole of the 6th century, their heroic period. Yet in spite of severe losses sustained in battle by this or that particular clan, their power as a whole went on increasing, till at the dawn of the 7th century they had wholly absorbed the feeble kingdom of Kindeh, and encroached yearly more and more on the narrowing bounds of Yemen, Irak, and Ghassan. Nor, probably, would they have stayed till they had become absolute lords over the whole, or nearly the whole, of the peninsula, had there not developed itself from among themselves a still more energetic element which, before many years had passed, reduced both northern and southern Arabs alike to common obedience, then raised them to an unexpected height of common glory, and at last plunged them, along with itself, into one comprehensive decline and ruin.

Rise of Koreysh.

This new and potent element was the well-known clan of Fihr or Koreysh. Its families, of Mustareb descent, had at an early period, which subsequent and Mahometan chroniclers have tried to identify with the fortunes of the mythical Ismael, established themselves in the southerly Hejaz, near the town of Mecca, a locality even then the principal religious and commercial centre of Arabia. Already, at the beginning of the 5th century, the chiefs of Koreysh had, by a mixture of violence and craft very characteristic of their race, rendered themselves the masters and the acknowledged guardians of the sacred "Káabeh." This square stone temple, or rather shrine, itself of unknown antiquity, was situated within the precincts of the town of Mecca; and to it the Arabs were in the habit of bringing yearly offerings, and of making devout pilgrimages, for centuries before Mahomet had adopted it into the new ritual of Islam as the house of the true God. The keys of the consecrated building had originally been in possession of delegates appointed by the monarch of Yemen, but the Koreysh Arabs, having once obtained them, held them fast for ever after, and successfully repelled every effort, both of their own pagan competitors and of the invading Christian Abyssinians, 570 A.D., to recapture or to seize them. Their possession of the temple-keys not only gave the tribe of Koreysh a semi-religious pre-eminence over all the other clans of Arabia, but also placed at their disposal the treasures of gold, silver, jewels, and other offerings accumulated by the pagan piety of ages in the temple of Mecca.

Trade with Yemen.

A more important, as also a more creditable, source of wealth to the Koreysh clan was their Red Sea coast traffic, particularly with the ports of Yemen and Abyssinia. Jiddah has been always the chief westerly seaport, and Mecca, which is only a few leagues distant, the principal inland emporium of Arab trade; and under the dominating influence of the clever and active merchants of Koreysh, both places acquired special prosperity and importance.

Fair of Okad.

Lastly, only a day's journey distant from Mecca, was held, in the pre-Islamitic times, the great yearly fair and gathering of Okad, so called from the name of the plain where it used to assemble,—a national meeting, frequented by men of all conditions, from all quarters of the Arab peninsula, and lasting through the entire month of Dhoo-l-kaadeh, which in pagan, as subsequently in Mahometan reckoning, immediately preceded the ceremonies of the annual pilgrimage. Here horse-races, athletic games, poetical recitals, and every kind of public amusement, diversified the more serious commercial transactions of an open fair, that, in its comprehensiveness, almost assumed the proportions of a national exhibition; here, too, matters of the highest import, questions of peace and war, of treaty and alliance, of justice and revenge, were habitually treated by the chiefs of the northern Arabs; the "children of Mezar," to give them their favourite "Mustareb" patronymic, assembled in a sort of amphictyonic council, not less ancient, but, while it lasted, much more influential throughout Arabia than that of Thebes ever had been in classic Hellas. In this assembly the immediate local proximity of the Koreysh chiefs, joined to their personal wealth, courage, and address, assigned them a predominant position.

Origin of Koreysh.

Of their pedigree, which, as is well known, includes that of Mahomet himself, we have a carefully—too carefully, indeed, for authenticity—constructed chronicle, bringing the family tree up in due form to Ishmael the son of Abraham, of whom the Koreysh figure as the direct descendants. In the same artificial annals the Yemenite or genuine Arabs appear under the cousinly character of the children of Joktan, the son of Heber. On these points all Mahometan annalists are equally positive and distinct; all other Arab testimony equally adverse or silent. That a fable so utterly defiant of reasonable chronology, and even of the common sense of history itself, should have been adopted as matter of fact by Arab vanity and ignorance, is less surprising than that it should have found favour in the eyes of not a few, indeed of most, of our own European writers. Enough here to say that Mahometan chroniclers, by adopting as irrefragable historical authority the Jewish records, and then retouching them here and there in accordance with their own special predictions and tenets, have succeeded in concealing the truth of their own national identity and story from themselves and even from others, under an almost hopeless incrustation of childish fiction. A correcter version of Arab history and pedigree will, so far as possible, be given towards the end of the present article. To sum up, at the opening of the 7th century of our era, and coincidently with the first appearance of the prophetic autocrat and destined remodeller of Arabia, the overteeming life and energy of the great peninsula was, broadly taken, thus divided:—Foremost stood the tribe of Koreysh, with their allies, a powerful confederacy composed of tribes belonging to the Mustareb or northern stock, and occupying the upper half of the westerly coast and region. Next in importance came the countless independent and, thus far, uncentralised clans of the centre of the peninsula; they, too, mostly are of Mustareb origin, though a few claimed the more ancient and aristocratic kinsmanship of Yemen; but without, however, paying any allegiance to its rulers. Lastly, to the south, east, and north, still existed the noble but enfeebled relics of the old Yemenite kingdoms of Sanaá, Hira, and Ghassan, half-sunk into Persian or Byzantine vassalage, and exerting little authority, even within their own ancestral limits.

Contact with foreign nations.

But, however important to the country itself and in their ultimate results to the world at large, might be the events that took place within Arabia during the pre-Islamitic epoch, they had small bearing on the nations outside the peninsula. The Yemenite queen of Sheba's ambassage to Solomon, even if an historical event, led at least to no historical results; and with other coeval rulers and nationalities, Greek, Persian, and Macedonian, the Arabs rarely came into any other contact than that of distant and desultory traffic. Nor do the frontier skirmishes by which an Antigonus or a Ptolemy attempted, without success, to gain a footing in Arabia, deserve more than a passing notice; and Pompey himself, victorious elsewhere, was foiled on its frontiers.

At last, during the reign of Augustus, Ælius Gallus, the Roman

Expedition of Ælius Gallus.

prefect of Egypt, undertook a military expedition against Yemen itself, with the view of annexing that region, which report enriched with immense treasures, to the Roman empire. With an army composed of 10,000 Roman infantry, 500 Jews, and 1000 Nabatheans, he crossed the Red Sea in 210 galleys, and landed at Moilah, or Leuce Come, in 25° N. lat., near the modern Yambo. After some delay, the consequence of disease and disorganisation among his troops, he marched southward until he reached the inland district and city of Nejran, on the nearer frontier of Yemen. The town of Nejran he is said to have taken by assault, as well as a few neighbouring places, probably mere villages, of little note. Meanwhile a large force of Arabs had assembled to oppose him, but Gallus easily defeated them, and advanced to Mareb itself, then, we may suppose, the capital of Yemen. But the Roman soldiers, unaccustomed to the heat of the tropical climate, and much reduced in numbers, were incapable of laying siege to that town; and their general found himself thus forced to retreat, and recrossed the sea to Egypt without having effected any permanent settlement on the Arab side. Later attempts made by Roman governors or generals under Trajan and Severus were restricted to the neighbourhood of the Syrian frontier; and the ruined cities of Bosrah and Petra yet indicate the landmarks of the extreme southerly limits reached by imperial dominion over Arab territory.

Abyssinian invasion of Yemen.

More serious, and more lasting in its consequences, was the great Abyssinian invasion of Yemen in 529, when Aryat, son or lieutenant of the king of Abyssinia, landed in Aden with an army of 70,000 men, to avenge his co-religionists, the Christians, who had been cruelly persecuted by Dhow-Nowas, king of Yemen, himself a proselyte to, and an ardent propagator of, the Jewish code. The expedition was successful; Dhow-Nowas perished; Christianity was proclaimed; and for seventy-six years the Ethiopian conquerors retained subject to their rule the southern and richer half of the peninsula. Their king Abraha even advanced, in 569 A.D., the year of the birth of Mahomet, as far as Mecca; but beneath its walls suffered a repulse, which has been magnified by the Koran and Mahometan tradition into the proportions of a miracle. Persian assistance, furnished by the great Chosroes, ultimately enabled the Arabs under Seyf, son of Yezen, the last direct lineal descendant of the old kings of Sanaá, to liberate their territory from its dusky usurpers, 605 A.D.

Era of Mahomet.

The 7th century had now commenced, and before long the wonderful successes of Mahomet, or, in more correct orthography, Mohammed, 622–632 A.D., while they closed in one great centralising effort the era of Arab progress and development within the land, opened a marvellous phase of new activity and almost boundless extension without. The story of the great prophet and of his book, the obstacles he encountered and overcame, his labours, his reverses, his wars, his final and decisive success, belong to the separate article that bears his name. Here it may suffice to state that at his death, 632 A.D., the eleventh year of the Islamitic era of the Hejrah or flight, which he himself had founded, Mahomet left the entire Arab peninsula, with the sole and transient exception of the tribe of Tameem, and a few Yemenite clans, who for a short while preferred the revelations of his rival Moseylemah, the "false prophet" of Nejd, united under one sceptre, and in one creed.

Election of Abu-Bekr.

After the disputes which might naturally be expected from a general election and turbulent electors, and which, fomented by the ambitious and intriguing Ali, nephew and son-in-law of the prophet, ran so high between the "Ansar," or chiefs of Medinah, and the "Mohajireen," or those of Mecca, as to threaten the premature disruption and extinction of the Islamitic empire, Abu-Bekr, father of Ayeshah, the favourite wife of Mahomet, was chosen to be the great man's caliph,—"Khaleefah" is the Arab word—or successor. His reign lasted only two years; but it sufficed for the subjugation of the rebel tribes of Nejd and Yemen, the conquest of Damascus, and the commencement of the long career of victory that carried the arms, the language, and the institutions of Arabia over half the old world, from the banks of the Indus to the shores of the Atlantic, and from the burning sands of the mid-African desert to the green vineyards of pleasant France. These events we will now pass in cursory review.

Fall of Damascus.

Syria, distracted by long sedition and the bitter rivalry of ecclesiastical sects, fell a first and comparatively easy prey to the hardy invaders. Led by Khaled, the boldest and most talented among the early Mahometan generals, the Arab troops occupied Bosrah, overran the region of Hauran, and advanced against Damascus. The Byzantine army hurriedly sent by the Greek emperor Heraclius to the relief of the besieged town, was defeated with tremendous slaughter on the plains of Eznadin, where fifty thousand men are said to have fallen on the Christian side alone; and Khaled, following up his victory, instantly invested the capital of southern Syria. After a seventy days' siege, and in spite of the brave defence made by the Christian garrison under the leadership of Thomas the patrician, son-in-law of the emperor himself, Damascus was taken, half by storm, half by capitulation, on the 3d of August, 634 A.D., 13 A.H.; and amid all the vicissitudes of succeeding centuries has remained ever since, not only a Mahometan, but an Arab city.

Battle of Yamook.

Heraclius, who, unaware at first of the importance of the crisis, had hitherto remained almost inactive in Antioch, his north-Syrian residence and capital, now, roused to exertion, collected an army of 80,000 men, the greater number of whom, reinforced by 20,000 auxiliaries from among the Ghassanide Arabs, were led at first by the emperor himself, then by Manuel, a tried Byzantine general, to meet the ever-advancing Mahometans. These last, under the standard of Khaled, had already added Homs or Emesa, Baálbec or Heliopolis, and Hama, the Hamath of Scripture, to their list of conquests. They now fell back on a strong position behind the windings of the Yermook or Hieromax, a small stream issuing from the southern slopes of Mount Hermon, which now bears the name of Jebel-esh-Sheykh. The battle, in which Manuel took the offensive, Khaled the defensive part, raged for several days, and ended in the total defeat of the Greeks, 636 A.D., who are said to have lost upwards of 100,000 men, including Manuel himself, while at least 5000 of the victors remained on the field.

Conquest of Palestine Syria, and Mesopotamia.

Syria was now open to the Arabs; and Jerusalem, which, with the difficult and mountainous district of south-eastern Palestine, had hitherto been prudently neglected by Mahometan strategy, capitulated, 637 A.D., to the caliph Omar, who, apprehensive lest Khaled, if left to himself in Syria, should establish a semi-independent principality of his own, came thither in person to receive the keys of the holy city. Aleppo, and Antioch itself, soon followed; last the sea-coast, with Jaffa, Beyrout, Tripoli, and its many other towns and ports, was overrun; and within six years from the death of Mahomet the entire Syrian region, from Mount Taurus to the Red Sea, had become what, so far as language and usages are concerned, it has never since ceased to be, an Arab province. Within a short time after, Mesopotamia underwent the same fate; and the conquests of Tarsus and Diar-Bekr brought the Arabs in immediate contact with the uplands of Armenia and Koordistan, which for all succeeding times remained the ultimate limits of their permanent occupation.

Conquest of Persia.

With so much fighting on their hands to the west of the Euphrates, the Arab conquerors had for awhile refrained from attacking the great Persian empire to the east of that river, except by a few desultory and for the most part unsuccessful raids. Nor did the battle of Hira, in which the Arab armies under Jereer destroyed a large body of Persian troops, and evenged the previous losses of their countrymen, more than restore the apparent balance between the two empires. But Yezdegird, the last of the Persian monarchs, rashly provoked the extreme chances of a decisive war by sending his best general, Rustum, across the Euphrates with an army of 120,000 men, to offer battle to the Arabs, then commanded by Sáad, a native of Yemen, in the open plains of Kadeseeyah or Cufa, not far from the site of ancient Babylon. After four days' hard fighting, the Persians gave way, having lost the greater number of their men, besides the imperial standard, once the apron, so tradition said, of an Ispahan patriot blacksmith, and for many ages the palladium of Iran. The Arab general, profiting by the utter discomfiture of his opponents, crossed the Euphrates and the Tigris, took possession, almost without resistance, of the royal capital of Medain or Ctesiphon, where spoils of immense value were found, and pushed on to the more ancient metropolis of Susa, in Chusistan. But the completion of the work of conquest was reserved to his successor in the field, Nóoman Ebn-Mekran, who in the battle of Mahavend, 641 A.D., near Ecbatana or Hamadan, destroyed the last hopes of Persian independence. Yezdegird fled, to fall soon after by the hand of an obscure assassin; and his daughter, carried away captive, was taken in marriage by Hasan, the son of Ali—an ill-omened marriage, that, by its dower of Persian pretensions and sympathies, contributed not a little to the disunion and subsequent downfall of the Arab empire. The whole of Persia, from the Caspian and the Euphrates to the Indian Ocean, now received the religion and the rule, though not the language, of Arabia; Khorasan, Kerman, Mekran, Seistan, and Balkh, were next subdued, and for a while the Oxus became the eastern limit of Arab dominion. Thus before a century had elapsed the entire region west of the Indus obeyed the Arab and Mahometan caliph of Damascus.

Conquest of Egypt and Africa.

Westerly the first Arab conquest was Egypt. This important acquisition was made by Amroo, a man alike distinguished as a general and a statesman, during the reign of the caliph Omar. Farmah, or Pelusium, the easterly key of Egypt, was first reduced, and the conquerors, proceeding inland, assured their communications with Arabia and the Red Sea by the occupation of the Delta and Cairo. Thence, after much hard fighting, they reached and invested the city of Alexandria, and a fourteen months' siege was rewarded by the capitulation of that city, December 22, 640 A.D. No further resistance was offered; the Coptic population gladly exchanged the polished but heavy Greek yoke for the barbarous but lighter rule of the Arabs; and Egypt, like Syria, has remained socially, though not politically, a dependency of Arabia to the present day. The subjugation of northern Africa, including Tripoli, Carthage, Tangier, and the entire coast from the Nile to the Atlantic, occupied sixty years more; but in the battle of Utica, 698 A.D., the last remnants of the Byzantine empire were obliterated from the southern shores of the Mediterranean, and Africa was no less closely and permanently annexed to the Arab empire than Syria and Egypt had already been.

Conquest of Spain.

At last, at the opening of the 8th century, Musa, the talented and ambitious administrator of these vast provinces, received the well-known message of the traitor, Count Julian, that brought on the invasion of Spain. At the order of Musa, his lieutenant, Tarik, crossed the straits which yet bear his name, 711 A.D.; and soon after disembarking in Andalusia, met and defeated the armies of Spain in the decisive battle of Xeres, where Roderick, last of the Gothic kings, lost his crown and life. Tarik, 16,000 of whose soldiers are said to have remained on the field, requested and received fresh troops, with which he speedily reduced Malaga, Granada, Cordova, Seville, and finally the Spanish capital, Toledo, itself. Musa now followed in person, took the command somewhat abruptly from his lieutenant, received the submission of Saragossa and Barcelona, reached the Pyrenees, and reduced the whole of Spain, Galicia excepted, to an Arab dependency. His own recall and disgrace, the result of court intrigue and royal ingratitude, stayed awhile the further spread of the Arab torrent.

Invasion of France.

But in 731 A.D. the celebrated Mahometan general, Abd-er-Rahman, at the head of a numerous army, crossed the Pyrenees, and by the victories, or rather massacres, of Arles and Bordeaux, reduced the whole of France south of the Loire. But at Tours he met the main French army, commanded by Charles Martel, mayor of the palace, and founder of the Carlovingian dynasty. Here, in a bloody battle of seven days, the tide was turned. Abd-er-Rahman himself fell, and his troops were dispersed, and fled, never to return. Not long after, 759 A.D., Pepin, son of Charles, delivered France from the lingering vestiges of Mahometan rule. Spain, however, remained for more than five centuries an Arab settlement; and her language, literature, and usages bear even yet the imprint of those who ruled her so long. Sicily too, Candia, Rhodes, Cyprus, Malta, Sardinia, and even Corsica, with other islands of less note in the Mediterranean, became each in turn, though none for long, Arab possessions. In Asia Minor, on the contrary, on the shores of the Black Sea, and east of Samarkand, the Arab invaders, in spite of brave and reiterated attempts, two of which, 670 and 717 A.D., were directed against Constantinople itself, were never able to make good their footing. But at the close of the Benoo-Omeyyah dynasty, 755 A.D., their empire comprised the whole basin of the Mediterranean, with the exception of its northern side; in Africa its only limits were the great central desert, in Asia the plateau of Kobi and the Indus, and throughout almost all these regions the Arab element either remained absolutely predominant down to our own time, or has at least left distinct traces of its existence.

Extent of the Arab empire.

Internal organisation.

We must now give a brief glance at the internal condition and institutions of this vast empire, which were such as to afford from the very first no favourable omen of political stability. Mahomet, when dying, not only omitted to name a successor, but, worse still, designated no electors; and through all the centuries of Arab rule the conditions both of elective and of hereditary right were never accurately defined. Hence the early rivalries, already alluded to, between the "Ansar" and the "Mohajireen;" and hence, not long after, the yet more dangerous contention between the family of Omeyyah, from which Othman, the third Mahometan caliph, descended, and the kindred house of Hashim, the more immediate relatives of the prophet. Meanwhile, within the ranks of Hashim itself, Ali, nephew of Mahomet, and husband of Fatimah, his only daughter, denying every right of free election, advanced his own special title to the throne by the presumed claim of nearness of blood, a title persistently urged by his descendants, and for centuries a constant source of dissension and weakness in the empire. Nor, whilst the nomination of the caliph himself, the centre and keystone of the Arab political edifice, was thus left undefined, were the remaining details of the construction at all preciser in their character. No accurate line of demarcation separated the executive from the judicial, or these again from the financial department; no municipal organisations were established or even acknowledged; absolute despotism was the only form of government, whether primary or delegated, in the capital as in the provinces; actual resistance and revolt the only remedies against its abuse. Such an empire might conquer, but could not govern, at least for long.

Internal history. The first four caliphs.

These inherent evils manifested themselves by their unmistakeable bad effects from the very first. Once only, when Abu-Bekr died, 634 A.D., after only two years of reign, the elective accession of Omar, the austerest, but also the most capable of all the early Arab rulers, was sanctioned by an almost unanimous approval; though even then the restless intrigues of the ambitious and unprincipled Ali made themselves manifest. After a glorious reign of ten years, the conqueror of Syria, Persia, and Egypt, perished, 644 A.D., assassinated by a Persian slave, Firooz by name; and Othman, son of Affan, of the noble family of Abd-esh-Shems, was elected in his place. The twelve years of his administration were ceaselessly disturbed by the insubordination of Ali and his partisans, who at last, impatient of delay, broke into the residence of the ancient caliph at Medinah, and murdered him there, 656 A.D. Stained with blood, Ali usurped the throne; while Ayeshah, daughter of Abu-Bekr, and widow of the prophet, collected round her the avengers of the blood of Othman, and the first civil war of Islam was inaugurated by a hard-fought battle, known as the "Day of the Camel," near Bosrah, 656 A.D. Ayeshah was defeated; but the cause of Othman was soon after taken up by his talented kinsman, Muawwiyah, governor of Syria, who in the battle, or rather series of battles, fought near Sofeyn, on the upper Euphrates, 658-9 A.D., broke the strength of Ali's faction. Driven from Syria, Egypt, and Arabia, Ali retired to Cufa, where an assassin's dagger avenged on his own person the crime by which he had opened the way to ill-gotten and precarious power, 660 A.D.

Ommiade caliphs

Muawwiyah, left by his rival's death sole though not undisputed ameer-el-moomeneen, or "ruler of the faithful," fixed his seat of government at Damascus, where he and the fourteen succeeding princes of his line ruled for eighty-nine years. Victorious abroad, his dynasty, generally called by European authors the "Ommiade," from the name of Omeyyah, father of the race, was for its first forty years harassed by frequent insurrections within the limits of the empire. The initial disturbances from which all that succeeded directly or indirectly took rise, were due to the intrigues of the two sons of Ali, Hasan and Hoseyn, both of whom were deeply imbued with Persian superstition, and who thereby soon gave the schism that they headed a religious as well as a political character.

Revolt of Hoseyn the Ali family.

After the death of the lazy and contemptible Hasan, his younger and more active but equally faithless brother Hoseyn, raised the standard of revolt in the eastern provinces, where he hoped to gather round him his Persian auxiliaries; but before he could draw his followers to a head he was met at Kerbela, on the Euphrates, by the well-organised troops of the caliph Yezeed, son of Muawwiyah, and perished miserably, 680 A.D. His descendants and kinsmen, for there were many, continued, however, now one of them, now another, to revive the pretensions of their family; and for more than a century they disquieted the empire, especially on its eastern and southern frontiers, with sedition and rebellion. At last their evident defection from orthodox belief, joined to the extravagance and licentiousness both of their teaching and practice, so disgusted the Arab race that scarcely any adherents were left them, except among the Moorish tribes of northern Africa, where their influence, founded on the strangest impostures, predominated for a time, and in the still more congenial soil of Persia. There indeed the sect obtained a permanent footing and ultimate supremacy. Thus originated and thus was perpetuated the first and widest spread of Mahometan schisms; the adherents of the legitimate caliphate and the orthodox doctrine assuming the name of "Soonnees" or "Traditionalists," while the sectaries of Ali are known as "Sheéah" or "Separatists" to this day.

Revolt of Abd-Allah Ebn-Zobeyr.

More formidable, however, to the Damascus princes, though sooner extinguished, was the revolt of Abd-Allah, son of Zobeyr, a brave but narrow-minded leader, and nearly connected by blood with Mahomet himself. Supported by the townsmen of Mecca and Medinah, besides a great proportion of the northern or "Mustareb" tribes, he was for more than ten years acknowledged as caliph by half the Arab world, till slain by Hejjaj Ebn-Yousef, the greatest of the Syrian generals, during the storming of Mecca by the Damascene troops, 692 A.D. The intrepid but ferocious Mukhtar, at first a supporter of Abd-Allah but afterwards his rival, and head of the "Khowarij" or "seceders," maintained a separate revolt on his own account in Cufa, till slain in battle by Musáab, son of Zobeyr, brother of Abd-Allah. The "Khowarij," however—brave and well-meaning though visionary men, some of whom were nothing else than over-zealous Mahometan priests or reformers; others, sectaries of Ali and his family; others, again, free-thinkers of republican tendency—found a new and successful leader in the courageous Shebeeb, a native of Hasa, who for several years maintained their cause on the upper Euphrates, while the revolt of a large portion of the Ommiade army itself, in the extreme east of the empire, where the caliph's own general, Abd-er-Rahman, headed the insubordination, shook the empire to its foundations. But over these and other enemies triumphed the military and administrative skill of Hejjaj; and it was only under him, the scourge of rebels, and pillar of the Ommiade caliphs, 705 A.D., that anything like real internal tranquillity was even for a brief period given to the empire.

Decline of Ommiade dynast.

Half hereditary, half elective, the family of Omeyyah numbered fifteen successive princes on the throne, mostly men of talent, able administrators, and some of them distinguished authors and poets. But their personal merits were unavailing against the downward progress of disorganisation, the necessary result of an essentially defective system of government, and rapid territorial extension out of all proportion with the means of consolidation; and the latter years of their dynasty present a melancholy scene of turbulence and confusion. Then appeared a new enemy, more dangerous than any of the preceding, to the Damascus sceptre, in the person of Ibrahim, great-grandson of Abbas, the uncle of the Prophet, who after long and secret intrigues, now gave himself out as the acknowledged head of the family of Hashem, from old time the hereditary enemies of the no less noble family of Abd-esh-Shems and Omeyyah, and consequently the legitimate claimant of sovereign power. His cause was upheld by the terrible Abu-Muslim, a gloomy but talented fanatic, native of Khorassan, who raised on Ibrahim's behalf the standard of revolt in Kerman. Soon Persia and its adjoining provinces, despairing of finding to themselves a worthy leader among the frivolous descendants of Ali, joined the kindred ranks of the children of Abbas. Ibrahim, indeed, perished; but his younger brother, Abd Allah Abu-Abbas, more known in history as "Es Saffah," or "the Bloodshedder," took his place, and was proclaimed caliph everywhere to the west of the Euphrates. Syria, Arabia, and Egypt still held out for Merwan, the last of the Ommiade caliphs; but the great military talents, stained by remorseless cruelty, of Abu-Muslim, turned the scale. The decisive battle was fought on the banks of the river Zab, near Irbeel (the *Arbela* of classic history), 749 A.D., and the whole of Syria was soon after overrun by the black-turbaned armies of Persia. Merwan himself, after much unavailing display of personal courage, fled to Damascus, and thence to Egypt, where he was overtaken and killed by his pursuers, 750 A.D.

Fate of the Omeyyah family.

Urged on by the pitiless Abu-Muslim, who shortly after himself fell a victim to the suspicions of his own equally cruel but more treacherous master, the victorious Saffah sought out everywhere the members, however remote, of the Omeyyah family, and put them to death under circumstances of the most infamous barbarity. The very tombs of the dead were broken open, and the bones of the great Múawwiyah and his noble successors dispersed. One youth of the doomed house alone, Abd-er-Rahman by name, effected his escape to the still friendly provinces of Africa, and thence to Spain, where he founded the illustrious dynasty that reigned in Cordova over the Iberian peninsula for two centuries and a half.

Decline of Arabia.

But with the fall of the Benoo-Omeyyah dynasty and the caliphate of Damascus fell the prosperity of Arabia herself, never again to rise. Arabs of the noblest, wealthiest, and most gifted stock, descendants of the princely Abd-Shems, the head of Koreysh in pre-Islamitic times, the Ommiade princes had established the centre of their government in a city intimately connected by land and by sea, by commerce and by nationality, with Arabia proper and the Hejaz, and in steady adherence alike to the feelings and policy of their race, they always regarded their native country as the choicest jewel in their own imperial crown. They were Arabs first and caliphs afterwards. Hence it was from Arabia that they drew almost exclusively the officials of their world-wide administration, both for peace and war; the provincial governors, generals, collectors, judges, administrators of their nomination were all, or nearly all, of Arab blood; and the improvement or enrichment of Arabia herself, the facilitation and extension of Arab trade and commerce, and the encouragement of Arab talent, literary and artistic, were the foremost of their cares. Meanwhile the peninsula, obedient indeed to the caliph as to its supreme head, but retaining in great measure the local institutions of its hereditary government by chiefs and in tribes, enjoyed a degree of general tranquillity, and even of comparative unity, that it had never realised before, nor has ever since. Even the hereditary rivalry between the northern or "Mustareb" Arabs, who about this time assumed the title, which they still bear, of "Keysee,"—a title derived from the numerous and influential stock of "Keys-Eylan," and thence communicated to the rest—and the southern or "Yemenee" Arabs, a rivalry founded in diversity of race, fostered by long and bloody wars, and continued, though under certain modifications, to our own time, might, and often indeed did disquiet, but could not overthrow, the beneficial order of prevailing tranquillity.

Policy of the Abbaside dynasty.

With the accession, however, of the Abbaside caliphs, 750 A.D., the good days of Arabia came to an end. Though they also were, like their Ommiade predecessors, Arabs by origin, and indeed of the purest Arab blood, they owed their place on the throne, not to Arab partisans, but to the influence and the arms of the anti-Arab and eastern provinces, Persian, Tatar, and Turkoman, beyond the Tigris; whilst the Arab half of the empire had almost unanimously declared for their supplanted rivals. Hence the Abbaside policy rested on a non-Arab base; and its representatives, although descendants of Koreysh and Hashim, systematically neglected or even depressed the Arab element of their rule, while they strengthened and elevated the Irano-Turanian or central Asiatic. Their throne, at first transferred from Damascus to Hashimeeyah, the newly-founded residence of Abd-Allah Es Saffah, on the Euphrates, was soon after removed further east to the banks of the Tigris. Here, close to the ruins of the old Persian capital of Madain, the second Abbaside caliph, Almansur, laid, 760 A.D., the foundations of that great city which, under the Persian name of Baghdad, still remains a monument of his personal energy and of the policy of his race.

Decline of the Abbaside caliphs.

Within its walls, surrounded by Persian ministers or slaves, amongst whom the family of Barmek has attained a tragical celebrity, and by an armed body of Turkish or Turkoman guards, at first their servants, but before long their masters the descendants of Abbas held for a century the substance, and for four centuries more the shadow of a sceptre. Some of their names, and that of Haroon-el-Rasheed, 768 to 809 A.D., in particular, are connected with great events and famous memories, but the records of their reigns belong to Perso-Asiatic rather than to Arab history. Indeed, from the death of the eighth caliph of the race, El-Mostásim, 842 A.D., to the accession of the last of their dynasty, El-Mostásim, 1242 A.D., these princes were mere puppets in the hands of the Persian, Koord, Turkoman, or Turkish mercenaries, by whom they surrounded themselves as a protection against their own Arab subjects. Meanwhile province after province separated itself from their empire, and reasserted its own native character and independence, till in 1258 A.D. the pagan and Tatar chief Holagoo, grandson of Genghis-Khan, stormed Bagdad, and extinguished the decrepit dynasty of Abbas in the blood of the last caliph. Yet Arab genius, though deprived of political support, maintained by its philosophical and literary vigour through all those dreary centuries, nor has even in our own time wholly lost, a certain intellectual ascendancy in Baghdad and its vicinity.

Karmathian revolt.

Meanwhile the Arabian peninsula itself, neglected or despoiled by the Abbaside caliphs, had sunk year by year more deeply into clannish disorganisation, till the revolt of the Karmathians, about the end of the 10th and the beginning of the 11th century, detached Arabia definitely from the overgrown empire that she herself had founded. This revolt had been long preparing. Hatred of centralised rule, a strong attachment to local, tribal, and even in some places semi-municipal organisation, both joined to a deep underlying scepticism, had from the very first originated and fostered throughout Arabia a wide-spread, though covert opposition to the establishment of Islamitic despotism, and jealousy of the predominance conferred by Mahomet and his successors on their kinsmen of the northern and western tribes, and on Koreysh in particular, had united in secret antagonism to Islam and the caliphate the other tribes of the peninsula, but especially those of the centre, east, and south. Hence the Karmathian outbreak soon took the form of an Arab reaction against foreign and uncongenial influences and institutions, and being such, could hardly fail of substantial success. As to the special tenets professed by the Karmathians—so called from Karmath, their mystic founder, circ. 890 A.D.—they were, in their ultimate expression, pantheistic in theory and socialist in practice.

Disorganisation of Arabia.

From the sea-coast provinces of Bahreyn and Katar, its first avowed centre, the uprising, headed by its terrible leader Suleyman Abu-Jahir, spread rapidly over the rest of Arabia; and in the year 929 of our era Mecca itself was stormed, and the Káabeh ruined by his troops, while the sacred black stone itself was carried off to Hasa, where it remained twelve years. The feeble attempts of the Abbaside caliphs to check the movement proved utterly ineffectual; all was confusion, and for two centuries more a bloody partisan war, or rather an ever-recurring series of petty wars, devastated the peninsula. When this at last gave place to the quiet, not of peace but of exhaustion, Arabia, from Syria to Aden, was, with the sole exception of the narrow Hejaz coast-strip, detached in fact as in name from the pseudo-Arab empire of Baghdad, and had returned to its primitive independence. But by the same process the land had relapsed, hopelessly this time, into the semi-barbarism that invariably follows a prolonged vicissitude of petty tyrants, vicinal wars, interrupted communications, waste of life and property, and the fatal insecurity of universal lawlessness. Ease, wealth, trade, science, literature, all had perished from Arabia, till after a long anarchy, of which little memory is preserved, and that little of less interest, the country subdivided itself into the provincial sections that, with slight modifications, it has retained ever since.

Rearrangement of the provinces.

Oman, with the adjoining regions of Katar and Hasa, was organised into a semi-elective monarchy of a limited character, under the leadership of the Nebhan and subsequently of the Yáarebah clan; while its rulers, in opposition to the orthodox head of Islam at Baghdad or elsewhere, assumed the half spiritual title of Imam, and have since retained it. Yemen, the wealthiest and most populous territory of Arabia, split up into an infinity of petty provinces, governed each by a distinct prince, while some one or other would from time to time assert a transient sovereignty over the rest. The barbarous districts of Mahrah and Hadramaut on the south-east, with the mountain fastnesses of Nejd and Shomer, were abandoned to the anarchy of clannish alliances or feuds. The Hejaz alone, with the sacred territory or Haram of Mecca, under the headship of the "shereefs" or "nobles," the lineal descendants of Koreysh, retained some kind of constituted authority connected with the outer world, and paid a respectful but distant allegiance, sometimes to the government of Baghdad, more often to that of Egypt.

Fatimite dynasty in Egypt.

For, on the ruins of the Aghlabite dynasty, founded by Ibrahim Ebn-Aglab, the general of Haroon-el-Rasheed in North Africa, 797 A.D., with the inland city of the Keyrawan for capital, there had arisen, 909 A.D., a new kingdom, that of the Fatimites, so designated from one Obeyd-Allah, its originator, a real or pretended descendant of Ali and Fatimah. These Fatimites, able but tyrannical mystics, having united under their rule the whole of the north

African coast, invaded Egypt; and Moezz-Allah, their caliph, having, 972-3 A.D., driven the Abbaside governor from the shores of the Nile, established his own throne in the city of Cairo, which his victorious general Jowher had founded the year previous. From this capital he and his descendants ruled for two centuries more, not only over Egypt, lower and upper, but, though at the price of frequent wars, over Syria to the east and Tripoli to the west, till the last of the Fatimite caliphs, Adhid-Billah, was, 1171 A.D., dethroned by the Koordish conqueror Salah-ed-Deen, better known in history and romance as Saladin, the chivalrous opponent of our own Richard I. But though no Arab prince has ever since reigned in Egypt, the Hejaz with its sacred cities remained annexed to that country, and Yemen in part followed suit.

Turkish occupation. At last, 1517 A.D., the Turkish sultan, Selim I., conquered Egypt, and obtained from the last real or supposed surviving Abbaside kinsmen of the prophet a formal investiture of the Mahometan caliphate, which thus definitely changed the character of that office from national to politico-religious. On this occasion the shereef of Mecca presented the sultan with the keys of the city; and the Arab tribes in general, those of the east excepted, proffered their allegiance to the Ottoman government. This subjection, real in Hejaz and Yemen, nominal elsewhere, the country continued for half a century, till the shereef Muttahir, impatient of a foreign yoke, attacked and routed the Turkish force of occupation, then commanded by Murad Pasha, and for a short time re-established Arab independence. Selim II. sent fresh troops, who at first gained some advantages over the Arabs; but in 1630 the Yemenite chief Khasim expelled the Turks from the whole of his native province, and restored a shadow of the old Himyarite throne at Sanaa. Here, 1761 A.D., the celebrated Danish traveller, Niebuhr, found the

Kingdom of Yemen. Imam, as he was styled, of Yemen, governing thirty provinces, six on the coast and twenty-four inland, besides several smaller states; and possessed of an income, chiefly derived from the custom-dues of Loheya, Mokha, and other seaports, equalling, it was thought, £1,000,000 sterling per annum. The standing army was reckoned at 5000 men, mostly infantry. Subsequently, Wahhabee encroachments on the north, the British occupation of Aden to the south, and Egyptian invasion under Mehemet Ali and his successors, considerably weakened the power of the Imam of Sanaá, till in 1871 a Turkish army, sent from Syria, took the capital, and put an end to the Arab dynasty of Khasim. At the present date Yemen is a province of the Ottoman empire, though with every prospect of not long remaining so.

Hejaz. Between the Hejaz and the Ottoman government the yearly pilgrimage, with the accompanying largesses of the Ottoman sultans, formed a more enduring link; one interrupted, indeed, from time to time by occasional rebellions, but as often renewed by Arab neediness, till the province, with its sacred cities, was definitely annexed, though only for a time, by the great Egyptian usurper Mehemet Ali.

Other provinces. But in the rest of the peninsula, in Nejd, Oman, Mahreh, Hadramaut, and the other adjoining districts, the Ottoman claims were from the beginning of the 17th century absolutely ignored, and no collision was possible, because no point of contact existed. This state of things was, however, at last modified by the Wahhabee movement, one of the most important in the history of Arabia, and the end of which we have not yet seen. Of this a brief account must now be given.

Rise of Wahhabus or Abd-el-Wahhab. Born at the town of Horeymelah, in the centre of Nejd, 1691 A.D., Abd-el-Wahhab, or the "Servant of the Bountiful," had in early life travelled far in Mesopotamia and Syria, report even adds India, seeking knowledge in observation and the conversation of the learned, to whom his own superior intelligence gave him recommendation everywhere. Returning in mature life to the secluded quiet of his native land, he gave himself up to thought and study, mostly theological. Convinced by the comparison between what he read and what he had seen in his travels, and continued to see around him in Nejd itself, where hardly a vestige of Mahometanism remained, that the primitive faith of Islam had become considerably corrupted in theory and totally so in practice, and that Turks, Persians, and Arabs, were all of them in fact, though after different fashions, no longer true Muslims, but mere idolaters and polytheists, he determined himself to inaugurate a reform that should reassert the doctrine and practice of the Koran as they had been at the beginning.

Wahhabee reform. The invocation of saints, including Mahomet himself, a practice borrowed by Mahometanism from foreign example; the honours paid at the shrines and tombs of the dead; the use of intoxicating liquors; the wearing of silk and gold—to sum up, every belief or practice directly or indirectly condemned by the Koran, or even not sanctioned by it—with all these Abd-el-Wahhab declared open war. His special and notorious prohibition of tobacco, a prohibition rigorously observed by his followers, and which subsequently became in a manner their distinctive badge, must be attributed to an excess of sectarian puritanism; nor can it be doubted that hatred of foreigners, and of the Turks in particular, had a large share in the zeal manifested by himself and his disciples for what they not altogether wrongly, considered as in a peculiar sense the national or Arab religion it was a view that had the sanction of the Koran itself.

Like Mahomet, Abd-el-Wahhab commenced his preaching when about forty years of age, and, like the prophet, soon drew down on himself the persecution of those he failed to convert. Driven from Eyaneh, where he had established himself, by the hostility of its chiefs, themselves stirred up to persecution of the rigorous doctrines by the far-sighted Arav, governor of the neighbouring province of Hasa, he found refuge with the sheykh Mohammed Ebn Sáood, the warlike chief of Dereyeeyah, who put his sword and that of his clan at the disposal of the new apostle. The reform thus supported soon extended itself, partly by persuasion, partly by force; and when Abd-el-Wahhab died in 1787, at the advanced age of ninety-six, he had already seen his doctrines dominant from the coast of Bahreyn to the confines of Mokha and Aden.

Ebn Sáood Conquest of Nejd. Abd-el-Aziz. War with the Turks. His disciple and patron, Ebn Sáood, after many victories gained over the governor of Hasa and other enemies or rivals, died in 1765, leaving the whole of Nejd, now consolidated into one government under one head, to his son and successor Abd-el-Aziz, who, on his accession, now assumed the titles of Imam and Sultan. Under this chief the important provinces of Abu-Areesh, south of Mecca, and of Nejran, on the frontier of Yemen, were added to the Wahhabee dominions. These conquests, or rather annexations, naturally enough excited the alarm of Ghalib, the shereef or governor of Mecca, who by his representations succeeded in at last awakening the long negligent Turks to the danger which threatened their frontiers from the national and religious union of the Arab race. Orders were issued from Constantinople, and in 1797 an army of 5000 Turks, with an equal number of allied Arabs, advanced into Hasa, which had already become Wahhabee territory, and laid siege to Hofhoof, the capital of the province. But harassed by the Wahhabees and fearful of risking a general engagement, they retired without having effected anything except to provoke the bitter resentment of an enemy who had now learned not only to hate but to

Storming of Kerbela. despise them. The consequence was that the Wahhabees before long took the initiative; and in 1801 their collected armies invaded the territory of Baghdad, and laid siege to Kerbela, a locality famous for the tomb of Hoseyn the martyr, son of Ali, and a centre of popular Mahometan superstition. The town was stormed, the inhabitants massacred, and spoils of immense value were transferred from its shrines to the Wahhabee treasury. Victorious on the east, the Wahhabee arms were next directed westward; Taif, the well known pleasure-ground of Mecca, was invaded and subdued with

Taking of Mecca. great bloodshed in 1802; and in the April of the following year Mecca itself, though not till after a brave resistance, came into Wahhabee possession. Ghaleb fled to Jiddeh, the only place in Hejaz that held out against the invaders; and Sáood, son of Abd-el-Aziz formally assumed the government of Mecca, whence he dictated to the Porte the terms on which alone he declared that he would henceforth permit the observances of the yearly pilgrimage from all parts of the Mahometan world. Shortly afterwards he succeeded in person to the Wahhabee imamate, his father having been assassinated by a Persian in the mosque at Deréyeeyah.

Sáood's reign Under Sáood the Nejdee kingdom attained its greatest extension and prosperity. Internally its government was such as that of Arabia had been under the first caliphs and their Ommiade successors,—namely, a despotism regulated by the prescriptions of the Koran; and the revenues at Sáood's disposal fluctuated between £200,000 and £300,000 yearly. This sum he expended chiefly for military purposes. In 1804 he conquered Medinah, plundering the rich offerings accumulated by the superstition of ages round the prophet's tomb, besides treating the inhabitants of the town with great severity.

From this date till 1811, open war, in which the Wahhabees were generally successful, was waged between them and all their neighbours on every side, but especially against the Turks, whose Syrian possessions were ravaged sometimes by Sáood's best general Abu-Noktah, sometimes by his gigantic negro lieutenant Hark, up to Anah on the Euphrates, and within sight of the walls of Damascus. At this time, too, the inhabitants of Bahreyn and the adjoining coast having embraced Wahhabee doctrines, combined them with profitable piracy on the Persian Gulf, till the British expeditions sent from Bombay in 1810 and 1819 broke up the robber nest of Ras-el-Kheymah, and set bounds to the insolence of the piratical zealots.

For during these events the customary pilgrimage of Mecca and Medinah had been interrupted, the Wahhabees allowing none but such as conformed to their own doctrines and habits to approach the sacred cities. Thus the whole extra-Arabian Mahometan world was roused to indignation against the new and exclusive reform, and the Ottoman Porte, after some futile efforts of its own, consented to entrust the chastisement of the Arabs to its doubtful and already over-powerful Egyptian vassal, Mehemet Ali.

War with Egypt. In 1811 this cruel and treacherous but highly talented man began the work, and, in spite of many difficulties and even reverses, never faltered in it till it was fully accomplished. The details of the campaign that reduced Arabia, though only for a few years, to an Egyptian province, being well known, a very summary mention may here suffice.

Tousoon Beg's campaign.

Tousoon Beg, son of Mehemet Ali, commanded the first expedition. It was directed against the northern Hejaz, and landed in 1811 at Yembo, which town the Turks took and made a base of further operations. A severe check inflicted on them by the Arabs in January 1812 retarded their advance, but by the end of the year Tousoon stormed Medinah, and his troops made a frightful massacre of the Wahhabee garrison and inhabitants; to which atrocity the treacherous murder of 1500 more, who after holding out long and bravely in the town castle, had surrendered on terms of safe-conduct, was soon added. Meantime the intrigues of Mehemet Ali detached the shereef Ghaleb from the Wahhabee cause; and Jiddeh was treacherously surrendered to the Turks in 1813. Mecca and the Teif district were immediately occupied by Ottoman troops. Mehemet Ali now came over in person; and his troops having been reinforced by those of his son Tousoon, he felt himself strong enough to break his promises to the sheykh Ghaleb, whom he arrested, dispossessed of power, and sent to die in exile.

Mehemet Ali's campaign.

For a year and a half Mehemet Ali remained at Mecca, collecting his forces for a decisive blow. Meanwhile, in 1814 Sáood had died, leaving as successor his son Abd-Allah, a chief equal to his father in every respect except prudence, in which he was unfortunately deficient. Mehemet Ali having completed his preparations, left Mecca early in 1815 with a large army, and advanced towards Yemen; while the Wahhabees, who are said to have been 30,000 strong, occupied the mountain pass of Bisha on the way, and rashly hazarded a general engagement. The battle, in which Mehemet Ali displayed much personal courage, was desperate, and ended in the utter discomfiture of the Arabs, several thousands of whom were killed on the field. Mehemet Ali followed up his victory, and in a few months had reduced the entire mountainous district north of Yemen, besides taking alive as prisoners Bakrooj and Tami, two of the most renowned Wahhabee chiefs, both of whom, in violation of his promises, he made be put to death with atrocious tortures. But the exhaustion of his own soldiers obliged him to relinquish his further march south; he returned to Mecca, and in the summer to Egypt; Tousoon Pasha, left to conduct the war, concluded peace with the Wahhabees, and shortly after himself died of the plague. The treaty he had signed was disavowed both at Cairo and Constantinople; and in September 1816 the celebrated Ibrahim Pasha, adopted son of Mehemet Ali, landed at Yembo, and commenced the final campaign. For more than a year he exercised his troops in frequent but well-timed and generally successful skirmishes with those of Abd-Allah, who in person commanded the Wahhabee armies; while his crafty diplomacy, equal to that of Mehemet Ali himself, won over tribe after tribe to the Egyptian cause. Well supplied with provisions, and his flanks covered by his Arab allies, Ibrahim, in spite of a severe repulse beneath the walls of El-Rass, subdued the entire province of Kaseem, entered Nejd on the north-west by the pass of Shakrah, and in April 1818 appeared beneath the walls of the capital, Deréyeeyah, on which Abd-Allah with his forces had retreated.

...of the Wahhabee ...ion

The siege lasted five months, and was conducted with great ability by Ibrahim, whose military skill at last triumphed over the determined courage of the garrison and inhabitants. Not, however, till the town had been gradually reduced to a confusion of ruinous heaps did Abd-Allah consent to surrender, and then only on honourable terms, which, as usual, the conqueror granted freely, but with no intention of observing. The Wahhabee chief was sent under strong guard to Egypt, and thence to Constantinople, where, December 19th, 1818, he was beheaded in the public square in front of St Sophia.

Egyptian occupation of Arabia.

Deréyeeyah was razed to the ground by the conqueror, and remains at this day, like Eyaneh, a formless heap. The provinces of Hareek and Hasa submitted after slight resistance; and the whole of Arabia, Oman excepted, now lay at the mercy of Ibrahim, who showed none. After a bloody series of executions and massacres, he placed garrisons in all the strongholds that he permitted to remain standing; and Arabia had to submit to the military conscriptions and other exactions and oppressions that have ruined, and still ruin, every other province of the Ottoman empire, aggravated in this case by the licentiousness of the conquerors and the long outstanding mutual hatred of Turk and Arab.

Revival of Wahhabee power.

Ibrahim returning to Egypt, left Khaleel Pasha as vice-regent of Arabia, who for a while maintained despotic rule over the country. But Turkee, the younger son of Abd-Allah, who on the downfall of his family had fled to the mountainous fastnesses of Toweyk, soon organised guerilla bands, that, aided by the peasants, succeeded in rendering the central and eastern provinces of the land untenable by the Turks. The inhabitants of Hareek and Hasa were the first to throw off the yoke; and the town of Riad, celebrated as the birthplace, 1400 years before, of the prophet Museylemah, now became the restored Wahhabee capital. Turkee, like so many other Arab rulers fell the victim of an assassin, but his son Feysul succeeded to his ability as well as to his popularity and power. The Egyptian government, by this time at open war with the Ottoman, made several unavailing attempts to put down the revolt; but the wars between Mehemet Ali and the Porte in Syria and Anatolia diverted its serious attention from the less important, because poorer, acquisitions made by Ibrahim in Arabia, till in 1842 Khoorshid Pasha, the last representative of Egyptian rule, was, partly by force, partly by craft, for Feysul was a master in both, compelled to quit his frontier residence in Kaseem; and this populous province was re-annexed to the Wahhabee empire, while Aseer, throwing off foreign rule, returned to Wahhabeeism and independence.

Present condition of central Arabia.

Hasa, Hareek, the whole of Nejd, Kaseem, and the provinces adjoining Yemen on the north, with Aseer, were now re-united under the sceptre of Feysul, and a broad belt of Wahhabee rule thus again stretched across the centre of the peninsula, from the Red Sea to the Persian Gulf. But over Bahreyn, Oman, and Yemen, the Wahhabees, though they have frequently attempted it, have never been able to re-establish their former dominion; and in Shomer and Jowf to the north, between Nejd and Syria, a new kingdom of a different and much more liberal character, that of the brave and clever Telal, sprung up, and has since maintained its independence. Nor have the often-repeated Wahhabee inroads on Mecca and the Hejaz been attended with their former success. Still, within its actual though narrowed limits, the Wahhabee government has remained well-organised and strong,—a constant menace to its neighbours, and a genuine specimen, nor a wholly unfavourable one, of Arab autonomy. But in 1870, Feysul, already aged and blind, was assassinated, as his father had been before him, and the dissensions of his two sons, Abd-Allah and Sáood, the former of whom advanced the rights of first-born, the latter those of popularity to the throne, led to a civil war, and gave occasion to Ottoman interference. An armed force was sent, and advanced along the shore of the Persian Gulf into the province of Hasa, where it occupied the capital, Hofhoof. With this, however, its success terminated, and the difficulties of crossing the "Dahná" desert strip seem likely to place an effectual barrier to any further progress. Aseer, however, a stronghold of Wahhabeeism, has been invaded by the Turks, who have gained there some temporary and superficial advantages, while the new kingdom of Shomer, weakened by the untimely death of its accomplished prince Telal, has also offered facilities for Turkish interference, though not of a military description.

Oman.

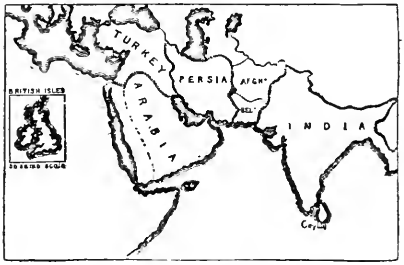
To these varied changes the kingdom of Oman has for many generations remained in great measure a stranger. But its capital, Mascat, was occupied by the Portuguese in 1508, who retained it till the middle of the 17th century. It was then retaken by the Yáarebah princes, who had all along maintained their power in the interior, and now for a century more became the sole though not the undisputed rulers of Oman, which was at this time often harassed by Persian invasion. In 1737 the country was formally attacked by the armies of Nadir Shah; the principal towns were at last taken, the inhabitants massacred, and for four years Oman groaned under the Persian tyranny. A deliverer, however, appeared in the person of Ahmed Ebn-Sáood, of Yemenite origin, but not of the reigning family. By a series of daring deeds he succeeded in expelling or destroying the enemies of his country, and was in return elected Imam in the year 1741, since which time his family have occupied the throne of Oman. Under the Imam Sultan Saood and his son the Seyyid Sáood, the Omanee kingdom attained its greatest splendour at the beginning of the present century. Its power then extended not only over Oman and a large tract of the Arabian mainland, but also over Bahreyn, Ormuz, Larej, Kishm, and the other islands of the Persian Gulf; besides the coast of Katar, with its celebrated pearl fisheries, on the Arab side, that of Barr-Faris, with the harbours of Linja and Bander Abbas, on the Persian, and a long strip of African sea-shore, south of Cape Guardefui, with the islands of Socotra and Zanzibar. Sultan Sáood was killed in 1804, but his son, of the same name, proved his not unworthy successor; and though unable to prevent considerable encroachments of the Nejdee Wahhabees on the north and west of his dominions, saved Oman itself from conquest and annexation. He consolidated the Arab power in Zanzibar and the east African coast, and when he died in 1856, after reigning fifty-two years, he left the kingdom of Oman the most flourishing state in the entire Arabian peninsula. Its proximity to India has often involved this government in relations, sometimes amicable, sometimes hostile, with ourselves; but a detail of them need not detain us here. Suffice it to say, that on the death of Sultan Sáood, Zanzibar was, partly by British influence, detached from the Arab empire; while the death of the late Imam, Thoweynee, son of Sáood, who perished, assassinated by his own son, in 1866, inaugurated a period of civil wars, from which Oman is still suffering. Her Wahhabee neighbours, too, continue their restless attempts at encroachment on her western frontier, while Katar and Bahreyn, with their pearl fisheries, have been wholly lost to the Mascat sceptre.

Lastly, the Hejaz is at the present date absolutely under the Turkish government, while Aden has, ever since its first capture in

Ottoman power in Arabia.

1839, remained a British possession. Thus Nejd itself, with the inland districts immediately adjoining, and the desolate coast districts of Mahrah and Hadramaut, are now the only parts of the peninsula where Arab independence can be said fully to maintain itself; though with this difference, that in the last-named provinces it is merely the independence of barbarism and poverty, while in the former it is that of organisation and not contemptible resources. Nor can it be well doubted that the recent encroachments of the Ottoman government, or rather misgovernment, will prove equally ephemeral with those of Sultan Selim or Mehemet Ali, and that Arabia will in a short time, probably within a few years, regain its previous autonomy Arab institutions are far from perfect, yet they are better than Ottoman oppression, and the Wahhabee empire might easily, under a judicious head, relax from its intolerance and become a centre, not of strength only, but of order, prosperity, and even civilisation, for the whole Arab nation, restoring, not, indeed, for external conquests, the days of which have long gone by, but for internal wellbeing, the better times of the Ommiade dynasty.

Future prospects.



Sketch, showing relative size of Arabia.

Antiquities.

Arabia proper is singularly destitute of antiquities, in the ordinary sense of the word, the northern or "Adscititious" Arabs having been, so long as they remained within their own territory, a remarkably unconstructive race, and the "pure" or southern Arabs not much better in this respect. Niebuhr, in his justly celebrated Travels through Yemen, mentions the ruins of Ghamdan, the ancient palace of the Himyarite kings, near Sanaá, as well as the remains of several other fortresses in adjoining villages; but these ruins, like those subsequently visited by Palgrave in Jowf, bore no distinctive traces of architecture or date, beyond a barbaric coarseness of material and great thickness of wall. More remarkable, because better defined in history, are the remains of the great dyke of Mareb already mentioned; its vestiges, said to be colossal in their dimensions, extend across a ravine of about 2 furlongs in breadth; they are in part of hewn stone, and testify, if not to the skill, at least to the diligence of the Himyarite Arabs. A few Himyaritic inscriptions have been discovered, some in Yemen, more in the provinces of Hadramaut and Mahrah, but have been too carelessly copied to afford proper materials for philological investigation. When decipherable, they indicate a dialect resembling the Abyssinian or Amharic; but throw no real light on the history of the country or the condition of its inhabitants.

Destruction of antiquities by the early Mahometans.

It is true that in addition to the non-constructive character of the early Arab race, account must be taken of the destructive policy, aggravated by iconoclastic zeal, pursued by the conquering Mahometan tribes of the north, who within their own territory, even more than in the acquired lands of Egypt, North Africa, and elsewhere, carried out the plan of establishing their own religion and system, not merely on the ruins, but, so far as possible, on the effacement of whatever had preceded it. Hence, of the old idol temples which once covered Arabia, nothing now remains except the megalithic vestiges of an enormous stone circle, resembling those found in some parts of Europe, and consisting of large boulders, each about 14 feet high, placed on end, and originally crowned by a similar horizontal series. This was visited by Palgrave when travelling in the province of Kaseem, near Bereydah; two others are reported to exist in the same district. Nor, the Meccan relics apart, had any of the numerous idols once worshipped throughout the peninsula been discovered till the Swiss Munzinger, three years since, found among the heaps of a deserted village near Aden a small bronze statue representing a naked hermaphrodite figure, over the head of which rises an ornament resembling the Egyptian *pshent*.

The black stone and Káabeh.

The black stone of the Meccan Káabeh, said to be of volcanic formation, and perhaps an aerolite, had, however, been an object of popular adoration long before Mahomet preserved it from destruction by giving it a place in a new and more enduring superstition; and the Káabeh itself, though ruined and rebuilt again and again, the last time in 1627, till not a vestige probably of the original structure now remains, has yet, it appears, certainly preserved the outline, and, in all essential respects, the dimensions of the original pagan shrine. It is an oblong massive structure, almost a trapezium, though the sides and angles are slightly unequal; its length 18 paces, its breadth 14, and its height from 35 to 40 feet. There are no windows, and the only entrance door is placed 7 feet above the ground; the entire building is of large, irregular, and unpolished blocks of ordinary stone. Its ornamentation is wholly modern.

Wells.

Lastly, several wells, jotted with seeming capriciousness over the desert, are said to be, and probably are, of great antiquity; certainly they are works which much exceed the skill of the Arabs of our own day. One such, "Beer Shekeef" by name, in the north-west of the peninsula, presents a cylinder of about 5 feet in diameter at top, but gradually enlarging till it reaches the water at a depth of nearly 200 feet, and is lined with hewn stone throughout. The Arabs declare it to be a work of pre-Islamitic times. Less remarkable in its proportions, but not less ancient, is the holy well called of Zemzem, at Mecca. But this and the great mosque of that city, as also the famous mosque of Medinah, which encloses the tomb of the prophet, and other buildings of the same category, will find their proper place in other articles. So will also the celebrated excavations of Petra, which, besides their being beyond the limits of Arabia proper, are not in themselves Arab but Græco-Roman in their character. With regard to the numerous mosques and other buildings, some of great beauty, erected by Arab architects in conquered countries, as in Syria, Egypt, Africa, or Spain, they are in fact nothing more than adaptations of the various local styles, and often of the very materials that the conquerors found ready to their hand.

Literature Pre-Islamitic poetry

But if poor in architectural, Arabia is superabundantly rich in literary monuments. Passing over as of more than doubtful authenticity the verses ascribed to kings and heroes of Yemen, especially at dates of a thousand years or more before the Christian era, we find undeniable specimens, at least two full centuries before Mahomet, of poems which in vigour and polish yield to few ever composed in the Arab or in any other language. To give at length the names and stories of the authors, many of them men, and even women, no less distinguished in their day by the sword than by the pen, would be, in a brief review like this, merely to note a dry and unmeaning catalogue. Suffice it that, even at this early date, we find the metrical and rhythmical laws, simple yet susceptible of the highest art, which have ever since regulated Arab poetry, already laid down in their completeness, and exemplified, the former by a scansion of almost Horatian elegance and variety, the latter by a severe nicety that Pope himself might have admired, but could hardly have imitated. Divided into sixteen classes, each class including several variations, the metres are based, like the Greek and Roman, on long and short vowels, irrespective of accent, but admitting cæsura, elision, and every prosodiacal delicacy. Some are adapted to gay, some to serious topics: love, war, description, moral precepts, philosophical speculation, elegy, satire—all find here their appropriate expression. The rhyme, which often involves not one but two syllables, is in every piece determined by that of the opening line. Alternate rhymes, choruses, and accentuated instead of quantitative metre, did not appear till later, and were imitated from extra-Arab models.

Public recitations.

Yearly, at the festival of Okad, the best masters of the art used to meet for the purpose of reciting their compositions, and receiving the reward, not of applause only, but also of more tangible advantages. Eulogies of chiefs, rulers, and distinguished men, formed a considerable portion of the poetry of those days; and a single ode or "kaseedah," as it was called, has been known to be rewarded, according to the means or liberality of the person eulogised, with a hundred valuable camels, or several thousand gold pieces. Love and war had also their inevitable share in the domain of verse, and descriptions of manner and scenery occur, though rarely in comparison. Lastly, elegies—some of them very touching in their deep and tender melancholy—and didactic pieces, chiefly ethical, take rank among the most carefully finished productions of the early Arab muse. Meanwhile, the greater number of poets had each his special patron, whose generosity took charge of the remuneration that in our days is looked for from the press; while a greater degree of publicity was given to a few chosen works of genius by the custom of suspending in some place of common resort (the Káabeh, it is asserted) such pieces as in the yearly gatherings of Okad had obtained the highest palm of acknowledged excellence. Seven of these, known in Arab literature by the title of the *Múallakat* or "Suspended," as being emphatically the best of their kind, and all of them belonging to the 6th century, have become for succeeding ages the accepted and classical standards of Arab poetical composition.

Prose literature.

Written prose up to the date of Mahomet's appearance there was absolutely none; and spoken eloquence, though always highly esteemed and diligently cultivated among the Arabs, had never been embodied in the permanence of writing. The irregular, half-rhythmical, half-rhyming sentences of the Koran were the first attempt in the direction of prose, which afterwards came into general use, and was applied to history, biography, philosophical treatises, romance, and every other description of subject. But prose never emancipated itself wholly from its original trammels of a misapplied cadence, to which was also too often added a redundant phraseology, the latter partly due to Persian literary influence; this florid style being, however, with many authors varied by breaks, as it were, of writing as excessive in its plainness as the other in its ornamentation.

Poetry.

But if unsuccessful in prose, the Arabs were not so in poetry. This, even before the era of the prophet, had, as we have seen, attained no ordinary degree of excellence; and it reached its highest point during the following century, under the Ommiade dynasty, when Omar Ebn Rabeeyah, of the tribe of Koreysh; Jameel, of the Benoo Adhrah; Jareer and Farazdak, both of Tameem; and Noseyyeb, a negro by birth—the first and second masters of erotic, the third and fourth of satirical, and the fifth of descriptive poetry—with a cloud of lesser celebrities, lived and sang in the sunshine of the Damascene court. The 8th and 9th centuries, agitated by civil dissensions or oppressed by the tyranny of the Abbasides, were less favourable to the Muses, till the reaction of the Greek and Persian minds, with which the Arab spirit was now yearly brought into more intimate contact, gave rise to a new and brilliant school, less true to the simplicity of nature or the purity of Arab diction, but richer in imagery and deeper in philosophic thought, illustrating, too, the transition from the objective to the subjective which has accompanied and half veiled decline in the literature of every nation, turn after turn. Abu-Teman, of the tribe of Tai, known not as a poet only, but also as a critic and the compiler of the celebrated anthology, the *Hamasa*, the "Golden Treasury" of the Arabs, first came forward in this field. His successor, the well-known Mutenebhe, is still esteemed by many the greatest of Arab poets; in range of thought and polish of diction he certainly excels all besides. Later still, in the 11th century, appeared Toghrai, who in his *Lameyyah*, the title of his principal piece, entered the lists against Shanfarah, the most brilliant of pre-Islamitic poets, and, it seems, furnished our own Tennyson with the model of his "Locksley Hall;" while a little later, Ebn Faridh, in Egypt, composed the mystico-erotic volume that has never in its kind been surpassed, or even equalled, by the poets of any land.

Decline of literature.

With the decline of the Arab race, however, their muse drooped also, and for many centuries maintained but a languishing existence, which in our own time has been galvanised rather than invigorated into a kind of revival by the modern literary schools of Beyrout, Damascus, Baghdad, and the Hejaz. In Nejd, Yemen, and Oman, rough poems on the primitive Arab model, besides others modulated with alternate rhymes, and in which accent takes the place of prosody, a species commonly called "Nabtee" or Nabathean verse, are yet in vogue. The Hispano-Arab poets, mostly mere imitators, and in bad taste too, need not detain us here. Epic and dramatic poetry were never even attempted by the Arabs.

Romance.

Romance, analogous though not similar to the European novel, was always a favourite branch of Arab literature; and in the *Thousand and One Nights* it obtained a world-wide celebrity and success. The original of this entertaining work appears to have been composed in Baghdad about the 11th century; another less popular but very spirited version is probably of Tunisian authorship, and somewhat later in date. The stories of Antarah, of the Benoo Hilal, of Mohalhel, of Barakat, and countless others, belong to the same class of writings, though cast in more of a biographical form, not unlike that adopted by the great Defoe. Strictly objective in character, the Arab novel, though often a vivid portraiture of the outside of men and customs, has never portrayed, or attempted to portray, the inner workings of the human mind.

Biography

With memoirs, biographies, collections of anecdotes, and the like, Arab literature is stored in excess, the bulk of such works being, as might be supposed, of somewhat superficial interest; while not a few of them are, on the contrary, possessed of great merit and value. Thus the *Book of Songs*, or "Kitab el Aghanee," composed in the latter part of the 10th century by Abu-Faraj, of Ispahan, and containing, in twenty successive volumes, short but entertaining notices of all the principal Arab poets or singers, with specimens of their compositions, is, in addition to its speciality, a perfect treasure of the most varied information regarding the men and the times; and the *Life of Mahomet*, by Abul-Feda, of Aleppo, displays considerable critical acumen as well as narrative power. Nor should we forget the judiciously-selected biographies of Mahometan celebrities by Ebn Khallikan, in the 12th century, or those of Koteybah of an earlier date; but of such compositions as these the Arab name is legion.

History.

History, however, proved from first to last an effort beyond Arab skill, which contented itself with the less intellectual task of multiplying chronicles to an almost unparalleled amount. In this the voluminous work of Ebn

Atheer, which, after commencing the Arab annals, along with those of the world from the creation itself, carries them down to the overthrow of the Abbaside caliphate in the 13th century; that of Musa'oodee, containing a pre-Islamitic summary of the geography and history of the world in general, till the birth of Mahomet, after which the chronicle confines itself exclusively to the fortunes of the Arab empire; and that of Abul-Feda, especially interesting by its curious notices of pagan Arabia, may be mentioned as favourable specimens in their line. In particular, Egypt was amply chronicled by Makreezee and Siyootee; Spain by Makkaree; Africa by Ebn Kateeb; Syria and Baghdad by writers out of number. A more voluminous, and, it must be added, a more childish collection of writings could scarcely be found in any language.

Theological writings. We may imagine (for it would be a waste of time to catalogue) the theological writings, glossaries, commentaries, discourses, and so forth, which, from the first century of Mahometanism to the extinction of Arab empire, have illustrated or obscured the great book on which that empire was founded—the Koran. Beydawee in the 10th, Jelal-ed-deen and Bokharee in the 11th, and El Ghazalee in the 12th century of our era, each was in his day considered a master in Islam, and their treatises are still reverentially studied in its schools. Legal dissertations by Malek, Ebn Hanbal, Shafeyee, Hanefee, and their disciples, load the shelves of every Arab bookcase; but the authors themselves were mostly of extra-Arab origin, and often reflect the Persian, the Turkoman, and even the Byzantine, rather than the genuine Arab mind.

Astronomy. From the fancies of astrology, in which the early Arabs—not wiser than their neighbours, but favoured with clearer skies—seem to have indulged freely, and which, though discountenanced by the practical good sense of Mahomet himself, have never been wholly abandoned by their descendants, a not unnatural transition led to the more useful study of astronomy. Specially patronised by the Abbaside caliph Al-Mamun, the Augustus of his race (813–833 A.D.), this science made great and rapid progress. The obliquity of the ecliptic, the diameter of the earth, and even the precession of the equinoxes, were then calculated with commendable accuracy; and shortly after, Abul-Mezar's *Introduction to Astronomy* and his *Treatise on the Conjunction of the Planets*, with the *Elements* of Al-Furjanee (though this last author was largely indebted to the Egyptian labours of Ptolemy), proved that the caliph's liberality had been well bestowed. But Al-Batinee, a native of Syria (879–920 A.D.), surpassed all his predecessors in the nicety alike of his observations and computations. Geber, at Seville, constructed (1196 A.D.) the first astronomical observatory on record; and Ebn-Korrah in Egypt proved by his example that the Arabs could be even better astronomers than the Greeks had been before them. Yet although the doctrine of attraction seems to have been dimly surmised by some of them, none ever succeeded in emancipating themselves from the clumsy and erroneous Ptolemaic geocentric system.

Mathematics. In mathematics the Arabs based themselves on what they had acquired from the Greek and Indian originals; the former gave them geometry, the latter algebra. Satisfied at first with translations of Euclid, Apollonius, and others, they ultimately left their masters behind. They reached in the 10th century the limits of spherical trigonometry, and solved quadratic and even cubic equations. In these studies the astronomers Geber and Ebn-Moosa chiefly distinguished themselves. Optics, too, and hydrostatics were investigated by the professors of Baghdad; but no special progress or remarkable discoveries are recorded as having been made in these sciences. In mixed as well as in pure mathematics the leading-strings of the Greek became the fetters of the Arab mind. Their practical application, however, of hydraulics in the construction of wells, water-works, reservoirs, sluices, canals, and the like, does them great credit; and of this peculiar skill ample traces, ill maintained by succeeding governments, remain in Spain, North Africa, Egypt, Syria, and Mesopotamia.

Fine arts. Debarred by religious scruples from the representation of animated forms in sculpture or painting, Arab decorators (for they are no more) found themselves restricted to vegetable or fantastic patterns and colour combinations, and in these, as the Spanish Alhambra and other buildings can testify, showed themselves no mean proficients. They made great use of glazed tiles and stucco, and possessed the art—one that they have lost long ago—of staining glass. Lastly, music, as the handmaid and enhancer of poetry, was a favourite and honoured pursuit among the Arabs, who, with comparatively rough instruments,—the rudiments of the flute, harp, tabor, and guitar, rather than the instruments themselves,—and with a scale, carefully and scientifically elaborated, but essentially differing from our own, produced results that real excellence alone could have merited or obtained. The voluminous "Book of Songs" already alluded to contained the history and points out the distinctive characteristics of a hundred airs, each esteemed a masterpiece by competent judges. For one alone its composer received from the Caliph Al-Nathik-Billah (842 A.D.) a sum equivalent to nearly £2300 sterling. It is noticeable that though the best voices were furnished by the Hejaz, the instrumental and scientific part was perfected by Persian instruction under the Abbaside caliphs of Baghdad.

Music.

Medicine and surgery. More widely recognised, however, are the Arab claims to proficiency in medicine, an art which Mahomet himself appears to have dabbled in, showing himself, if tradition speaks true, by no means so good a physician as he was a preacher. Under the caliphs, however, regular schools of the therapeutic science were established in Damascus, Baghdad, and Cairo, where the works of Hippocrates and Galen, translated from their originals in Greek, were adopted as the basis of instruction. Hence the great medical treatise entitled *El-Melekei*, or "The Royal," of Ali-Ebn-Abbas, which appeared in Aleppo towards the end of the tenth century, was essentially an enlargement of and appendix to the Galenic teaching. Shortly after Er-Razi, the Baghdad professor, published his writings on pathology, containing the first authentic description of exanthematous diseases. The *Canon* of Ebn Sina, commonly known as Avicenna, born 980 A.D., with his *Materia Medica*, which preluded in some respects that of Paracelsus, ultimately, however, superseded every other work in the Arab schools. But the neglect of anatomical study, with a superstitious horror of the practice of dissection, rendered the surgery of the Arabs imperfect and their medicine empirical. The invention of the probang and some improvements in the lancet and the couching needle are due, nevertheless, to Arab surgeons.

Botany and chemistry. Botany was chiefly studied as subsidiary to medicine; nor did chemistry ever attain the dignity of a separate science; as, however, an adjunct to the old herbal pharmacopœia, it received close and not unsuccessful attention. The principal mercurial and arsenical preparations of the *materia medica*, the sulphates of several metals, the properties of acids and alkalies, the distillation of alcohol,—in fine, whatever resources chemistry availed itself of up to a very recent date—were, with their practical application, known to Er-Razi and Geber, already mentioned. In fact, the numerous terms borrowed from the Arabic language—alcohol, for instance, alkali, alembic, and others—with the signs of drugs and the like, still in use among modern apothecaries, have remained to show how deeply this science is indebted to Arab research.

Grammar and rhetoric. Finally, and as though to counteract any foreign influence that the cultivation of these exotic sciences might correlatively introduce, Arab grammar and rhetoric were, from the days of the first Ommiade to those of the last Abbaside caliph, considered an indispensable item of respectable education. Every nicety of the language was investigated in the 8th, 9th, and 10th centuries by the rival schools of Cufa and Bosrah; and the *Alfeeyah*, a grammatical treatise of the celebrated Ebn-Malek, a native of the latter city, who flourished in the 9th century, is even now the standard work in the hand of every professor. But for absolute mastership, joined with exquisite taste, in the use of the subtlest refinements both of rhetoric and grammar, the palm must be assigned to Hareeree, the author of the celebrated *Makamat* or *Sessions*, a work esteemed by many as hardly less wonderful in the talent it displays than the Koran itself. It belongs to the 11th century, and though it has had many imitators, has never yet acknowledged a rival.

Mechanical inventions. Industrious and enterprising, the Arabs led the way by their invention and skill to most of the more complicated manufactures of our own times. In metallurgy, their art in tempering and enamelling has become justly famous; nor did any sword-blades ever rank higher than those of Damascus, nor any coppersmiths excel those of Baghdad, or gold and silver workmanship that of Oman. Specimens of their skill in porcelain yet remain in Spain and Syria; while the popular words "morocco" and "cordovan" attest their cleverness in preparing and dyeing leather. The pendulum and the semaphoric telegraph, if not invented, as some think, by the Arabs, were certainly introduced by them into Europe, as was also the manufacture of silk and of cotton, and an invention of the highest value—the mariner's compass. As early as 706 A.D. writing-paper was made at Mecca, whence it spread through all the Arabian dominions, and ultimately reached the Western world. In the discovery or use of gunpowder, so far back as the 11th century, the Arab claim to priority is contested by the Byzantines alone.

Influence of the Arab mind. In a word, the literature, arts, and sciences of the Arabs formed the connecting link between the civilisations of ancient and modern times; and the culture which they introduced into the countries they conquered has in almost every instance outlasted the rule of the conquerors themselves. To them, directly and indirectly, we owe the revival of learning and philosophy in Western Europe, and the first awakening of the critical and inquiring spirit that has in great measure rescued Europe from the lethargy of monkish ignorance and ecclesiastical bigotry; to them also, at least indirectly and by deduction, are due most of the useful arts and practical inventions laboriously perfected by later nations. Wide-spread as was the empire of the Arab sword, it has been less extended and less durable than the empire of the Arab mind. (W. G. P.)

ARABIAN PHILOSOPHY owed to Arabia little more than its name and its language. It was a system of Greek thought, expressed in a Semitic tongue, and modified by Oriental influences, called into existence amongst the Moslem people by the patronage of their more liberal princes, and kept alive by the intrepidity and zeal of a small band of thinkers, who stood suspected and disliked in the eyes of their nation. The Arabian philosophers have but a secondary interest in the history of their own lands. Their chief claim to the notice of the historian of speculation comes from their warm reception of Greek philosophy when it had been banished from its original soil, and whilst Western Europe was still too rude and ignorant to be its home. In the annals of philosophy the period from the beginning of the 9th to the close of the 12th century may be styled the "Flight into Egypt." During these four centuries free thought found a refuge under Mahometan princes until her oppressors were dead. In the course of that exile the traces of Semitic or Mahometan influence gradually faded away; and the last of the line of Saracenic thinkers was a truer exponent of the one philosophy which they all professed to teach than the first. The whole movement was little else than a chapter in the history of Aristotelianism. That system of thought, after passing through the minds of those who saw it in the hazy light of an Orientalised Platonism, and finding many laborious but narrow-purposed cultivators in the monastic schools of heretical Syria, was then brought into contact with the ideas and mental habits of Islam. But those in whom the two currents converged did not belong to the pure Arab race. Of the so-called Arabian philosophers of the East, Al-Farabi, Ibn-Sina, and Al-Ghazâli were natives of Khorassan, Bokhara, and the outlying provinces of north-eastern Persia; whilst Al-Kendi, the earliest of them, sprang from Basra, on the Persian Gulf, on the debatable ground between the Semite and the Aryan. In Spain, again, where Ibn-Badja, Ibn-Tofail, and Ibn-Roshd rivalled or exceeded the fame of the Eastern schools, the Arabians of pure blood were few, and the Moorish ruling class was deeply intersected by Jewish colonies, and even by the natives of Christian Spain. Thus, alike at Baghdad and at Cordova, Arabian philosophy represents the for a time victorious reaction of exotic ideas and of subject races against the theological one-sidedness of Islam, and the illiterate simplicity of the early Saracens.

Islam had, it is true, a philosophy of its own. There were Schoolmen amongst the believers in the Koran, not less than amongst the Latin Christians. At the very moment when Mahometanism came into contact with the older civilisations of Persia, Babylonia, and Syria, the intellectual habits of the new converts created difficulties with regard to its very basis, and showed themselves a prolific source of diversity in the details of interpretation. The radical questions on which these disputes turned were two. The first dealt with the possibility of ascribing manifold attributes to God—to a Being who was absolute unity. The other referred to the bearing of God's omnipotence upon the freedom of the human will. Ere the second century of the Hegira, sturdy adherents of the literal truth of the Koran taught a gross anthropomorphism, applying to the Creator the very bodily attributes of his creatures. These were the Sefatites, or partisans of the attributes. Another sect represented Mahomet as the teacher of an unqualified fatalism. Opposed to these narrow-minded exponents stood the comparatively liberal sect of the Motazalites, the Dissidents, who first appeared about 750. As they maintained, on one hand, that man was in some degree a free agent, and on another, elevated the unity of the divine nature far above the diversity of attributes, they came to be styled the partisans of justice and unity. It was with them that the Mussulman theology—the science of the word (*Calâm*)—first came into existence. Its professors, the *Motecallemîn* (known in Hebrew as *Medabberim*, and as *Loquentes* in the Latin versions) may be compared with the scholastic doctors of the Catholic Church. Driven in the first instance to speculation in theology by the needs of their natural reason, they came, in after days, when Greek philosophy had been naturalised in the Caliphate, to adapt its methods and doctrines to the support of their views. They employed a quasi-philosophical method, by which, according to Maimonides, they first reflected how things ought to be in order to support, or at least not contradict, their opinions, and then, when their minds were made up with regard to this imaginary system, declared that the world was no otherwise constituted. The dogmas of creation and providence, of divine omnipotence, chiefly exercised them; and they sought to assert for God an immediate action in the making and the keeping of the world. Space they looked upon as pervaded by atoms possessing no quality or extension, and time was similarly divided into innumerable instants. Each change in the constitution of the atoms is a direct act of the Almighty. When the fire burns, or the water moistens, these terms merely express the habitual connection which our senses perceive between one thing and another. It is not the man that throws a stone who is its real mover: the supreme agent has for the moment created motion. If a living being die, it is because God has created the attribute of death; and the body remains dead, only because that attribute is unceasingly created. Thus, on the one hand, the object called the cause is denied to have any efficient power to produce the so-called effect; and, on the other hand, the regularities or laws of nature are explained to be direct interferences by the Deity. God is the sole cause or agent in the universe: it is He who, directly, or by the mediation of His ministering angels, brings everything to pass. The supposed uniformity and necessity of causation is only an effect of custom, and may be at any moment rescinded. In this way, by a theory which, according to Averroes, involves the negation of science, the Moslem theologians believed that they had exalted God beyond the limits of the metaphysical and scientific conceptions of law, form, and matter; whilst they at the same time stood aloof from the vulgar doctrines, attributing a causality to things. Making the uniformity of nature a mere phantom due to our human customary experience, they deemed they had left a clear ground for the possibility of miracles.

But at least one point was common to the theological and the philosophical doctrine. Carrying out, it may be, the principles of the Neo-Platonists, they kept the sanctuary of the Deity securely guarded, and interposed between him and his creatures a spiritual order of potent principles, from the Intelligence, which is the first-born image of the great unity, to the Soul and Nature, which come later in the spiritual rank. Of God the philosophers said we could not tell what He is, but only what He is not. The highest point, beyond which strictly philosophical inquirers did not penetrate, was the active intellect,—a sort of soul of the world in Aristotelian garb—the principle which inspires and regulates the development of humanity, and in which lies the goal of perfection for the human spirit. In theological language the active intellect is described as an angel. The inspirations which the prophet receives by angelic messengers are compared with the irradiation of intellectual light, which the philosopher wins by contemplation of truth and increasing purity of life. But while the theologian incessantly postulated the agency of that God, whose nature he deemed beyond the pale of science, the philosopher, following a purely human and natural aim, directed his efforts to the gradual elevation of his part of reason from its unformed state, and to its final union with the controlling intellect which moves and draws to itself the spirits of those who prepare themselves for its influences. The philosophers in their way, like the mystics of Persia (the Sufites) in another, tended towards a theory of the communion of man with the spiritual world, which may be considered a protest against the practical and almost prosaic definiteness of the creed of Mahomet.

Arabian philosophy, at the outset of its career in the 9th century, was able without difficulty to take possession of those resources for speculative thought, which the Latins had barely achieved at the close of the 12th century by the slow process of rediscovering the Aristotelian logic from the commentaries and versions of Boëthius. What the Latins painfully accomplished, amid many senseless disputations and blind gropings after light, owing to their fragmentary and unintelligent acquaintance with ancient philosophy, was already done for the Arabians by the scholars of Syria. In the early centuries of the Christian era, both within and without the ranks of the church, the Platonic tone and method were paramount throughout the East. Their influence was felt in the creeds which formulated the orthodox dogmas in regard to the Trinity and the Incarnation. But in its later days the Neo-Platonist school came more and more to find in Aristotle the best exponent and interpreter of the philosopher whom they thought divine. It was in this spirit that Porphyry, Themistius, and Joannes Philoponus composed their commentaries on the treatises of the Peripatetic system which, modified often unconsciously by the dominant ideas of its expositors, became in the 6th and 7th centuries the philosophy of the Eastern Church. But the instrument which, in the hands of John of Damascus, was made subservient to theological interests, became in the hands of others a dissolvent of the doctrines which had been reduced to shape under the prevalence of the elder Platonism. Peripatetic studies became the source of heresies; and conversely, the heretical sects prosecuted the study of Aristotle with peculiar zeal. The church of the Nestorians, and that of the Monophysites, in their several schools and monasteries, carried on from the 5th to the 8th century the study of the earlier part of the Organon, with almost the same means, purposes, and results as were found among the Latin schoolmen of the earlier centuries. Up to the time when the religious zeal of the Emperor Zeno put a stop to the Nestorian school at Edessa, this "Athens of Syria" was active in translating and popularising the Aristotelian logic. Their banishment from Edessa in 489 drove the Nestorian scholars to Persia, where the Sassanidae gave them a welcome; and there they continued their labours on the *Organon*. A new seminary of logic and theology sprung up at Nisibis, not far from the old locality; and at Gandisapora (or Nisabur) in the east of Persia, there arose a medical school, whence Greek medicine, and in its company Greek science and philosophy, ere long spread over the lands of Iran. Meanwhile the Monophysites had followed in the steps of the Nestorians, multiplying Syriac versions of the logical and medical science of the Greeks. Their school at Resaina is known from the name of Sergius, one of the first of these translators, in the days of Justinian; and from their monasteries at Kinnesrin (Chalcis) issued numerous versions of the introductory treatises of the Aristotelian logic. To the *Isagoge* of Porphyry, the *Categories* and the *Hermeneutica* of Aristotle, the labours of these Syrian schoolmen were confined: these they expounded, translated, epitomised, and made the basis of their compilations; and the few who were bold enough to attempt the *Analytics*, seem to have laid down the pen with their task unaccomplished.

The energy of the Monophysites, however, began to sink with the rise of the Moslem empire; and when philosophy revived amongst them in the 13th century, in the person of Gregorius Barhebræus (1226–1286), the revival was due to the example and influence of the Arabian thinkers. It was otherwise with the Nestorians. Gaining by means of their professional skill as physicians a high rank in the society of the Moslem world, the Nestorian scholars soon made Baghdad familiar with the knowledge of Greek philosophy and science which they possessed. But the narrow limits of the Syrian studies, which added to a scanty knowledge of Aristotle some acquaintance with his Syrian commentators, were soon passed by the curiosity and zeal of the students in the Caliphate. During the 8th and 9th centuries, rough but generally faithful versions of Aristotle's principal works were made into Syriac, and then from the Syriac into Arabic. The names of some of these translators, such as Johannitius (Honein ibn-Ishak), were heard even in the Latin schools. By the labours of Honein and his family the great body of Greek science, medical, astronomical, and mathematical, became accessible to the Arab-speaking races. But for the next three centuries fresh versions, both of the philosopher and of his commentators, continued to succeed each other.

To the Arabians Aristotle represented and summed up Greek philosophy, even as Galen became to them the code of Greek medicine. They adopted the doctrine and system which the progress of human affairs had made the intellectual aliment of their Syrian guides. It was a matter of historical necessity, and not an act of deliberate choice. Just as the early poets of Rome, when they tried to naturalise the drama, reproduced the works of Euripides, the popular tragedian of their time, so the Arabians, when the need of scientific culture awoke amongst them, accepted Aristotle. From first to last Arabian philosophers made no claim to originality; their aim was merely to propagate the truth of Peripateticism as it had been delivered to them. In medicine and astronomy, as well as in philosophy, they entertained an almost superstitious reverence for their Greek teachers. It was with them that the deification of Aristotle began, and from them the belief that in him human intelligence had reached its limit passed to the later schoolmen. The doctrine is fixed truth has been ascertained: all that is needed is a faithful and skilful interpreter. Hence, their perpetual labour of exposition and illustration: their epitomes and paraphrases of Aristotelian doctrine. The progress amongst the Arabians on this side lies in a closer adherence to their text, a nearer approach to the bare exegesis of their author, and an increasing emancipation from control by the tenets of the popular religion.

Secular philosophy found its first entrance amongst the Saracens in the days of the early caliphs of the Abbaside dynasty, whose ways and thoughts had been moulded by their residence in Persia amid the influences of an older creed, and of ideas which had in the last resort sprung from the Greeks. The seat of empire had been transferred to Baghdad, on the highway of Oriental commerce, and the distant Khorassan became the favourite province of the caliph. Then was inaugurated the period of Persian supremacy, during which Islam was laid open to the full current of alien ideas and culture. The incitement came, however, not from the people, but from the prince: it was in the light of court favour that the colleges of Baghdad and Nisabur first came to attract students from every quarter, from the valleys of Andalusia, as well as the upland plains of Transoxiana. Al-Mansûr, the second of the Abbasides, encouraged the appropriation of Greek science, but it was Al-Mamûn, the son of Harûn al-Rashid, who deserves in the Mahometan empire the same position of royal founder and benefactor which is held by Charlemagne in the history of the Latin schools. In his reign (813–833) Aristotle was first translated into Arabic. Legend told how Al-Mamûn had been induced to send to the Byzantine emperor for Greek books on philosophy, in consequence of a vision in which a venerable personage, who made himself known as Aristotle, had excited without gratifying the curiosity of the caliph. Orthodox Mussulmans, however, distrusted the course on which their chief had entered, and his philosophical proclivities became one ground for doubting as to his final salvation.

In the Eastern provinces the chief names of Arabian philosophy are those known to the Latin schoolmen as Alkindius, Alpharabius, Avicenna, and Algazel, or under forms resembling these, or under other names derived from various parts of their complex Arabic designations. The first of these, Alkindius (Abu Jusuf Jacub ibn-Ishak *al-Kendi*), wrote in the reigns of Al-Mamûn and Al-Motassem (813–842). His claims to notice at the present day rest upon a few works on medicine and the astrological astronomy of his age,—the only remnant left of the 200 treatises which he is said to have composed on all the themes of science and philosophy. With him begins that encyclopædic character—the simultaneous cultivation of the whole field of investigation which is reflected from Aristotle on the Arabian school. Towards the close of the 10th century the presentation of an entire scheme of knowledge, beginning with logic and mathematics, and ascending through the various departments of physical inquiry to the region of religious doctrine, was accomplished by a society which had its chief seat at Basra, the native town of Al-Kendi. This society—the Brothers of Purity or Sincerity—divided into four orders, wrought in the interests of religion no less than of science; and though its attempt to compile an encyclopædia of existing knowledge may have been premature, it yet contributed to spread abroad a desire for further information. The proposed reconciliation between science and faith was not accomplished, because the compromise could please neither party. The fifty-one treatises of which this encyclopædia consists are interspersed with apologues in true Oriental style, and the idea of goodness, of moral perfection, is as prominent an end in every discourse as it was in the alleged dream of Al-Mamûn. The materials of the work come chiefly from Aristotle; but they are conceived in a Platonising spirit, which places as the bond of all things a universal soul of the world with its partial or fragmentary souls. Contemporary with this semi-religious and semi-philosophical society lived Alfarabius (Abou-Nasr Mohammed ben-Mohammed ben-Tarkhan *al-Farabi*) or Abunasar. From Turkestan, the place of his birth, he passed southward to Baghdad where he studied, and died at Damascus in 950, after living for some time at Aleppo on the invitation of its prince. The legendary accounts of Al-Farabi describe him as a man of vast erudition, the master of seventy languages, and accomplished both in the theory and the practice of the musical art. Of his numerous writings on all the branches of science only a few remain in Arabic or Hebrew versions, but his paraphrases of Aristotle formed the basis on which Avicenna constructed his system, and his logical treatises produced a permanent effect on the logic of the Latin scholars. He gave the tone and direction to nearly all subsequent speculations among the Arabians. His order and enumeration of the principles of being, his doctrine of the double aspect of intellect, and of the perfect beatitude which consists in the aggregation of noble minds when they are delivered from the separating barriers of individual bodies, present at least in germ the characteristic theory of Averroes. But Al-Farabi was not always consistent in his views; a certain sobriety checked his speculative flights, and although holding that the true perfection of man is reached in this life by the elevation of the intellectual nature, he came towards the close to think the separate existence of intellect no better than a phantasm and delusion.

Unquestionably the most illustrious name amongst the Oriental Moslems was Avicenna (980–1037). His fame in Europe rested more upon his medical canon than on his philosophical works; but even in logic and metaphysics his influence on the West was considerable. With him the encyclopædic tendencies of the school of Baghdad reached their culmination. He was followed by Algazel (Abou

Hamed Mohammed ibn-Mohammed al-Ghazâli), whose name was the last that attained a European reputation. Born near Tûs in 1058, he studied there and at Nisabur; and having left his native province of Khorassan at the age of 36, he was appointed to a high educational post at Baghdad. There, as well as at Damascus, Jerusalem, and Alexandria, his lectures attracted crowds of eager listeners. Suddenly he withdrew from active life, assumed the habits of the Sufite mystic, and devoted himself to contemplation of religious truth; and although he was persuaded to resume for a while his duties in the college of Baghdad, he soon returned to seclusion, and passed his last days in a monastery which he had himself founded at Tûs (1111). To Algazel it seemed that the study of secular philosophy had resulted in a general indifference to religion, and that the scepticism which concealed itself under a pretence of piety was destroying the life and purity of the nation. With these views he carried into the fields of philosophy the aims and spirit of the Moslem theologian. In his *Tendencies of the Philosophers* (*Makâcid al-Falâsifa*) he gave a resumé of the contemporary state of the speculative sciences as a preliminary work to his *Destruction of the Philosophers* (*Tehâfot al-Falâsifa*), in which the contradictions and errors of these sciences were pointed out, as well as their divergence from the orthodox faith. This indictment against liberal thought from the stand-point of the theological school was afterwards answered in Spain by Averroes; but in Baghdad it heralded the extinction of the light of philosophy. Moderate and compliant with the popular religion as Alfarabius and Avicenna had always been, as compared with their Spanish successor, they had equally failed to conciliate the popular spirit, and were classed in the same category with the heretic or the member of an immoral sect. The 12th century exhibits the decay of liberal intellectual activity in the Caliphate, and the gradual ascendency of Turkish races animated with all the intolerance of semi-barbarian proselytes to the Mahometan faith. Philosophy, which had only sprung up when the purely Arabian influences ceased to predominate, came to an end when the sceptre of the Moslem world passed away from the dynasty of Persia. Even in 1150 Baghdad had seen a library of philosophical books burned by command of the Caliph Mostandjed; and in 1192 the same place might have witnessed a strange scene, in which the books of a physician were first publicly cursed, and then committed to the flames, while their owner was incarcerated. Thus, while the Latin church showed a marvellous receptivity for ethnic philosophy, and assimilated doctrines which it had at an earlier date declared impious, in Islam the theological system entrenched itself towards the end of the 12th century in the narrow orthodoxy of the Assarites, and reduced the votaries of Greek philosophy to silence.

The same phenomena were repeated in Spain under the Mahometan rulers of Andalusia and Marocco, with this difference, that the time of philosophical development was shorter, and the heights to which Spanish thinkers soared were greater. The reign of Al-Hakem the Second (961–976) inaugurated in Andalusia those scientific and philosophical studies which were simultaneously prosecuted by the Society of Basra. From Cairo, Baghdad, Damascus, and Alexandria, books both old and new were procured at any price for the library of the prince, 27 free schools were opened in Cordova for the education of the poor; and intelligent knowledge was perhaps more widely diffused in Mahometan Spain than in any other part of Europe at that day. The mosques of the city were filled with crowds who listened to lectures on science and literature, law and religion. But the future glory thus promised was long postponed. The usurping successor of Hakem found it a politic step to request the most notable doctors of the sacred law to examine the royal library; and every book treating of philosophy, astronomy, and other forbidden topics, was condemned to the flames. But the spirit of research, fostered by the fusion of races and the social and intellectual competition thus engendered, was not crushed by these proceedings; and for the next century and more the higher minds of Spain found in Damascus and Baghdad the intellectual aliment which they desired. At last, towards the close of the 11th century, the long-pent spiritual energies of Mahometan Spain burst forth in a brief series of illustrious men. Whilst the native Spaniards were narrowing the limits of the Moorish kingdoms, and whilst the generally fanatical dynasty of the Almohades might have been expected to repress speculation, the century preceding the close of Mahometan sway saw philosophy cultivated by Avempace, Abubacer, and Averroes. Even amongst the Almohades there were princes, such as Jusuf (who began his reign in 1163) and Jacûb Almansor (who succeeded in 1184), who welcomed the philosopher at their courts, and treated him as an intellectual compeer. But about 1195 the old distrust of philosophy revived; the philosophers were banished in disgrace; works on philosophical topics were ordered to be confiscated and burned; and the son of Almansor condemned a certain Ben-Habib to death for the crime of philosophising.

Arabian speculation in Spain was heralded by Avicebron, a name under which the schoolmen conceived an Arab thinker, whereas modern scholars have shown that he was identical with Salomon ben-Gebirol, a Jewish sacred poet of no mean order, and still popular in the synagogue. Born at Malaga, and educated at Saragossa, he seems to have written most of his works between 1045 and 1070. His philosophical essay, known as the *Fountain of Life* (*Fons Vitæ*), although, in a Latin version made about 1150, it acted like a ferment amongst the seething mass of heterodox Christian theology, found no immediate acceptance among his own philosophical compatriots, or amongst the Arabian thinkers who succeeded him. His speculations were drawn from sources other than those which supplied the dominant school of the 12th century in Spain, and found a congenial home amongst those who had drunk deeply from the ideas of Scotus Erigena. The doctrine of Avicebron attributed matter to everything, even to the soul, and to simple substances, and held that ultimately there was one universal matter. Thus, while intelligible and sensible substances differ in their forms, they are at one in matter. The doctrine became important in the disputes as to the principle of individuation; where Duns Scotus, in opposition to Aquinas, reverted to the position of Avicebron, whom he also resembled in his doctrine of the superiority of the will to the intellect.

Such questions in the present age would seem to fall strictly within the sphere of logic. But it was the characteristic of the thinkers of the mediæval period, both Arabian and Christian, to magnify the power of abstract ideas, and to give a deep reality to logical and metaphysical ideas. The earlier schoolmen exaggerated the value of genera and species, till everything else grew faint in comparison, and the Arabian thinkers similarly took in awful earnest the distinction of material and formal. Abstractions were first realised with uncommon distinctness and became almost palpable; and then they were introduced into the world of popular conception. An irresistible attraction drew thinkers of different classes to apply their metaphysical subtleties to the religious ideas of a celestial order of beings, and the results of this application not unnaturally gave rise to heresies.

The ideas of Avicebron are the one-sided consequences of principles which had an influence, but a secondary one, on the whole Arabian school. They descend in the last instance from the Alexandrians,—particularly as Alexandrian ideas are presented in the book *De Causis*, and in the *Apocryphal Theology* of Aristotle. Both of these works (which passed under a variety of other names) belong to a class of writings of Neo-Platonic tone and contents, which were accredited by their ascription to Pythagoras, Empedocles, Plato, and Aristotle, and circulated amongst the Arabians before the canon of Peripatetic scriptures had been definitively fixed by the school of Baghdad. The *Theology* known as Aristotle's did not appear in Latin before 1519, when it was translated from an Arabic manuscript of the 9th century, whereas the *De Causis*, although unknown to the Moslem world, was familiar to the Latins of the 13th century The *Theology* was an exposition of the theory of Plotinus, the *De Causis* was extracted from the *Theological Elements* of Proclus, and both works presented the usual Alexandrian system of emanation and hypostases,—the graduated series of externalisations and manifestations of the first cause or absolute unity, firstly, in Intelligence, secondly, in the Soul of the universe, thirdly, in Nature and the region of mutability. These sucessive spheres of being, where the central unity expands into the circumference without losing its simplicity, and the circumference is instinctively led towards its controlling centre, lay at the basis of the conception of the universe held more or less by all the Moslem philosophers. The first of creatures, says Avicenna, is the Intelligence, in which are contained soul and life. The first cause is above all intelligence. The principles exert a causal influence according to their degree of elevation.

About a generation after Avicebron the rank of Moslem thinkers proper was introduced by Abou-Bekr Mohammed ben-Jahya, surnamed Ibn-Badja, and known to the Latin world as Avempace. He was born at Saragossa, and died comparatively young at Fez in 1138. Besides commenting on various physical treatises of Aristotle's, he wrote some philosophical essays, notably one on the *Republic or Régime of the Solitary*. In its general character, and in several peculiarities, it resembles the *Republic* of Plato. The Solitary of whom Ibn-Badja speaks is the stranger who seeks for a better commonwealth than the common vulgarity of the world,—who, like some rare plant that springs up unsown in a bed of ordinary flowers, would fain regain his native air. Ibn-Badja proposed to trace the steps by which such an one taken alone, rising above his animal nature, might by abstraction and reflection elicit the universal forms of material things from the data of sense, and thus finally apprehend the pure intelligences or speculative forms. As against Algazel, he maintained the right of the intellect to rise by scientific contemplation to the philosophical heaven,—to a union with the ever-active intellect which moves the spheres. The consciousness of this union is the commonwealth of the solitary,– the enduring commonwealth of intellect in which the philosopher abides.

The same theme was developed by Ibn-Tofail in his philosophical romance, called *Hayy ibn-Jakdhân* (the Living, Son of the Waking One), best known by Pococke's Latin version, as the *Philosophus Autodidactus*. Ibn-Tofail, the Abubacer of the schoolmen, was born at Guadix in Andalusia, and died at Marocco in 1185 At the court of Jusuf he combined the offices of vizier and physician, and employed his influence to introduce younger students to the notice of the prince. Ibn-Tofail wrote on medicine and astronomy, as well as philosophy, but his romance, which has been translated into Hebrew, Latin, English, and other European languages, is his only extant work. It describes the process by which an isolated truth-seeker detaches himself from his lower passions, and raises himself above the material earth and the orbs of heaven to the forms which are the source of their movement, until he arrives at a union with the supreme intellect. The experiences of the religious mystic are paralleled with the ecstatic vision in which the philosophical hermit sees a world of pure intelligences, where birth and decease are unknown.

It was this theory which Averroes (1126–1198), the last and most famous of the thinkers of Moslem Spain, carried out to his doctrine of the unity of intellect. The whole doctrine will be discussed under the heading AVERROES; but its general purport is this. Reproducing, on one hand, the customary psychology of Aristotle as it rises gradually from the mere sense to the understanding, it emphasises, on another hand, the permanent subsistence and action of intellect apart from all materiality and from the individuals who share in the intellectual power. In the active intellect it finds the motive principle, and the full fruition of human reason. Sometimes this intellect is invested with the supremacy of the sphere beneath the moon, and connected with a more universal intelligence through a hierarchy of spiritual principles in the celestial system. Such a mind is the sole actual intellect in which the generations of thinking men live and move. In complete union with it lies their perfect beatitude; and, save as a temporary participant in the blessings of this universal form, the intellectual soul is a nonentity.

The philosophers thus characterised were in almost every case physicians; and with their medical knowledge they frequently combined studies in mathematics, astronomy, and alchemy. In all these departments they were the pupils of Greeks, whose text they accepted almost as a revelation. Their talent lay in the elaboration of details, and in correcting certain mistakes of their guides, but they never introduced any comprehensive change. Still their conjunct prosecution of physical and metaphysical studies gave them an advantage over their Latin contemporaries, with whom the schools of dialectic grew into exaggerated prominence, whilst few traces were left, as at Salerno, of the medical and scientific pursuits of the ancient world. Their acquaintance with art was another feature in favour of the Arabians. Al-Kendi, Al-Farabi, and Ibn-Badja were musicians of note: Ibn-Tofail and Ben-Gebirol were famous as poets. Their studies in the sacred law and in theology did not unduly dominate their philosophical investigations, and they combined much practical work as physicians and statesmen with an almost incredible industry in appropriating and systematising the wisdom of Greece. But the great educational value of Arabian philosophy for the later schoolmen consisted in its making them acquainted with an entire Aristotle. At the moment when it seemed as if everything had been made that could be made out of the fragments of Aristotle, and the compilations of Capella, Cassiodorus, and others, and when mysticism and scepticism seemed the only resources left for the mind, the horizon of knowledge was suddenly widened by the acquisition of a complete Aristotle. Thus the mistakes inevitable in the isolated study of an imperfect *Organon* could not henceforth be made. The real bearing of old questions, and the meaninglessness of many disputes, were seen in the new conception of Aristotelianism given by the *Metaphysics*, and other treatises. The former Realism and Nominalism were lifted into a higher phase by the principle of the universalising action of intellect—(*Intellectus in formis agit universalitatem*). The commentaries of the Arabians in this respect supplied nutriment more readily assimilated by the pupils than the pure text would have been.

Arabian philosophy, whilst it promoted the exegesis of Aristotle and increased his authority, was not less notable as the source of the separation between theology and philosophy. Speculation fell on irreligious paths. In many cases the heretical movement was due less to foreign example than to the indwelling tendencies of the dominant school of Realism. But it is not less certain that the very considerable freedom of the Arabians from theological bias served indirectly to intensify the prevailing protest against Sacerdotalism, and prepared the time when philosophy shook off its ecclesiastical vestments. In the hurry of first terror, the church struck Aristotle with the anathema launched against innovations in philosophy. The provincial council of Paris in 1209, which condemned Amalricus and his followers, as well as David of Dinant's works, forbade the study of Aristotle's Natural Philosophy, and the Commentaries. In 1215 the same prohibition was repeated, specifying the Metaphysics and Physics, and the Commentaries by the Spaniard Mauritius (*i.e.*, probably Averroes). Meanwhile Albertus Magnus and Thomas Aquinas, accepting the exegetical services of the Arabians, did their best to controvert the obnoxious doctrine of the Intellect, and to defend the orthodoxy of Aristotle against the unholy glosses of infidels. But it is doubtful whether even they kept as pure from the infection of illegitimate doctrine as they supposed. The tide meanwhile flowed in stronger and stronger. In 1270 Stephen Tempier, bishop of Paris, supported by an assembly of theologians, anathematised thirteen propositions bearing the stamp of Arabian authorship; but in 1277 the same views and others more directly offensive to Christians and theologians had to be censured again. Raymond Lully, in a dialogue with an infidel thinker, broke a lance in support of the orthodox doctrine, and carried on a crusade against the Arabians in every university; and a disciple of Thomas Aquinas drew up a list (*De Erroribus philosophorum*) of the several delusions and errors of each of the thinkers from Alkindius to Averroes. Strong in their conviction of the truth of Aristotelianism, the Arabians carried out their logical results in the theological field, and made the distinction of necessary and possible, of form and matter, the basis of conclusions in the most momentous questions. They refused to accept the doctrine of creation because it conflicted with the explanation of forms as the necessary evolution of matter. They denied the particular providence of God, because knowledge in the divine sphere did not descend to singulars. They excluded the Deity from all direct action upon the world, and substituted for a cosmic principle the active intellect,—thus holding a form of Pantheism. But all did not go the same length in their divergence from the popular creed.

The half-legendary accounts which attribute the introduction of Arabian science to Gerbert, afterwards Pope Sylvester II., to Constantinus Africanus, and to Adelard of Bath, if they have any value, refer mainly to medical science and mathematics. It was not till about the middle of the 12th century that under the patronage of Raymond, archbishop of Seville, a society of translators, with the archdeacon Dominicus Gundisalvi at their head, produced Latin versions of the *Commentaries* of Avicenna and Algazel, of the *Fons Vitæ* of Avicebron, and of several Aristotelian treatises. The working translators were converted Jews, the best known among them being Joannes Avendeath. With this effort began the chief translating epoch for Arabic works. Avicenna's *Canon of Medicine* was first translated into Latin by Gerard of Cremona (*d.* 1187), to whom versions of other medical and astronomical works are due. The movement towards introducing Arabian science and philosophy into Europe, however, culminated under the patronage of the Emperor Frederick II. (1212–1250). Partly from superiority to the narrowness of his age, and partly in the interest of his struggle with the Papacy, this *Malleus ecclesiæ Romanæ* drew to his court those savants whose pursuits were discouraged by the church, and especially students in the forbidden lore of the Arabians. He is said to have pensioned Jews for purposes of translation. One of the scholars to whom Frederick gave a welcome was Michael Scot, the first translator of Averroes. Scot had sojourned at Toledo about 1217, and had accomplished the versions of several astronomical and physical treatises, mainly, if we believe Roger Bacon, by the labours of a Jew named Andrew. But Bacon is apparently hypercritical in his estimate of the translators from the Arabic. Another protegé of Frederick's was Hermann the German (Alemannus), who, between the years 1243 and 1256, translated amongst other things a paraphrase of Al-Farabi on the *Rhetoric*, and of Averroes on the *Poetics* and *Ethics* of Aristotle. Jewish scholars held an honourable place in transmitting the Arabian commentators to the schoolmen. It was amongst them, especially in Maimonides, that Aristotelianism found refuge after the light of philosophy was extinguished in Islam; and the Jewish family of the Ben-Tibbon were mainly instrumental in making Averroes known to southern France.

See Munk, *Mélanges de philosophie juive et arabe*, Paris, 1859; Renan, *De Philosophia Peripatetica apud Syros*, 1852, and *Averroès et l'Averroisme*, Paris, 3me ed., 1867; Jourdain, *Recherches critiques sur l'age et l'origine des traductions Latines d'Aristote*, Paris, 2me ed., 1843; Hauréau, *Philosophie Scolastique*, Paris, 1re ed., 1850, tome i. p. 359; Vacherot, *Ecole d'Alexandrie*, 1re ed., 1851, tome iii. p. 85; Abulfaragius, *Historia Dynastiarum*, ed. Pococke, Oxon., 1663; Schmölders, *Documenta philosophiae Arabum*, Bonn, 1836, and *Essai sur les écoles philosophiques chez les Arabes*, Paris, 1842; Shahrastani, *History of Religious and Philosophical Sects*, in German translation by Haarbrücker, Halle, 1850–51; Dieterici, *Streit zwischen Mensch und Thier*, Berlin, 1858, and his other translations of the *Encyclopædia of the Brothers of Sincerity*, 1861 to 1872; Prantl, *Geschichte der Logik*, 1861, vol. ii. pp. 297–396; and the Histories of Philosophy, *e.g.*, Erdmann's, vol. i. (2d ed.), p. 295, and Ueberweg's, vol. i., English translation, London, 1872. (W. W.)

ARABIAN SEA, the name applied to the large sheet of water, really a portion of the Indian Ocean, bounded on the E. by Hindustan, on the N. by Beloochistan, on the W by Arabia and the Gulf of Aden, and on the S. by an imaginary line stretching between Cape Guardafui, in the N.E. of Africa, and Cape Comorin in Hindustan. This is the Arabian Sea proper, but under the name Gulf of Aden it penetrates between Africa and Arabia, connecting itself with the Red Sea through the Straits of Bab-el-Mandeb; while on the N.W. the Gulf of Oman, with its continuation the Persian Gulf, separates Arabia from Beloochistan and Persia. Besides these larger ramifications, there are the Gulfs of Cambay and Cutch in the N.W. of India. An interest and importance belong to this sea as forming part of the chief highway between Britain and India. The islands it contains are few and insignificant, the chief being Socotra and the Laccadives. The Arabian Sea is more or less coextensive with the *Mare Erythræum* or *Rubrum* of the ancients, although these terms seem to have been applied with considerable vagueness.

ARABICI, a sect originating about the beginning of the 3d century, which is mentioned by Augustine (*De Hæres.*, c. 83), and called also *Thnetopsychitæ* by Johannes Damascenus (*De Hæres.*, c. 99). Its founder is unknown, and its history brief and obscure. Its distinctive doctrine was a form of Christian materialism, showing itself in the belief that the soul perished and was restored to life along with the body. According to Eusebius, the Arabici were convinced of their error by Origen, and renounced it at a council held about 246 A.D.

ARACATI, a town of Brazil, in the province of Ceara, situated on the Jaguaribe, about 10 miles from its mouth. It is well built, and carries on a considerable export trade in hides and cotton. The population is stated at 26,000.

ARACHNIDA

THE Arachnida, or, popularly speaking, the Spiders and their allied forms—from ἀράχνη, a spider, and εἶδος, the form or outward appearance—constitute a well-defined group within the great branch "Articulata" of the animal kingdom, though on one side its boundary lines melt almost insensibly into the Annelides, through the family of acarids—*Pentastomides*. Linnæus and others of the older systematists included all Arachnids (as then recognised) under the class *Insecta*, Lamarck first separating them into a distinct class. A few general remarks, therefore, on the branch *Articulata*, and its subordinate groups, may be useful, to show the general relations of that under consideration.

As distinguished from the *Vertebrata*, the animals of the branch *Articulata* may be characterised generally as having (besides the marked and uniformly different position of the chief organ of circulation and the nervous chords) an external skeleton, the different parts of which, of more or less solid consistency, are articulated, or jointed to each other, and contain within their hollows the vital and other organs. Internally, threads of nervous matter, springing from enlargements or knots (*ganglia*) upon two or more central longitudinal nervous chords on the ventral side of the body traverse the different parts of it; these chords, however, end in no *one* special mass, corresponding to the brain in the *Vertebrata;* and the nervous systems composed by these ganglia vary considerably in their special structure and arrangement in the different subordinate groups.

This being the distinctive *plan* of structure in the *Articulata*, a review of the whole group shows us that this plan is carried out in two well-marked leading ways—first, *without*, and secondly, *with*, *articulated legs*, or organs of locomotion and touch. Those *without* articulated limbs constitute the *Annelides* of Lamarck, which, for our present purpose, it is sufficient to characterise as having the articulate plan of structure carried out in the general form of a more or less cylindrical, lengthened body, composed of a number of rings, segments, or transverse folds, of which the first forms the head, *but destitute of articulated limbs.* Those *with* articulated legs constitute the *Condylopa* of Latreille, or the *Insecta* of Linnæus; but the term *Insecta* being now in general use to define a subordinate group, it will be better to adopt here the name given by Latreille. In the "*Condylopa*," then, the articulated plan of structure is carried out in the form of a more or less hard body composed of different pieces, of which one, two, three, or more, are generally *leading ones ;* to this body (in general to the anterior portion of it) are attached *articulate organs of locomotion* various in number, but never, or at least very rarely, less than six. The organs of sight (when present) are always in the head, and vary in number, position, and kind. To these two leading divisions of the branch Articulata—the *Annelides* of Lamarck, and *the Condylopa* of Latreille—we may give the designation of CLASSES, since they are each respectively composed of animals which thus primarily and markedly differ in the way in which their common articulate plan of structure is carried out.

Leaving now the class Annelides, to which has been given the name "Anarthropoda," and confining our attention to the "Condylopa," or "Condylopoda" (equivalent to the "Arthropoda" of more modern authors), we find that the latter contains the four following groups—"*Insecta*," "*Myriapoda*," "*Arachnida*," and "*Crustacea*."

These all agree in the way in which, as above explained, their *general articulated plan of structure is carried out*, but they differ in the *further modifications of this plan*, that is to say, in the number, division, and size (both absolute and relative) of the different articulations of the body (including the organs of locomotion, of manducation, and of touch), and in the respective value and relation of these to each other, as well as in the modifications of their respiratory and other internal systems, and also in other important points. Differing thus from each other, these four groups, usually (three at least of them) ranked as distinct classes, yet appear to be entitled only to the rank of sub-classes, being each merely an equally subordinate group of the class "Condylopoda."

The four sub-classes of Condylopoda (or articulate-legged Annulosa) may be separately and briefly characterised thus:—

Sub-class I.—INSECTA: subject in general to metamorphosis, more or less complete, during the progress to maturity; organs of locomotion, six; body divided into three principal parts—*caput, thorax*, and *abdomen;* respiration wholly tracheal.

Sub-class II.—MYRIAPODA: not subject to metamorphosis, properly so-called; organs of locomotion above six in number (twenty-four and more) developed by degrees, and affixed to the abdominal as well as to the other (numerous) segments into which the body is divided. Although occasionally some of the anterior segments coalesce, and the head is stated to be formed by five or more modified segments, yet no one or more parts of the body can be said to be principal ones; respiration is tracheal.

Sub-class III.—ARACHNIDA: not subject to metamorphosis, properly so-called, though, as with the Myriapoda, some portions of structure among certain acarids, and to a small extent even among the *Araneidea*, are progressively developed at the various moultings of the skin. Organs of locomotion, eight, body in general divided into *two* principal parts, *cephalo-thorax* and *abdomen ;* but where (as in some groups) the abdomen is divided into more or less distinct segments no organs of locomotion are ever attached to them; respiration, where distinct organs exist, is either tracheal, pulmo-branchial, or the two coexistent.

Sub-class IV.—CRUSTACEA: without metamorphosis; organs of locomotion various in number (not less than eight or ten), and attached to some or all of the many segments, abdominal as well as others, into which the body is divided; although in numbers of crustaceans no one part of the body can be called a principal part, yet in some very large and leading groups, the portion covered by the carapace (corresponding to the cephalo-thorax in Arachnids) may well be termed the *one* principal part; the abdomen being in this case more or less rudimentary or subordinate. Respiration in the Crustacea, where distinct organs are present, is branchial.

In this view the following diagram shows the relative positions of the several leading groups of the Articulata:—

ANIMAL KINGDOM.

Branch I. Radiata. II. Mollusca. III. ARTICULATA. IV. Vertebrata.

Class I. Annelides or Anarthropoda. II. CONDYLOPODA or ARTHROPODA.

Sub-class I. Insects. II. Myriapoda. III. ARACHNIDA. IV. Crustacea.

In this diagram the Myriapoda are placed, in the position ordinarily assigned to them, between the Insects and Arachnids, but perhaps a more natural position would be after the Crustacea, for they appear to connect the Insecta and Crustacea more than they do the Insecta and Arachnida. The point, however, of the special position of any large group in a linear series is tolerably unimportant. A linear arrangement is of course the only one possible on paper, but it cannot express the numerous cross relationships that become evident when the affinities of special groups are closely studied. By placing the Myriapoda after the Crustaceans, we seem to get an ascending series in respect to the organs of locomotion: in the *Insecta*, six—always attached to the thoracic segments, in the *Arachnida*, eight—almost always attached to the thoracic segments, in the *Crustacea*, eight, ten, and upwards—frequently attached to the abdominal as well as to the thoracic segments, in the *Myriapoda*, twenty-four and more—always attached to the abdominal as well as other segments. The relation of the Myriapoda to the Crustacea through the attachment of limbs to the abdominal segments is thus expressed; and by the meeting of the two ends of the line, the always acknowledged affinity of the former to the Insecta is also expressed.

Having thus briefly explained the most obvious relationships of the Arachnida, let us now proceed to a more detailed, though still general, diagnosis of this group. And first, in respect to their *external organisation*, Arachnids are articulate animals,[1] with eight articulated legs, each in general consisting of seven joints; the head and thorax are soldered together into one piece (cephalo-thorax), from which with few exceptions the legs invariably spring. In one group of the Arachnida (*Solpugidea*) the cephalothorax is separately segmented, as it is also in one family of the *Thelyphonidea* (*Tartarides*); the rest of the body forms also one more or less homogeneous piece (abdomen). The abdomen is always more or less closely attached to the cephalo-thorax; in some instances it is soldered to the thorax, and forms with it one undivided piece, in other cases it is only joined to it by a narrow pedicle. At times, also, the abdomen constitutes a simple unsegmented portion, at other times a segmented or annulate portion of the body, occasionally, as in the true scorpions, prolonged into a segmented tail: in one small but very distinct group (*Thelyphonidea*), the abdomen is prolonged into either a simple button, a short jointed, or a more or less long setiform tail; in another large group (*Araneidea*) the abdomen terminates with organs (spinners and spinnerets) for spinning threads. The *eyes* (when present) are simple, always sessile, and placed on the fore part of the cephalothorax; they seem to represent the simple ocelli of the Insecta; the large compound eyes of that order having here no representation, the caput of Arachnids appearing to begin at a point posterior to that which bears the antennæ and compound eyes of insects. In Arachnida the number of eyes varies from two to twelve. In front of and articulated beneath the fore part of the cephalo-thorax, and moving in different planes in different groups, are two independent, variously modified, organs for seizing and compressing the insects or other substances on which Arachnids in general prey; these organs are often called mandibles, but more generally, and very appropriately, *falces*: these are considered by some systematists to be the true homologues of the antennæ[2] in insects, and to have been derived from those portions of the insect organisation by long and unceasing modification; when, however, the caput of an Arachnid (scorpion or spider, for instance) is compared with that of a coleopterous or hymenopterous insect, in which the mandibles are well developed, there seems far more reason to conclude that the *antennæ* of the insect *have no homologue at all in the Arachnid* (Claparède, *l.c. post*), but that the falces of the latter are the true representatives of the mandibles of the former. Behind the falces (and also used in manducation) are two other large movable portions of structure called maxillæ; these vary in shape and size, and form in fact lateral and hinder boundaries to the mouth, as well as an apparatus for comminuting and squeezing the food substances; from each of these maxillæ, on the outer side, springs a palpus of four or five joints, varying in structure and use. Between the maxillæ most Arachnids have also a fixed piece (*labium*) of various form, completing the hinder limits of the mouth organs, and in some (perhaps in most) there is, within the parts already named, another portion (*tongue*), not yet sufficiently observed either in regard to its form or use, but probably acting so as to hinder choking. In some Arachnidans these different parts of the mouth are soldered together and form a tolerably simple sucking apparatus, analogous to the mouth of some insects (*Hemiptera*, &c.) As observed above, Arachnids are not, in a proper sense, subject to metamorphosis: in most of them there is little real change after they leave the egg; though, in some of the lowest forms, indeed, there are after-changes by moultings of the skin, which approach the incomplete metamorphoses of some insects.

With respect to the *internal organisation* of the Arachnida, it might perhaps be enough here to refer to the more detailed accounts given further on, where the separate *orders* are under consideration; but the following summary will probably make our general view of the whole sub-class more complete.

Muscular System.—Of this it is enough to say that it is similar to that of the rest of the Articulata, consisting of flexor and extensor muscles, situated within the hollows of the limbs, besides groups of fibres by which the epidermis and parts within it are connected and held together. On the outer surface these groups frequently show, at their points of union, boss-like marks or foveæ, or impressed spots of various forms and sizes, often presenting by their position distinctive peculiarities of form; it is probable that many others of the external specific markings are dependent on the course and position of the muscular fibres, as well as of the heart and other organs.

Circulatory System.—The vital fluid is circulated by means of an elongated muscular vessel or heart, varying in form, and, instead of being placed, as in the Vertebrata, on the ventral side of the body, extending along the back of the abdomen. This vessel is often divided into chambers[3] or compartments by valves, having also valvular orifices on its upper side for the flowing in of the fluid (Newport), and giving off vessels (arteries) for its distribution to the rest of the body. In the lower forms, however, of Arachnids (among the *Acaridea*) no such principal muscular vessel is found, the vital fluid being in such cases supposed to circulate generally in the body, and to be distributed irregularly into different portions by the muscular movements of the intestinal canal.

Respiratory System.—Arachnids breathe by means of *tracheæ* (spiracular tubes, as in the Insecta), as well as by *pulmo-branchiæ*, said to be a kind of compound of the gill of fish and the lung of mammals, though in reality there seems better reason, as we shall see further on (p. 293), to consider the pulmo-branchiæ as merely peculiarly modified tracheæ;

[1] Embryology shows that the first pair of legs in arachnids are homologous to the labial palpi of insects (Claparède, *l. c. post*). This is strictly true according to their use in one order—Thelyphonidea; and in many of the Araneidea also these legs are chiefly used for feeling and exploring the obstacles in their way.

[2] Hence their name among French arachnologists, "Antennes-Pinces."

[3] L. Dufour (*Savants étrangers*, xiv pp. 594–609) controverts this in respect to the Scorpionides, and apparently with success, establishing the fact of the dorsal vessel being simple and unchambered.

both these organs have external orifices (stigmata) variously situated, but commonly in some part of the abdomen. In some Arachnids (certain groups of the *Araneidea*) respiration is effected by both of the above organs; while in others (certain of the *Acaridea*) no distinct organs of respiration exist.

Digestive System.—Digestion is effected by a simple alimentary tube or canal running from the mouth to the anus. This tube is various in its form, as well as in the intestines issuing from it; in some groups, as the *Araneidea* and *Acaridea*, the above canal has large lateral cæcal appendages; in others (*Scorpionides* and *Thelyphonides*) the alimentary canal has no such lateral enlargements. In some Arachnids there have also been found a liver (or mass of substance in the abdomen exercising the functions of a liver), an organ performing the part of kidneys, and salivary glands, often of large size, while in others no distinct organs of digestion exist.

Nervous System.—This consists of ganglia or nerve-knots, formed by enlargements of longitudinal nervous cords (generally two in number), differing in position and in the nerves issuing from them. In one large group (*Acaridea*) where the abdomen usurps, as it were, the place of all the rest of the body, there is no longitudinal nerve cord; a single nerve mass occupies the interior of the abdomen, and sends forth nerves to the various surrounding parts.

Generative System.—Generation is effected by two distinct and separate sexes, the single exception known being the *Tardigrada*, a group of *Acaridea* approaching nearly to the Entozoa, and said to be hermaphrodite. In females the parts of generation consist of two sacs (ovaria), one on each side of the alimentary canal. These have a common external orifice (vulva), various in its shape, beneath the anterior extremity of the abdomen; and connected with this opening there is frequently an epigyne, or ovipositor, often of some length, and of characteristic form. In *males* (except among the phalangids and scorpions) there is no intromittent organ,—the generative parts consisting of two long tubes, similarly situated to the ovaria in females, in which the seminal fluid is secreted; these tubes end in a simple external, very minute orifice, in a similar situation to the vulva of the female.

Arachnids are either oviparous or ovo-viviparous. As before observed, they undergo no proper metamorphosis, but as growth takes place there are more or fewer successive moultings of the skin; and complete development of all the parts does not occur until the last moult, when the creature becomes adult, and so fitted to perpetuate its kind.

With regard to the position held by Arachnids in the great scheme of nature, it seems, from the considerations shortly entered into above, undeniable that they are very closely linked to the rest of the Articulata by much, both of external and internal structure, common to the whole branch. The office they subserve is evidently the keeping down of the superabundant supply of the insect world; some even operating to check the too rapid advance of higher animals.

Assuming that the operation, in some shape or other, of evolution has brought the different groups of Articulata to the varied forms and conditions they now respectively present, it is plain that the higher, at least, of the arachnidous orders must, in all probability, have been modified from some one or more of the other groups, perhaps in the main from the Insecta and Myriapoda,—certainly not the Insecta, for instance, from the Arachnida. Thus, we should define Arachnids, generally, to be insects modified for the purpose of preying upon their congeners; while some of the lower forms of Arachnids, such as *Demodex*, *Tardigrada*, and *Pentastoma*, carry us back to the remote past, before the branch Articulata, in any of its great groups, had attained more than a very slight progress towards its present dignified and highly organised forms.

The above being a general summary of the external and internal organisation of the Arachnida, an examination of the whole group shows us that their different characters, and the ways in which their articulated plan of structure is carried out, are variously correlated and modified, forming structural complications of several marked kinds, whence we get the different *orders*, being the next subordinate groups, into which Arachnids are divided. These *orders* are seven in number, and form so many well-defined groups, but of very different extent. Advancing from the more simple to the more highly organised, we begin with the *Acaridea*, comprising the mites and ticks, and including also the *Tardigradides*, *Pentastomides*, as well as *Demodex*. The second order is that of the *Pycnogonidea*, marine parasites, which, in a certain plane, appear to connect the Acaridea with the next or third order, *Phalangidea*; these last are popularly known as "Harvest-men." Next to them, and forming the fourth order, come the *Solpugidea*, a small but very distinct group, constituting a link in one plane between the *Phalangidea* and *Scorpionidea*, which last, including the Chelifers, or False Scorpions, form the fifth order. Not far removed from these is the sixth order, *Thelyphonidea*, comprising groups which partake of the characters both of the Scorpionidea and of the next—the seventh and last—order, *Araneidea*, or true Spiders.

Sub-Class.—ARACHNIDA

Orders.—I. Acaridea. II. Pycnogonidea. III. Phalangidea. IV. Solpugidea. V. Scorpionidea. VI. Thelyphonidea. VII. Araneidea.

The following abstract shows the chief ordinal characters of these seven groups of Arachnids:—

Order I. ACARIDEA.—Cephalo-thorax and abdomen united so as to form one piece, generally without mark of union; palpi and falces variable in structure; the several parts of the mouth often united; legs terminating variously, generally eight in number, sometimes only six in the immature state, and in one or two instances but four, even when adult; eyes, when present, variable in number (2 to 6), and placed on the cephalo-thorax; respiration, when proper organs for it exist, wholly tracheal; nervous matter gathered into one large mass, or ganglion; reproduction ovo-viviparous as well as oviparous. Maturity is reached by quasi, or imperfect, metamorphoses in some of the groups.

Order II. PYCNOGONIDEA.—Cephalo-thorax segmented, linear; abdomen rudimentary, forming merely a small terminal segment to the cephalo-thorax; the mouth consisting of the termination of a tubular article forming the head, sometimes accompanied by some more or less distinct parts; legs eight, multi-articulate; in females a supernumerary pair, between the first two and used for bearing ova; organs of respiration, none; metamorphosis imperfect, as in the last order.

Order III. PHALANGIDEA.—Cephalo-thorax and abdomen of tolerably equal size, and united throughout their whole breadth, but the junctional line evidently marked; abdomen annulate or segmentate, caused by transverse folds in the epidermis; falces two-jointed, didactyle; legs in general inordinately long, and very slender; the two terminal joints multi-articulate, and ending with claws; eyes two, on the vertex of the cephalo-thorax; respiration tracheal; reproduction oviparous; no metamorphosis of even an imperfect kind.

Order IV. Solpugidea.—Cephalo-thorax distinct from the abdomen and segmented, the first segment forming the head; abdomen annulate; falces one-jointed, didactyle; palpi terminating with a capsule containing a peculiar organ, the use of which is not yet known; eyes two, on a small eminence at the fore part of the head in the medial line; respiration tracheal; legs terminating with two curved fingers; manner of progressive growth unknown.

Order V. Scorpionidea.—Cephalo-thorax formed of one undivided piece, united to the abdomen throughout its entire breadth; abdomen annulate, prolonged (in one of the families) into a segmented tail, ending with a poison bulb armed with a sharp perforated point, through which the poison is emitted; falces didactylous; palpi terminating with a didactyle claw; eyes variable in number, two to twelve, variously grouped on the fore part of the cephalo-thorax; respiration, in one family, tracheal, in another, pulmo-branchial; ganglia several, distributed along the nervous chord; reproduction, in some oviparous, in others ovo-viviparous; organs for spinning beneath the fore part of the abdomen in one family; no metamorphosis.

Order VI. Thelyphonidea.—Cephalo-thorax undivided, but its segmental structure generally visible in grooves and furrows, following the course of the soldered joints; abdomen annulate, joined to the cephalo-thorax by a pedicle; palpi very strong, didactylous (in a modified form); falces monodactylous; legs of the first pair excessively long, antenniform, the last joints very fine, multi-articulate, and devoid of a terminal claw; eyes, when present, eight, disposed in three groups on the fore part of the cephalo-thorax; abdomen either terminating with a button-like segment, a short two-jointed tail, or a multi-articulate setiform one; respiration pulmo-branchial; manner of progressive development unknown. In one family, ganglia two, closely united; in others unknown.

Order VII. Araneidea.—Cephalo-thorax undivided, but traces of segmentation commonly more or less visible, united to the abdomen by a narrow pedicle; abdomen without segments or annuli, ending with organs for spinning; falces monodactylous; palpi more or less filiform in males, with the last joint more or less complicated in structure, and used in copulation, terminating in females (but not invariably) with a claw or claws, sometimes pectinated; legs terminating with two or three curved claws, and, except the third (which is rarely so), generally more or less pectinated; ganglia two or three in number; respiration tracheal, as well as pulmo-branchial; reproduction oviparous.

We have thus far obtained a general view of the leading groups of the sub-class Arachnida, both in respect to its relation to collateral groups of equal value, and the relation of its own members to each other, and also a synoptical view of the leading characteristics of the seven orders into which Arachnids may be divided. We now propose to touch shortly, but in greater detail, upon each of those orders, and, as far as our limits will permit, upon the families and genera comprised in them, adding a few general remarks upon each group.

Order I.—Acaridea.

The inclusion in this order of such aberrant forms as Demodex, Pentastoma, and Tardigrada, somewhat destroys its homogeneity; undoubtedly they indicate a passage from the Annelides (Anarthropoda) to the Arthropoda, but whether it would not be more consistent with a strict scientific method to separate the two latter, at least, from the Acaridea, and make each the type of a distinct order, is a point for the future consideration of systematists. At present the balance of opinion appears to be for including them as the lowest transitional forms of the lowest order of Arachnids. With regard to the position of Tardigrada, see Packard's *Guide to the Study of Insects*, p. 668, where Claparède is quoted from his *Studien an Acariden*; also *Introduction to the Classification of Animals*, Huxley, pp. 123–124, where the position of Pentastomides is also considered. See likewise on this, Cobbold's *Entozoa*, part iii. pp. 393–402, where reference is made to Leuckart's *Bau- und Entwicklungsgeschichte der Pentastomiden.*

Owing to the excessively small size of most of the Acaridea, and their obscure mode of existence, much of their economy and internal structure is yet unknown. The following is an endeavour to present their characters in somewhat greater detail than in the short abstract given above.

External Structure.—In their general form the Acaridea are more or less round, oblong, or oval; the integument in some is soft, in others coriaceous, and some are quite hard, like a Coleopterous insect.

The cephalo-thorax and abdomen are consolidated into one piece devoid of articulations; not only is the head, as in other Arachnids, soldered to the thorax, but the portion (cephalo-thorax) formed by this union is generally joined invisibly to the abdomen, which is consequently merged in the general covering of the body. In the family Bdellides, however, and also in some other instances, the junctional points of the different parts of the body are visible enough. The legs are eight in number in the mature acarid, except in Pentastoma, which in a state of maturity has none (fig. 1)—the four abnormal-looking legs visible in the young state disappearing in the adult (fig. 2). Many other Acaridea have six legs only until the last moult, when maturity is attained, one or two, even in the adult state, being said to have but four. Each leg consists in general of seven joints, and the tarsi end, in some, with two movable hooks; in others the tarsus is dilated at its extremity as if for feeling with, while in some of those whose habits are aquatic it is expanded; in short, the structure of this part is very various, and adapted to the habits of the different genera.[1] Dugès distinguishes the different kinds of legs as follows:—1. *Palpatorii*; 2. *Gressorii*; 3. *Remigantes*; 4. *Cursorii*; 5. *Textorii*; 6. *Carunculati.*

The parts of the *mouth* consist of two movable pieces, or falces, in front of which is another piece (labium); on each side of the labium is a strong piece (maxilla), and from the outer side of each of the maxillæ springs a palpus of four or five joints. The different forms and structure of these parts give good characters for the subordinate divisions of the Acaridea. The mouth parts in the species of Acaridea present greater variety than is to be found in any other order, no doubt owing to the greater variation in their mode of existence. In some instances the falces, maxillæ, and labium form, by their union, a sort of tube or proboscis fitted for piercing, holding on to, and sucking the juices of their prey; when not so united, the falces are terminated variously by a didactyle claw, somewhat like the claw of crab, or by a movable fang (sometimes twofold) as in the true spiders (Araneidea), or they consist of "two long styles, which by moving backwards and forwards alternately, perforate the substance of their prey."

The *palpi* of Acaridians are also variously formed, and, like the legs, have been minutely and well distinguished by Dugès, who (*l.c.*) divides them into seven kinds.—1. *Rapaces*, armed with hooks for seizing hold with. 2.

[1] Dugès's "Recherches sur l'ordre des Acariens," *Ann. Sc. Nat.*, 2e ser. t. i. ed. 2

Anchorarii, found in aquatic species, and used for retaining their position by means of terminating points. 3. *Fusiformes*, without any claw on the last joint. 4. *Filiformes*, as their name implies, filiform, or not at all tumid. 5. *Antenniformes*, chiefly differing from the last in their greater length. 6. *Valvæformes*, flattened, or excavated, or sheathed in form. 7. *Adnati*, or united throughout the greater part of their length to the labium, and always slightly developed.

The *eyes* in very many Acaridians are entirely wanting; When present they vary in number, being generally two, four, or six, and are placed on the cephalo-thorax; sometimes, as in the family Hydrachnides, they apparently consist of mere spots of pigment beneath the cuticle;[1] in some other cases there is but one eye, which is composed of a varying number of small facets.

INTERNAL STRUCTURE.—The *Organs of Digestion* consist, in many species, of a short intestinal canal, which branches out into lateral cæca, "*à sa partie stomachale*," and has an anal orifice on the lower side of the abdomen, more or less near to its posterior extremity (Walck., *Ins. Apt.*, iii. 135). The researches of Dujardin (*Ann. Sc. Nat.* 1845, tom. iii. p. 14) show in two families (Hydrachnides and Trombidides) a curious modification of these organs. In this, the juices upon which these creatures exist are sucked in, apparently, into simple cavities in the substance of the body; these cavities are without walls of any kind, and from them the juices circulate through the body, and thus form its support.

The *Organs of Respiration* consist generally of tracheæ, communicating outwardly with the air by means of minute orifices, "stigmata," which, in the genus Oribates, are situated between the first and second pairs of legs. In one numerous family (*Acarides*) no special organs for breathing exist, respiration being apparently effected by the general surface of the body. Different genera exhibit these two modes of respiration in various forms of union. M. Dujardin (*l.c.*, p. 17) speaks of tracheæ, in the family Trombidides, having an external orifice at the base of the falces on their upper side,—the use of these tracheæ being for expiration, while inspiration is performed through the general surface of the body and the plumose hairs attached to it, or, as in the family Hydrachnides, by "stomata," *i.e.*, apertures covered with very delicate membrane.

The *Nervous System* in Acarids is ganglionic, as in the rest of the Articulata; and, as we should expect from the simple form of the body (occasioned, as we have seen, by the almost complete fusion of the head and thorax in the abdomen) extremely simple. In the families Trombidides and Acarides, and probably in the rest also, the nervous apparatus consists of "one large globular ganglion, from which nervous filaments are given off, both before and behind."

With regard to the *Circulatory System* in the Acaridea too little, apparently, is yet known to make it possible to speak certainly. It is highly improbable but that, in some of the higher groups, distinct organs exist, though such do not yet appear to have been discovered. The results hitherto are negative; no traces of circulatory organs have been found in such of the lower acarids as have been subjected to minute dissection, and hence the supposition[2] that the intestinal canal, by means of muscular movements and contractions, operates in the irregular propulsion of the vital fluid to various parts of the body.

The *Reproductive System* of the Acaridea is very simple. The external organs consist of an opening on the ventral surface, generally between the coxæ of the hinder pair of legs. Acarids are both oviparous and ovo-viviparous; in the latter case the young are produced through a large orifice or vulva nearly one-third of the length of the body, and closed by two valves. Some are supposed to be hermaphrodite, but this, though true of the Pentastomides, is uncertain in respect to others of this order. Parthenogenesis, however, certainly exists in some species. The ova appear commonly to be produced in the substance of the general tissue of the body without the presence of any ovarian apparatus with distinct walls; it is certain, however, that ovaries are present in some species—in the family Trombidides, for instance, in which a tubular double branched ovarium was discovered by Dujardin. Some of the Acaridea, as Tetranychus, produce silk, and spin webs, but the silk-secreting organs have yet to be discovered; neither do any external organs, such as spinnerets, appear yet to have been noticed. The development of Acaridians from the egg is a subject of great interest and importance, for which, see Claparède's *Studies on Mites* (*Studien ar Acariden*), and Siebold in *Kölliker's Journ. Sc. Zool.*, 1868, part iv.

GENERAL OBSERVATIONS.—Acaridians are universally distributed; they are to be found under stones, dead leaves, or bark of trees, in the ground, in water, in unrefined sugar, upon dried meat, fruits, cheese, and putrid animal matters, upon all of which they feed. Some are parasitic, both externally and internally, in the flesh of different animals, living upon the juices of the creatures they infest. One species, *Sarcoptes Scabiei*, is the cause of the disease called the "itch;" another is our troublesome "Harvest-bug." Some are parasitic upon insects of different kinds; others are said to have been found in the brain and eyes of man. All are small, great numbers almost microscopic; the smaller kinds, particularly of the Acarides, are very difficult to preserve as cabinet objects, and from this, as well as from their minuteness, the order, generally, does not receive that attention to which, from their diversified forms and modes of life, Acaridians are certainly entitled.

From various considerations of structure, the Acaridea may be divided into ten families, each containing one or more genera. These families may shortly be characterised as follows:—

Fam. 1. *Pentastomides.*—Body annulate, vermiform, lancet-shaped; the segments of the cephalo-thorax continuous with the body, and furnished with four strong claws or rudimentary legs; this appears (Rolleston, *Forms of Animal Life*, p. 118) to be the larva or immature state, the adult form being destitute of limbs (which are replaced by four hooks—two on each side of the mouth), and reversing the ordinary progress of many acarids, from a fewer to a larger number of legs; organs of respiration and circulation, none (Huxley). On this abnormal family, of which one genus and eighteen species have been described, see Cobbold's *Entozoa*, pp. 393–402, and authorities there quoted. (See figs. 1, 2.)

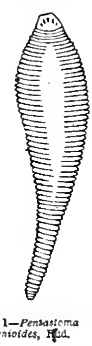


FIG. 1—*Pentastoma tænioides*, Rud.

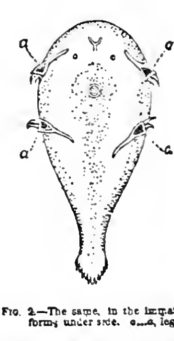


FIG. 2—The same, in the immature form; under side. a...a, legs.

[1] Rymer Jones, *An. King.*, 2d ed. p. 411.
[2] See Packard's *Guide to the Study of Insects*, p. 627.

Fam. 2. *Tanurides* (ταναός, long, οὐρά, a tail).—The type of this family is *Demodex folliculorum*, Simon (fig. 3), a very curious parasite found in the follicles of the human nose—hence its specific name. It is long and slender; the abdomen drawn out into a wormlike tail; the fore part or cephalo-thorax has in the adult state four pairs of rudimentary legs, in the immature state three pairs. This is one of the lowest forms of acaridians, and presents in its adult state the immature vermiform appearance of the higher genus Typhlodromus (Packard, *l.c.*)

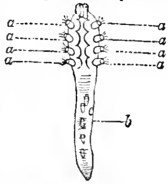


FIG. 3.—*Demodex folliculorum*, Simon; under side. *a...a*, rudimentary legs; *b*, abdomen.

Fam. 3. *Tardigradides*.—Body cylindrical, vermiform, but with no distinct abdomen; it is furnished throughout its whole length with four pairs of rudimentary limbs, of which the fourth pair is quite at the posterior extremity; eyes, two; falces, style-like. These animals are microscopic in size and aquatic in habits; they are hermaphrodite, and are now generally held to be acarids of a very low grade (Packard, *l.c.*, p. 668). Several genera have been characterised. Fig. 4 represents *Milnesium tardigradum*, Schrank.

Fam. 4. *Acarides*.—We now come to the more typical forms of Acaridea.

The family Acarides have a soft, thin-skinned body, with the thoracic junction often visible; falces either scissor-like or styliform; maxillæ obsolete; legs of the two first pairs often widely distant from those of the hinder ones; in some lowly organised forms, "face-mites," four legs only are found; perhaps these are the immature form of some other species (?); eyes, none. In this family are included the cheese, itch, and sugar mites, with numerous others parasitic on various animals. Some forms, as *Heteropus ventricosus* (Newport), *Dermaleichus*, and *Typhlodromus*, particularly in the immature state, exhibit an evident link between the last two families and the higher acarids; on the agamic reproduction of a species of this family (Cheyletus) see R. Beck in *Q. J. Microsc. Sc.*, April 1866; also Newman's *Zoologist*, 2 ser., i. p. 236.

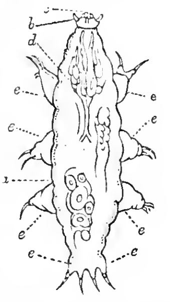


FIG. 4.—*Milnesium tardigradum*, Schrank. *a*, ovary; *b*, palpi (?); *c*, parts of mouth; *d*, alimentary canal; *e...e*, legs (rudimentary).

Fam. 5. *Oribatides*.—Body hard and horny; the thoracic junctions visible; form of the abdomen, round, globular, oval, quadrangular, or hemispherical; palpi, short; maxillæ, large and toothed; eyes, almost obsolete; cephalo-thorax, generally with two wing-like projections and two or three cup-shaped pedicellated stigmata on the edge, leading to the respiratory tubes. The Oribatides in general live on vegetable matter, and several genera have been characterised. The immature forms of many species vary greatly from the adults, so that numbers have been described as distinct species. See on this family an elaborate paper by M. H. Nicolet, in the *Arch. du Mus.*, t. vii. pp. 383–482, pls. 24–33.

Fam. 6. *Gamasides*.—Body, oval, flattened; epidermis, dense; falces, scissor-like; maxillæ, free; legs, equal in size and of similar form; eyes, obsolete. There are several genera of this family parasitic on various animals.

Fam. 7. *Ixodides*.—Body, round, oval, or somewhat oblong, of a leathery consistency; palpi, short, three or four jointed; falces, saw-like, and, with the other parts of the mouth, joining in the formation of a beak for thrusting into and holding on to their prey. Eyes, often obsolete; legs weak. On the generation of Ixodes, see a paper by Prof. Gené, communicated by A. Tulk to *Ann. and Mag. N. H.*, No. 188, Sept. 1846, p. 160. When gorged with the juices of their victim the abdomen attains an enormous size, and appears almost to obliterate all the rest of the body. In this family are comprised the "ticks" (Ixodes), which are often so tormenting to mankind, and domestic and other animals (figs. 5, 6). Among these ticks is included also the noted genus *Argas*, of which a species, *A. reflexus* (Latr.), has lately been found at Canterbury, England. Some of the largest known acarids are contained in this family.

Fam. 8. *Hydrachnides*, or water-mites.—Body, oval, or almost globular; palpi, short; legs, ciliated for the purpose of swimming; eyes, two. These acarids are found in salt as well as in fresh water. Some are parasitic, when immature, on water-bugs and water-beetles; others, through life, on the gills of the fresh-water mussel.

Fam. 9. *Trombidides*.—Body, stout, round, or oval, and often somewhat oblong; frequently broader before than behind; sometimes clothed densely with a kind of pubescence. The two hinder pairs of legs far removed from the two fore pairs. Eyes, two. The colour of the species of this family is generally of a bright red.

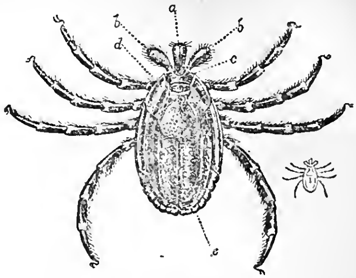


FIG. 5.—*Ixodes ægyptius*, Savigny. *a*, falces; *b*, *b*, palpi; *c*, caput; *d*, cephalothorax, *e*, abdomen.

scarlet, or yellowish. Among them is the red mite, *Tetranychus telarius* (Linn.), popularly called the "red-spider," which infests hothouses.

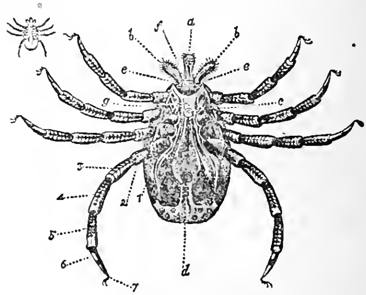


FIG. 6.—The same; under side. *a*, falces; *b*, *b*, palpi; *c*, genital aperture; *d*, anal orifice; *e*, *e*, *f*, maxillæ and labium soldered together; *g*, sternum.

Fam. 10. *Bdellides*.—Body, oblong-oval, showing the junctions of caput, thorax, and abdomen; palpi, long; eyes, two to six, sometimes obsolete; legs, long and strong; parts of the mouth forming a tapering pointed beak of greater or less length, and looking like a prolongation of the caput. The Bdellides live in damp places, under moss, &c., and on the floors of caverns.

The above characters of the Acaridian Families are abridged chiefly from A. S. Packard's *Guide to the Study of Insects*. Besides Claparède's *Studien an Acariden*, and Nicolet's *Mémoire* on *Oribatides*, and other works above noted, may be mentioned Dr C. Heller on the anatomy of *Argas persicus*, *Sitzungsb. d. K. Akad. d. W. Math. Naturw. Cl.* Bd. xxx. No. 16, 1858, pp. 297–326, Taf. i.–iv.; Charles Robin's *Mémoire zoologique et anatomique sur diverses espèces d'Acariens de la Famille des Sarcoptes*, 1860, with 8 plates; also by same author, "Mémoire sur les Sarcoptes avicoles, et sur les metamorphoses des Acariens," *Comptes Rendus*, tom. lxvi. pp. 776–786; H. A. Pagenstecker, *Beiträge zur Anatomie der Milben*, Heft 1, "Trombidium," 2 Taf. 32 pp., Leipsic, W. Engelman, 1860; P. J. van Beneden, "Recherches sur l'histoire naturelle et la développement de l'Atax Ypsilophorus (*Hydrachna concharum*)," *Nouv. Mém. de l'Acad. de Belge.*, tom. xxiv. 1850 (24 pp. ed. 1. pl.) Of the older works on Acaridea may be mentioned that of Hermann, *Mémoire Apterologique*, in fol., Strasbourg, 1804; and P. Gervais, in Walckenaer's *Ins. Apt.*, tom. iii. pp. 132–288, pls. 31–36 and 38, 1844; Doyère, "Mémoire sur les Tardigrades," *Ann. Sc. Nat.*, 2 ser. "Zool.," tom. xiv. 1840, pp. 269–361; Suite, *Ibid.*, tom. xvii. 1842, pp. 193–205, and tom. xviii. 1842, pp. 5–35, with 8 plates; P. J. van Beneden, "Recherches sur l'organization et la développement des Linguatules (*Pentastoma*, Rud.) suivies," &c., 39 pp. with 1 pl., in *Nouv. Mém. de l'Acad. de Belge*, tom. xxiii. 1849.

Order II.—PYCNOGONIDEA.

The creatures of this order form a small group which it appears now necessary to receive among the Arachnida, though their true position has been hitherto (and to some extent still is) a matter of much difference of opinion among naturalists. They seem to connect the more typical Arachnida with the Crustacea, and also to form a passage from the Acaridea to the Phalangidea. It appears, however, when their peculiar structure, both external and internal, is considered, impossible to include them within either of those orders; it is therefore proposed here to constitute them a separate order between the acarids and phalangids. The characters of the order are—

EXTERNAL STRUCTURE.—*Body*, linear, composed of four segments; *caput*, tubular, in form of a beak or proboscis, and either simple, or ending with palpi and mouth organs; *abdomen*, rudimentary; *legs*, eight (each thoracic segment bearing a pair), very long, and consisting of eight to nine joints, terminating with a claw or claws. In the immature (so-called larval) state the legs are four only in number. The females have a supernumerary pair between those of the first pair, used for carrying the ova. *Palpi*, when present, filiform, and composed of five to nine joints terminating with a claw. *Eyes*, four.

With regard to their *internal structure*, the Pycnogonidea have a dorsal vessel (circulatory apparatus) divided into chambers, a stomach sending forth cæcal prolongations into the legs and palpi, an abdominal intestine with dilated cloaca, and a nervous system, consisting of a cephalic and opththalmic ganglia, closely united together and joined by the œsophagian fillet to the abdominal ganglia, which are four in number, of large size, sessile, and emitting from their lateral extremities nerves into the legs (Cuvier's *Règn. An.*, edition cited *post*, pl. 22), but no organs of respiration (Huxley, *l.c.*, and Cuvier's *Règn. An.*, *l.c.*)

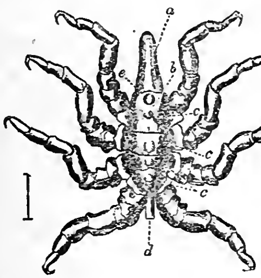


FIG. 7.

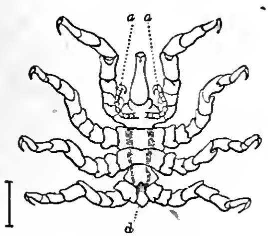


Fig. 8.

FIG. 7.—*Pycnogonum littorale*, Müller. *a*, parts of mouth, forming a beak; *b* caput; *c...c*, thoracic segments; *d*, rudimentary abdomen; *e*, eyes
FIG. 8.—The same; under side. *a*, *a*, supernumerary pair of legs.

This order contains but one family, *Pycnogonides*, divided into several genera—Pycnogonum, Phoxichilus, Nymphon, and Ammothea. Some of the species are parasitic on cetaceous animals, others are found secreted among seaweed along the sea-shore, and feed on small marine animals. Some are British, and others exotic.

The genera may be thus shortly characterised.

Genus *Pycnogonum* (Brunnich).—Body short and thick; legs, short, strong; without either falces or palpi. The species of this genus are parasitic on the cetacea. Figs. 7, 8, *P. littorale* (Müller).

Genus *Phoxichilus* (Latr.)—Body narrow; legs of great length; falces present, but no palpi.

Genus *Nymphon* (Fabr.)—Resembles Phoxichilus in the narrow body and long legs, which are also slender, as well as in having falces; but in the present genus there are also two palpi, each of five joints. Fig. 9, *Nymphon coccineum* (Johnston).

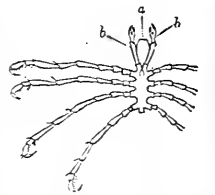


FIG. 9.—*Nymphon coccineum*, Johnston; under side. *a*, head; *b*, *b*, palpi.

Genus *Ammothea* (Leach).—Body short and rather broad; legs long; beak of great size and length; much longer than the falces, which are short. Palpi 9-jointed, the third joint much the longest; terminal tarsal claws double, and of unequal size. Supernumerary legs 9-jointed, and inserted under the first pair of legs behind the beak.

The latest authority in regard to their systematic position, *i.e.*, whether Crustacean or Arachnidan, is Dr Anton Dohrn, who says in a memoir, "Ueber Entwicklung und Bau der Pycnogoniden" (contained in a publication, entitled *Untersuchungen über Bau und Entwicklung der Arthropoden*, Leipsic, Engleman, 1870): "Die Pycnogoniden sind weder Arachniden noch Crustaceen." Dr Dohrn enters fully into the development and structure of *Pycnogonum littorale*, and of a species of another genus formed out of Phoxichilus, *Achelia lævis*. The present writer has not, however, had an opportunity of studying this memoir

Order III.—PHALANGIDEA.

The Phalangidea present a very well defined and compact group, though the transition, in one plane, from the Acaridea, through the families Cyphophthalmides and Trogulides, is tolerably apparent, while in another plane they show evident affinity to the Pycnogonides. The following are more detailed characters of the order:—

EXTERNAL STRUCTURE.—The *body* is of a more or less round, oval, or oblong, and sometimes quadrangular form; the integument is either hard and horny, or coriaceous, and generally destitute of hairs, but often tuberculous and armed with spines.

The *cephalo-thorax* and *abdomen* are united throughout their whole breadth, the junction frequently shown by a slight constriction, but always visible from a strongly-marked groove or ridge; the upper side of the cephalo-thorax, and sometimes of the abdomen, is frequently furnished with spines, sharp teeth, or tubercles. The abdomen is articulate, or segmented in a modified form, from several more or less strongly developed transverse foldings in the epidermis.

The *mouth organs* are rather complex (fig. 11), consisting of three pairs of maxillæ, above which is a tongue (*languette*); and below the maxillæ is a membranous lip (*labium*). From the first pair of these maxillæ there issue two five jointed palpi, the intermediate joints of which often exhibit processes or branches, the last or digital joints ending with a claw. The other two pairs of maxillæ support the basal joints of the two first pairs of legs. The presence of these supernumerary, or crural, maxillæ strongly supports the idea long since advanced by Savigny and others, that the palpi are but modified legs (see, however, note 1, p. 272 *supra*); the same idea being also raised in regard to the Thelyphonidea and Solpugidea by the use as palpi of the first pair of legs, which are in fact completely palpiform, and differ markedly from the rest in their structure. Above these parts, directly in front of the upper extremity of the cephalo-thorax, are two *falces*, each of which consists of two, or (in *Cyphophthalmides*, G. Joseph) three joints;

the second joint terminates with a didactyle claw or pair of pincers, formed by a movable claw acting in opposition to a fixed one.

The *falces* vary greatly in their size and development. The terminal joint is sometimes articulated to the basal one at the extremity of its longer axis or at its end; at other times it is attached by its shorter axis, or more or less near the middle. In some species they are furnished with processes or horny prolongations, differing in size and form in different species; this is, however, only a modification of the last mentioned mode of articulation.

The *legs* are, in most species, very long and slender; in some groups they are, however, shorter and stronger, while in others they are of extreme length and tenuity. They are eight in number; the seven normal joints, of which each is composed, may be more properly described as consisting of five invariable and two variable ones; the sixth (or metatarsus) being divided into several immovable divisions, and the seventh (or tarsus) subdivided into a greater or less number of minute movable articulations, the terminal one furnished with one or two fine claws. The legs are often armed (some, at least, of their joints) with strong spines and spiny processes; this is particularly the case in the family Gonyleptides. The first joint (coxa) of each leg is immovable, being fixed to the side and under part of the cephalo-thorax. Between the fixed (or basal) joints of the legs is an oblong, or at times somewhat obtusely triangular, *sternal plate*, divided at its base from the abdomen by a transverse groove; the anterior extremity is free, and beneath it is concealed (according to the sex) the penis of the male, or the ovipositor of the female; in some species of Phalangides these organs are of great length and varied in form; this sternal plate forms the lower side of the cephalo-thorax. The *eyes*, two or eight[1] in number, are generally of large size, and situated on the sides of a common eminence on the upper side of the cephalo-thorax; this eminence is often armed with spines and tubercles.

INTERNAL STRUCTURE.—*Muscular System.*—Every one who has seen the mode in which the Phalangides run would naturally suppose that the muscles required to keep the body raised and balanced between their long slender legs in rapid course must be exceedingly strong; and this is found to be the case. The muscles are of large size, consisting of numerous strong "fasciculi," which arise from the interior of the basal joints (coxæ) of the legs, and, almost entirely filling up their hollows, pass on into the next joint (trochanter), and so on to the end of the second part of the tibiæ; thence two long delicate tendons, continuing forwards, traverse the whole length of the tarsal joints, running along their under surface. The muscles by which the falces and palpi are worked consist of an *elevator* and a, somewhat larger, *depressor* for each. Other muscles and muscular fibres connected with other parts and organs are minutely described by A. Tulk,[2] whose descriptions, however, cannot be usefully abridged, and are too extensive and detailed for our present space.

Organs of Digestion.—These consist of a simple longitudinal pouch forming the stomach or main intestinal canal, contracted at each end, enlarged in the middle, and giving off on all sides numerous lateral pouches or cæca of different sizes, to the number, in *Phalangium opilio* (Latr.), of thirty. These are minutely detailed by Tulk, who divides them into—(1), those on the dorsal surface of the main canal; (2), those on its ventral surface; (3), those on its sides. The pharyngeal tube and œsophageal canal are modified so as to be qualified not only for the passage of simple fluids, but also for solid substances; these first, however, having undergone a process of quasi-mastication by means of the external parts of the mouth. At the opposite end of the alimentary canal a simple, short intestine connects it with the anus, the external aperture of which is situated at the hinder extremity of the abdomen. With regard to the office of the lateral cæca, an examination of their contents has led to the suggestion that they secrete a peculiar granular substance, which is thence discharged into the stomach, and "agglutinates the particles of food together," covering them with a membranous integument which serves to protect the delicate coats of the intestine from laceration by the sharp and spiny nature of their food-contents (Tulk, *l.c.* p. 248). Biliary tubes have been described by Treviranus; but it seems probable that the anterior pair of these, at least, are tracheæ connected with the stigmata on each side of the fore margin of the cephalo-thorax. These stigmata were mistaken by Tulk for eyes (*l.c.* p.156).

The *Organs of Respiration* are tracheal. The stigmata in Phalangium (and Gonyleptes ?) are four in number,—two beneath the fore part of the abdomen, situated one at the base of each of the posterior legs, but usually concealed by the coxal joints, and one on each side of the fore margin of the cephalo-thorax; each of the former pair opens into a large obliquely longitudinal tracheal trunk; these two trunks give off various smaller branches and tubes, which convey the air to all parts of the body. With two of these tubes, probably, the cephalic stigmata are connected.

The *Organs of Circulation* are very simple, consisting, in Phalangium, of an elongated dorsal vessel acting as a heart, lying in a groove upon the upper surface of the alimentary canal, and divided into three chambers. Ramifications from this vessel serve to carry the vital fluid to every portion of the body (Tulk). From researches since made by M. Blanchard,[3] it appears that this fluid is recollected from the general circulation into two large lateral vessels (vascular sinuses), from which it is returned by other channels to the dorsal vessel, or heart itself. The structure of the heart consists of a series of transverse, curved, and muscular bands, leaving between them light and membranous intervals (Tulk).

The *Nervous System* of phalangids is very similar in its type to that of some other arachnids. Two large ganglia (cephalic and thoracic) occupy the cephalo-thorax, and from these nerves issue to the various parts, some of them leaving ganglionic enlargements in their course, whence again finer nerves distribute themselves to the adjacent structures. Tulk mentions a striking peculiarity connected with the nervous system of phalangids, which is a power possessed by them to move the nervous centres backwards or forwards at will; this is effected by means of several large transversely striated muscular fasciculi radiating from the sides of the thoracic ganglion, to which they are attached by short tendons (Tulk, *l.c.* 326).

The *Organs of Generation* in the Phalangidea (which are oviparous), are different from all other arachnids in the large external parts connected with them. In the female, the internal parts consist of an ovisac and ovarium (Tulk); whence, by means of the oviduct, the ova are conducted into the ovipositor. This is a long membranous tube; the first or basal part of it is surrounded by annuli or rings of hairs or bristles; towards the extremity it is scaly, and also furnished with some hairs, and the extreme point has two small lateral tufts of hairs. The ovipositor is protruded, at the will of the animal, from the vulva, which is situated at the fore margin of the sternal plate, or else it is, when at rest, withdrawn into its sheath, leaving no outward trace of it visible. In the male, the seminal vessels consist of a cluster of "slightly tortuous cæcal tubes," whence the spermatic fluid is passed by a duct into a penis of enormous length compared to the size of the animal (fig. 12, *d, e, f*). This organ is a slender curved tube, furnished at its extremity with a recurved hook, and contained in a sheath; both the sheath and penis when at rest lie in a longitudinal direction beneath the ventral surface, of the thorax, but can be protruded at will from the external aperture, which is similar, and similarly situated, to that of the female. The form of the penis varies in different species, as also does the ovipositor of the female. The organs of generation, both male and female, of *Phalangium opilio*, are detailed a great length by Tulk, *l.c.* Both the penis and ovipositor may be made to protrude by a slight lateral pressure beneath the fore margin of the sternal plate.

GENERAL OBSERVATIONS.—The Phalangidea have been found in all parts of the world, but though often very numerous in individuals, the number of species as yet discovered is comparatively small. In the British Islands, where about sixteen species have been observed, they are popularly known by the name of "Harvest-men,"[4] probably because most numerous at the time of harvest. They run with great rapidity over and among grass and low herbage, and many live among the leaves and mossy covering of trees, among moss on the ground, heath, and stems of herbage; also under stones, and among rubbish and debris. Their prey is small insects, the young of the true spiders, and some species of Acaridea. The small size of the body, compared with the inordinate length of the legs, in some genera is exceedingly striking. In an undescribed species of Leiobunus, from the Brazils, the length of the body is but a line and a half, while that of

[1] H. C. Wood, in *Trans. Amer. Phil. Soc.*, xiii. p. 440.

[2] "Upon the Anatomy of *Phalangium opilio* (Latr.)," *Ann. N. H.*, Nos. 76, 77, and 78, Oct. 1843.

[3] "De l'appareil circulatoire et des organs de respiration dans les Arachnides," *Ann. Sc. Nat.* 3 ser. "Zool.," xii. 318–352, pls. 6–8.

[4] "Monograph on the British Species of Phalangiidæ or Harvest-men," by R. H. Meade, F.L.S., *Ann. N. H.*, June 1855, pp. 393–416.

the longest legs exceeds fifty lines; being in the proportion of about 1 to 32. Phalangids part easily with their legs, or with portions of them; and when detached these legs retain the power of motion for a considerable time, due probably to sustained nervous energy. The order may be divided into about four well-marked families.

Fam. I. *Cyphophthalmides.*—Characterised by an oval, flattened body, short legs, with undivided tarsi; falces projecting far in front of the fore part of the caput, and three-jointed (Joseph). Eyes on pedicles, one on each side of the cephalo-thorax near the lateral margin.[1] One genus only, Cyphophthalmus (Joseph), and two species, *C. duricorius* (Joseph), and *C. corsicus* (Simon), have as yet been discovered, both of very small size, and both South European. They have an exceedingly acaridian appearance, and seem evidently to connect the acarids with the more typical Phalangidea. See G. Joseph (*Berl. Ent. Zeitschr*, 1868, pp. 241-250 and 269-272), who speaks of but two tracheal stigmata; probably the thoracic stigmata were overlooked. The form of the maxillæ appears to be peculiar.

Fam. II. *Trogulides.*—Somewhat similar in general appearance to the former family, but differing in the parts of the mouth being concealed beneath a kind of hood, which projects beyond the fore margin of the cephalo-thorax; and in the eyes, which are placed, well separated, in a transverse line at the constriction, where the hood joins the caput. Two genera,[2] Cryptostemma (Guérin) and Trogulus (Walck.), have been characterised; of the former one species only is yet known, *C. Westermanni* (Guer.), Guinea. Of the latter genus the species are few, and little appears to be known of their habits or economy; one only, of small size, *Trogulus Cambridgii* (Westwood[3]), has been found in England (at Bloxworth, among moss, by the Rev. O. P. Cambridge), remarkable from the dense clothing of short squamose hairs on the body, and hooked spine-like bristly hairs on the legs.

Fam. III. *Phalangides* (figs. 10, 11).—Characterised by their small,

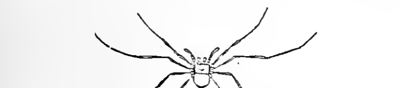


FIG. 10.—*Phalangium copticum*, Savigny. *a*, *a*, falces; *b*, eyes; *c*, cephalo-thorax; *d*, abdomen; *e*, *e*, palpi; *f*, junctional line of cephalo-thorax and abdomen.

round, oblong, or oval body; exceedingly long, slender legs, with multi-articulate tarsi; eyes close together, one on each side of a tuberculous eminence on the vertex of the cephalo-thorax (fig. 12, *a*); the eminence, as well as other parts of the body, often armed with spines. Falces (fig. 13) often of great size and length, the terminal joint articulated sometimes at its end, sometimes further on. Several genera of this family have been characterised, and numerous species recorded, mostly European, but our space will not permit of further details, which may be found in the work of Hermann before noted,

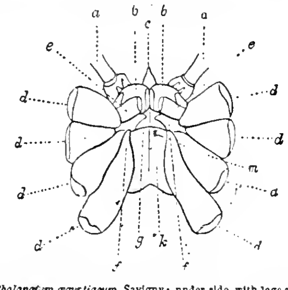


FIG. 11.—*Phalangium ægyptiacum*, Savigny; under side, with legs and palpi truncated, and without abdomen. *a*, *a*, palpi; *b*, *b*, maxillæ; *c*, tongue; *d...d*, first joints of legs; *e*, *e*, *f*, *f*, supernumerary maxillæ, supporting first two pairs of legs, and used in eating (?); *g*, membranous lip (*labium*); *k*, sternal plate (*sternum*); *m*, fore-margin of sternal plate, under which (at *) are sexual organs.

under *Acaridea;* also in those of Latreille, *Sur l'Histoire des Insectes connus sous le nom de Faucheurs* (*Phalangium*) (pub. 1802), and

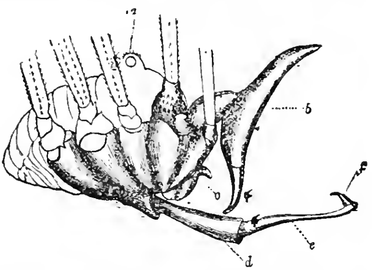


FIG. 12.—Harvest-man (*Phalangium cornutum*, Linn.); profile, with legs and palpi truncated. *a*, eye eminence; *b*, falces; *c*, portion of mouth apparatus; *d*, sheath of penis protruded; *e*, penis; *f*, the glans.

Herbst; in *Natursystem der ungeflügelten Insekten*, 1798-99; P. Gervais, in Walck. *Ins. Apt.*, vol. iii. p. 94; and Koch, in *Die Arachniden*, 1831-1848; and in numerous isolated papers by various later authors. Most of the anatomical details known of the order Phalangidea have been obtained from species of this family.

FIG. 13.—Falces and palpi of *Phalangium copticum*.

Fam. IV. *Gonyleptides.*—This differs from the last in the generally more or less quadrangular form, or roughly diamond shape; the cephalo-thorax is proportionally larger, often appearing almost entirely to overwhelm the abdomen; it is also more spinous and tuberculous; the palpi are longer, some joints often of great strength and length, and armed with strong spines, sometimes assuming, with the strong terminal movable claw, a raptorial appearance. The legs are shorter and stronger, and those of the hinder pair are usually armed with spiny processes, tubercles, and spines; the coxal joints being often inordinately developed, reaching to the extremity of the abdomen, to which, as well as to the cephalo-thorax, they are immovably attached. The tarsi are not multi-articulate. The species are tolerably numerous, and all exotic. Several genera have been characterised, on the species of the chief and typical one of which, *Gonyleptes* (Kirby), a Synonymic List, with descriptions of some new species, has been published by Mr A. G. Butler, in *Ann. and Mag. N. H.*, Feb. 1873, pp. 112, 117, pl. 3., continued in *Jour. Linn. Soc.* 1874, vol. xii. pp. 151-155, pl. 8. Some of the works quoted on Phalangides also treat of this family. H. C. Wood, jun., considers the order generally in *Trans. Amer. Phil. Soc., U.S.*, vol. xiii. pp. 435-442, pl. 24.

[1] Since the above was written, Professor Westwood has founded a new genus—Stylocellus—on *S. sumatranus* (Westw.) *Thesaurus Entomologicus Oxoniensis*, Oxford, 1874, p. 200, plate 37, fig. 7.

[2] Professor Westwood (*l.c.* p. 201) separates Cryptostemma, and (with Cryptocellus, a new genus founded on *C. fœdus*, Amazons, *l.c.* fig. 6) forms a new family CRYPTOSTEMMIDES, between Cyphophthalmides and Trogulides.

[3] *L.c.*, p. 202, fig. 6.

Order IV.—SOLPUGIDEA.

This order constitutes a small but very distinct and remarkable group of tropical and semi-tropical Arachnids. At first sight they remind us a good deal of the true spiders (Araneidea), but their position, when we examine their structural details, seems to be more naturally assigned between the Phalangidea and the next order (Scorpionidea) (figs. 14, 15).

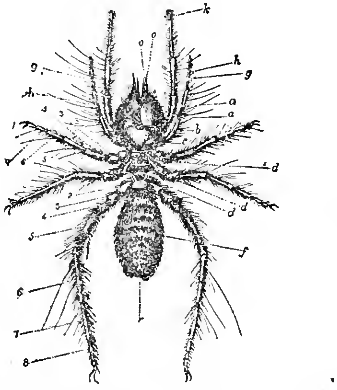


FIG. 14.—*Galeodes araneoides*, Pallas. *a, a,* falces; *b,* eyes; *c,* head; *d, d,* thorax; *f, f,* abdomen; *g, g,* palpi; *h, h,* palpiform legs; *k,* digital joint (capsule); *o, o,* shear-like points of falx; *r,* anus.

EXTERNAL CHARACTERS.—The *body* is elongated and clothed with hairs; it is divided, as in other Arachnids, into two main portions (cephalo-thorax and abdomen), but each of these portions is composed of several segments or articulations. The caput forms the first segment of the cephalo-thorax; and this is followed by three others closely united to each other, and of a somewhat quadrangular form. Close behind each coxal joint of the legs of the second pair is a small transverse slit or stigma leading to tracheæ.

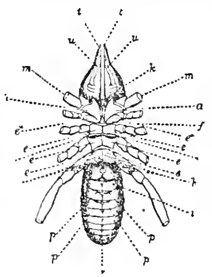


FIG. 15.—Under side of *Galeodes araneoides*, with legs and palpi truncated. *a, a,* maxillæ; *e...e,* basal leg joints; *e* e*,* first joints of first pair of legs; *f* labium; *h, h,* fish-tail appendages; *i,* external orifice of sexual organs; *k,* tongue; *m, m,* palpi; *o, o,* respiratory organs at base of second pair of legs; *p..p,* orifices leading to tracheæ at fore-margins of second and third segments of abdomen; *r,* anus; *t, t,* fixed upper fangs or claws of falces; *u, u,* movable lower ditto.

The *eyes* are two in number, and seated on a tuberculiform eminence on the fore part of the caput; this eminence is furnished with two long slender spines, placed in a transverse line between the eyes, and projecting forwards.

The *legs,* articulated by a fixed joint to the lower surface of the thoracic segments, are long and strong, furnished with hairs (some of which are remarkably long), bristles, and spines, varying in length and strength. The legs of the first pair are palpiform and not used in running, probably having the sole office of feelers. The number of joints of those of the first and second pairs is seven, while those of the third and fourth pairs have eight, an extra joint being inserted between the basal and next adjoining joints; the tarsi of the first pair are simple, or undivided, and terminate with two small curved claws, while those of the other three pairs are often divided into two, three, or more articulations, besides a small terminal or heel joint, from which spring two long curved finger-like claws, each ending with a curved (apparently movable) nail or talon. The number, however, of the tarsal joints appears to differ in some species from others, and even in the different legs of the same species. The legs of the second, third, and fourth pairs belong to the three thoracic segments respectively, while those of the first pair are closely united (and even soldered) by their basal joints to the basal joints of the palpi beneath the caput, thus furnishing an additional reason for supposing them to be more of a palpal than of a crural nature; between the bases of the first pair is a small triangular piece (with its apex directed forwards), unnoticed by authors hitherto (?) and which may be regarded as a rudimentary sternal lip (labium); on the under sides of the three basal joints of each of the fourth pair of legs is a longitudinal row of five curious scale-like or lamelliform appendages, of a subtriangular or somewhat fish-tail form, each articulated to a separate foot-stalk, which is again articulated to the surface of the leg joint; beginning from the basal joint the form of the last two of these appendages differs a little from that of the rest. That these remarkable portions of structure have some special office is scarcely to be doubted, but as yet their part in the animal economy has not even been conjectured. They appear to differ slightly in structure in different genera.

Articulated immediately below the fore-margin of the caput are two enormous, massive *falces,* each consisting of a single joint, and ending with a didactyle claw or pair of toothed jaws, the upper fixed, the lower movable, and articulated horizontally with a vertical movement, closing upon each other like scissors or shears; these falces are projected in a line almost parallel with the caput, and are generally equal in length to the whole of the cephalo-thorax. From the fore part of the upper side of each of the falces are often seen one or two curious elongate styliform appendages varying in size and form; their use, if any, which may be doubted, is unknown, they are probably distinctive of sex, and appear to be characteristic of species. Underneath the caput, and forming the basal joints of two long strong five-jointed palpi, are the *maxillæ;* these are strong, cylindrical, and have a more or less strong blunt-pointed apophysis at the extremity on the inner side. Like similar parts in other Arachnids, these maxillæ, in conjunction with the affixed basal joints of the first pair of legs, form the lower boundaries of the mouth, the labium (mentioned above) being apparently too rudimentary to subserve any practical purpose. The *palpi* are furnished with hairs, spines, and bristles similar to the legs, and the last (digital) joint consists of a kind of capsule containing a peculiar organ, said to be protruded only when the animal is in a state of irritation, the use of which does not appear to be known; doubtless it has some special function beyond that of a mere palpus, and the analogy of the use of the palpi in the males of the Araneidea would lead us to suspect a similar use in the present instance, *i.e.*, as connected in some way with the process of generation. Between and within the maxillæ is a portion of the *mouth organs,* composed of several parts of a peculiar shape, and furnished with two slender feather-like appendages; this is called by Walckenaer the lip (*lèvre*); but its place and office is undoubtedly more that of the tongue (*languette*), though probably in the rudimentary state of the true labium it partly performs the duty of a sternal lip. Dugès and M. Edwards in Cuvier's *Règne Animal* (Arachnides, p. 83), speak of the "labre," but it is evident from their description that a portion of the *languette* is alluded to, not the part mentioned above as representing the labium. The *abdomen* is oblong, oval, or somewhat elliptic in its form, about equally convex above and below, and composed of nine or ten articulations, which decrease in breadth from the fore to the hinder extremity; it is closely united to the cephalothorax throughout its entire breadth. The external orifice leading to the organs of generation is situated at the posterior margin of the first articulation, and besides the two stigmata before alluded to, behind the basal joints of the second pair of legs, there are two other stigmatic openings[1] at the hinder margin of each of the second and third articulations of the abdomen; these stigmata are protected by a kind of comb-like fringe, and the anal orifice consists of a long vertical slit situated at the extremity of the terminal articulation.

INTERNAL STRUCTURE.—The *Muscular System* of Solpugids appears to be very similar to that of other Arachnids; it has been fully displayed by Dr M. Kittary in the work quoted in note, of the present page.

The *Respiratory System* is tracheal and complicated. Five (according to Dr Kittary) openings at the hinder margins of the second, third, and fourth sub-abdominal articulations, lead to the abdominal tracheæ; these consist of three longitudinal parallel tubes, into the outer one of which the short branches from the external openings lead, and with these are connected various other branches supplying air to the different parts of the body. The abdominal tracheæ also lead into those of the cephalo-thorax, which have their outer openings (two in number) behind the basal joints of the second pair of legs. The thoracic tracheæ send branches into the legs, palpi, and falces.

There is probably some variation in different species in the details of their respiratory organs. *Galeodes Araneoides*, for instance, does not appear to have the fifth outward opening in the abdomen (fig. 15).

The *Circulatory System* consists of an elongated dorsal vessel or heart, running from the middle of the cephalothorax backwards through the connection between the thorax and abdomen, but does not reach the hinder extremity of the latter. The thoracic portion is of an oval form, but it contracts in passing into the abdomen, enlarging again gradually as it runs backwards. Dr Kittary does not appear to have traced the various vessels which, no doubt, exist to convey the vital fluid from the heart to the different parts of the body.

The *Organs of Digestion* consist of an elongated stomach in the cephalo-thorax, with lateral cæca; this stomach is continued backwards into the abdomen in the form of a long single intestinal canal, leading into a cloaca at its posterior extremity. A kind of branching network of minute vessels secrete urine, and convey it from the whole abdominal mass by several main branches into the hinder part of the intestinal canal. Beneath the stomach is an organ described as probably the liver, and another answering to the pancreas.

The *Nervous System* is not particularly complicated, but bears great resemblance to that of other Arachnids, especially of the Araneidea. It consists of one large principal ganglion, or united pair of ganglia, from which branch nerves are sent off in all directions to the different parts and extremities of the body; that which runs to the hinder extremity of the abdomen has an enlargement or kind of ganglion in its course.

The *Organs of Generation* are highly developed in the female, consisting of ovaries, and an oviduct leading to the external orifice. The male organs do not appear to be known. The Solpugidea are probably oviparous.[2]

The order Solpugidea comprises a single family, *Galeodides*, divided into five genera, characterised principally according to the number of the subdivisions of the tarsal joints of the second, third, and fourth pairs of legs:—1. *Rhax* (Hermann), the tarsi all one-jointed.[3] 2. *Aellopus* (Koch), tarsi two-jointed; those of the hinder pair destitute of claws (Koch). 3. *Galeodes* (Olivier), tarsi of the second and third pairs two-jointed, and of the fourth pair three-jointed. 4. *Solpuga*, tarsi of the second and third pairs four-jointed, and of the fourth pair seven-jointed. 5. *Gluvia* (Koch), all the tarsi undivided, *i.e.*, consisting of a single long thin joint.

Fifty-two species (of all the genera) have been described. See a recent paper, *List of the Species of Galeodides*, by A. G. Butler; also the older work of Koch, *Die Arachniden*. All the species, though varying considerably in size, are remarkably similar in general form and appearance, and nearly all are of sombre colouring.

GENERAL REMARKS.—The Solpugidea are nocturnal in their habits, living by day secreted under stones, among debris and rubbish, and in old ruined walls and buildings, in dry sandy places; from such retreats they come forth at night, and run with great swiftness. A recent traveller in Palestine relates, that when living in tents on the plains of the Jordan, near Jericho, each night, as nearly as possible between half-past nine and ten o'clock, several Solpugids entered the tent-door, running and racing with great speed over everything—tables, chairs, and beds—just like mad creatures, but apparently with no definite object, perhaps only attracted by the lights burning in the tent. When disturbed in their diurnal hiding-places they showed fight and were extremely pugnacious; but their being venomous is doubtful, though the Arabs seemed to dread them quite as much as they dreaded the true scorpions, which were also numerous under the large stones lying about. Some interesting details of the voracity and habits in confinement of a species of Galeodes, are given by Captain T. Hutton, *Ann. and Mag. N.H.*, 1843, vol. xii. p. 81. Like the Phalangidea, it swallowed the solid parts of insects, and even of a lizard five inches long. Captain H. assumes, as one use at all events, of the palpal organ mentioned above, that it is "a retractile sucker," to enable it to ascend smooth surfaces. This, however, is very questionable.

Order V.—SCORPIONIDEA.

In spite of differences in their internal anatomy, which appear to ally the Pseudo-Scorpionides more to the spiders than to the true scorpions, some leading features of external structure seem to stamp them at a glance as most nearly related to the latter. The impression inevitably created on a comparison of the true and false scorpions is that the latter are little scorpions without tails. Including them, therefore, here in the same ordinal group as the true scorpions, we may shortly characterise the order as follows:—*Body* elongated-oval; cephalo-thorax of one undivided piece, hard, horny, and often tuberculated or granulose, while traces of thoracic segments soldered together are generally more or less perceptible. *Abdomen* united to the cephalothorax throughout its entire breadth, and composed of several segments formed by articulated transverse coriaceous plates on the upper and under sides, united by two lateral cartilaginous membranes. *Falces* didactyle; *palpi* terminating with a didactyle claw or pair of pincers; the coxal joints of the legs, fixed to the lower side of the thoracic segments, form a kind of *sternum;* the sternal plate, properly so-called, being either wanting or very

[1] Dr Kittary in "Anatomische Untersuchung der Gemeinen (*Galeodes araneoides*) und der furchtlosen (*Galeodes intrepida*) Solpuga," *Bull. Mosc.* 1848, No. iv. tab. vi. fig. 2, *b, b, b*, indicates in *G. intrepida* a fifth stigmatic opening at the hinder margin of the fourth abdominal articulation.

[2] A more recent work on Solpugidea than that of Dr M. Kittary, is by L. Dufour, *Mem. Acad. Sc.*, tom. xvii. pp. 338–446, 1862.

[3] According to Koch, and also to Savigny, in his excellent figures. Dufour, who, *l.c.*, says *Rhax* has two-jointed tarsi, evidently had a species of some other genus before him, probably *Aellopus* (Koch), or else reckoned the metatarsus as a part of the tarsus.

rudimentary. *Eyes* various in number, two to twelve. So far the true and false scorpions run together, but when compared more closely, differences, especially of internal structure, appear, which necessitate their subdivision into two groups or sub-orders. Menge and others, on account of these differences, separate the two groups more widely still; but one chief ground of this wider separation, the respiratory system, being in one *tracheal*, in the other (so-called) *pulmonary*, seems scarcely sufficiently well established to warrant it. Not that there is not a wide difference in their respective respiratory systems, but that the whole question of the respiration of Arachnids is hardly so settled as to justify any broad lines of classification being based upon it. In some groups of the first order, Acaridea, and also in the second (Pycnogonidea), no traces have been yet found of a distinct respiratory system, though perhaps this arises from the minuteness of the creatures themselves and the extreme delicacy of the membranous walls of the air-vessels. This latter especially, as has been lately observed in regard to some obscure Myriapodous insects,—*Peripatus* (H. N. Moseley, "Challenger" Expedition, 1874, *Ann. and. Mag. N. H.*, 4 ser. vol. xiv. p. 225),—would make it almost impossible, by any means, to discover these tracheal tubes, when once the air had been expressed from them. Then, again, the so-called pulmonary organs of the true scorpions appear to be, simply, modified tracheæ, entirely destitute of that which specially stamps the true lung, that is, the presence of blood-vessels bringing the vital fluid together, and carrying it through the respiratory organs for aeration. The Araneidea, moreover, have both the tracheal and so-called pulmonary systems combined; and also in this (more extensively worked than any other) order—Araneidea—the researches lately published on their organs of respiration by Philipp Bertkau (*Arch. f. Nat.*, xxxviii. 1872, Heft. 2, pp. 208–233, pl. 7), show how much has yet to be learnt concerning this part of their internal structure. Considering, therefore, that the difference between the respiratory systems of the true and false scorpions should not separate them from the same ordinal group, these with other differences yet appear to necessitate a division within the order. We propose, therefore, to distinguish them under two sub-orders:—1. Pseudo-Scorpiones; 2. Scorpiones.

Sub-Order I.—*Pseudo-Scorpiones.*

These are distinguished from the Scorpiones chiefly by the absence of a tail and by their mode of respiration (figs. 16, 17, 18). The *body* is of an oblong-oval form; the cephalothorax is coriaceous; the abdomen sessile and, generally, composed above of eleven, underneath of ten segmental rings or articulations, usually covered above and below with a double longitudinal series of transverse corneous plates, united laterally by a membrane, the folds of which correspond to the transverse plates. In the second sub-abdominal segmental plate, on each side of the median line, there is (in some species) a small spiracular opening, and in the lateral connecting membrane of the third segment, opposite to the end of the third sub-abdominal plate, on either side, is another similar opening. These four stigmata are the external apertures to the tracheary system (fig. 18); behind and between the two first mentioned stigmata is a spinning organ, furnished with minute tubes for the emission of the silken threads; and close to this spinner, at the fore margin of the first abdominal segment, is the genital aperture.

The *legs* are closely affixed by the coxal joints to the lower side of the cephalo-thorax, and sit closely to each other, having a very small longitudinal space between them analogous to a sternal plate, of which, however, there is not even a rudimentary one, properly so-called. The number of joints in the legs is seven (Menge), but there appears to be a variation in this respect in some species. Each tarsus ends with two curved finger-like claws terminating with a short nail, and beneath them is another claw, modified at its extremity, gradually enlarging into a kind of conical form probably acting as a sucker for the purpose of adhesion to smooth objects (fig. 18, *d*). The tarsal claws spring from a small heel or claw-joint.

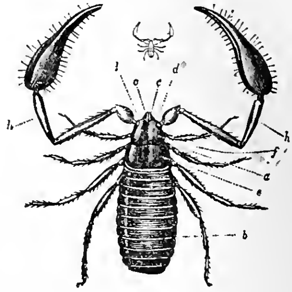


Fig. 16.

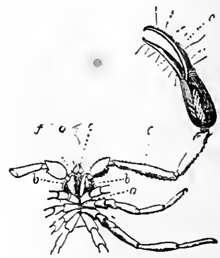


Fig. 17.

FIG. 16.—*Chelifer sesamoides*, Savigny. *a*, cephalo-thorax; *b*, abdomen; *c c*, falces; *d*, *d*, eyes; *e*, hinder segment of cephalo-thorax; *f*, front ditto; *h*, *h*, palpi.

FIG. 17.—The same; portion of under side. *a*, rudimentary sternum; *b*, maxillæ; *c*, palpus; *d*, digital joint; *e*, movable fang; *f*, labium; *o*, *o*, falces.

The *palpi* are five-jointed, long and strong, terminating with a digital joint of large size, more or less bulbous at its base, and drawn out at its extremity into a jaw-like claw, furnished with hairs and bristles, and generally serrated along its inner edge. Against this claw another, articulated to the extremity of the bulbous portion, acts in opposition like the pincers of a crab. Supporting the palpi on either side are the maxillæ, forming the lower side of the mouth, the upper side being formed by two didactyle falces; besides the movable jaw of the falces, there are connected with them some denticulate spines, or other spiny processes and bristles. Within the mouth is a tongue, which also serves as a sternal

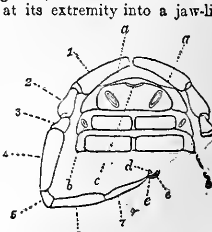


FIG. 18.—*Chelifer cancroides*, Linn.; portion of under side. *a*, *a*, *b*, *b*, orifices of the respiratory organs. *c*, genital aperture; *d*, sucker-like tarsal claw. *e*, *e*, superior tarsal claws.

labium, and differs in its form in different species. The *eyes*, two or four in number, are situated on each side of the fore part of the cephalo-thorax, but there are none in the medial line. In some instances eyes are wanting altogether.

With regard to *internal structure*, the Pseudo-Scorpiones are very similar in their *muscular system* to the spiders (Araneidea) (Menge). The *digestive apparatus* is simple; a large stomachal pouch contracted a little in the middle lies in the thoracic cavity, and from it the alimentary canal runs through to the hinder extremity of the abdomen, with a double crook in the course of its passage; this canal is imbedded on all sides in a mass of substance serving the function of a liver. The external spinning organs have already been mentioned; the internal apparatus resembles that of spiders, consisting of a number of small elongated pear-shaped sacs, communicating outwardly with the spinning tubes.

Nothing certain appears to have been discovered in regard to the *circulatory system* of the pseudo-scorpiones, except that a simple vessel runs along beneath the middle of the abdominal ridge; the vital fluid being found free among all the other organs of the body, so that the air is conveyed to the blood by numerous air-tubes, and not the blood to the air.

The tracheal character of the *respiratory system* has been just mentioned. The spiracular openings vary in number in different species, two or four. From the two hindermost of the abdominal apertures, when four are present, there issue more or less numerous thread-like tubes, which convey the air to the different parts of the abdomen. From each of the two foremost stigmata a main tube runs obliquely through the thoracic region, and from this tube finer ones issue to the rest of the cephalo-thorax and its adjacent parts—legs, palpi, and falces. When two spiracular openings only are present a large tube runs from each forwards into the thorax, and finer ones backwards into the abdominal parts.

The *reproductive organs* are simple. The external parts in both sexes are situated in the second (?) segment beneath the fore part of the abdomen, and consist of two small oval openings close together. Into each of these there opens in the male a curved horn-like sac, with a lateral direction, as well as a smaller longitudinal duct, the latter leading from a common seminal receptacle. In the female a two-branched oviduct leads from the ovaria into the external apertures; the mode of reproduction is oviparous, and the eggs are carried by the female beneath the fore part of the abdomen, somewhat like those of certain of the Araneidea.

General Observations.—The Pseudo-Scorpiones are all of very small size; they do not appear to form more than one family group, *Pseudo-Scorpionides*, of which several genera and numerous species have been described by various authors. They are widely distributed, being found in tropical as well as in temperate climates. Europe possesses many species, and even England has several—these being the sole representatives of the Scorpionidea in this more northern latitude. Their habitat is under stones, beneath the decaying bark of trees, on the damp soil, among moss and herbage; some are found amongst old papers in houses, and in herbaria, and others are said to be parasitic on the common house fly. For more minute details of structure and other particulars, see A. Menge, *Ueber die Scheerespinnen, Chernetidæ*, who separates them from the scorpions under the above name, as a family group, more nearly allied by their internal structure to the true spiders than to the former. Menge gives also a list of works on this sub-order. A paper lately published by Dr Ludwig Koch, at Nuremberg, 1873, pp. 68, describes and gives analytical tables of all the European genera and species at present known.

Sub-Order II.—*Scorpionidea*.

Between the solpugids and the scorpions (figs. 19, 20) the last group (Pseudo-Scorpiones) gives us an evident connecting link.

In the present sub-order, *Scorpionidea*, or true scorpions, the External Structure consists of a more or less elongated oval body, covered with a coriaceous, or hard and horny integument. The cephalo-thorax is tuberculate or granulose, and marked with various seams, or grooves, and ridges, no doubt indicating the union of the caput and thoracic segments. One longitudinal, and, in general, strongly

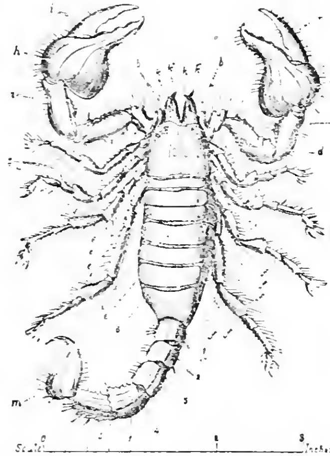


Fig. 19.—Scorpion (*Buthus ...*, Koch). *a, a*, palpi, of which *h, h*, are the digital or fourth joints, and *i, i*, the movable fingers; *b, b*, falces, with two movable fangs, *k, k*, and two fixed ones *k*, k*; *d*, eyes; *e...e*, upper segmental plates of abdomen; *f...f*, articulated cartilaginous membrane, connecting upper and under plates of abdomen; *m*, bulbous sting.

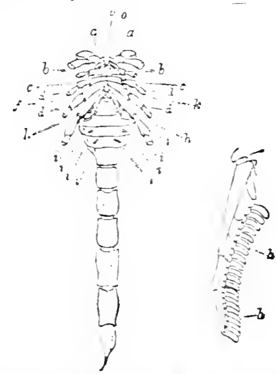


Fig. 20.—*Scorpio Americanus*, Sav., under side, with legs, palpi, and falces truncated: *a, a*, maxillæ; *b, b*, supernumerary or second pair of maxillæ, supporting first pair of legs; *c, c*, third pair of ditto supporting second pair of legs; *d...d*, basal joints of two hinder pairs of legs; *f*, orifice of sexual organs; *h, h*, comb-like appendages (also figured separately, enlarged); *i...i*, eight spiracles leading to breathing organs; *k*, rudimentary sternal plate; *o, o*, portion of third pair of supernumerary maxillæ acting as a sternal labium.

marked groove always divides the *caput* longitudinally, dividing also the tubercle on which the central pair of eyes is placed. This groove possibly represents the union of the two segments of a kind of duplex caput analogous to the duplex generative system noted *postea* (p. 285). The *abdomen* is sessile, *i.e.*, united to the thorax throughout its whole breadth, and composed of twelve segments, of which the five posterior ones form a tail; these latter are segments in the strictest sense, while those of the abdomen proper are, more correctly speaking, articulations covered above and below with transverse horny plates. Articulated to the fifth joint of the tail is a bulb terminating with a sharp curved sting. Poison secreted in the bulb is injected into wounds through two minute perforations near the extremity of the sting. The *legs* are not very robust, nor long, nor very unequal in length; each consists of seven joints, of which the basal ones (coxæ), are fixed to the under side of the cephalo-thorax, and act partly as a sternum; the only portion which can be said to represent a real sternal plate being a very small sub-triangular, or in some genera, quadrangular piece immediately behind the first segment of the abdomen between the extremities of the coxæ of the fourth pair of legs (fig. 20, *k*). These latter are soldered to those of the third pair, the junction being visible as a more or less distinct groove. The coxæ of the first and second pairs have angular pieces attached to them, used in manducation, and hence called supernumerary maxillæ (fig. 20, *o*, *o*, *b*, *b*); but while the pieces of the first pair might perhaps be so named, those of the second pair, closing together as they do on their inner margins, rather form a kind of sub-triangular sternal appendage representing the *labium*, of which there is none properly so-called. Each tarsus ends with two rather long curved superior, and one short straight tooth-like inferior, claws. The first and second segments of the abdomen underneath are almost rudimentary, between them and the anterior edge of the first segment is situated the external aperture to the organs of generation, the horny plate protecting it being divided longitudinally by a more or less distinct groove. From the second segment, and articulated to it, spring two very conspicuous, curious, comb-like appendages (fig. 20, *h*, *h*), composed of a longitudinal shaft of several distinct joints, with a number of slightly curved, bluntish tooth-like processes, fitting closely together, and articulated to their hinder edge, nearly at right angles, like the teeth of a comb. The shafts and teeth of these appendages vary in the details of their form and structure; their use has not yet been certainly ascertained, but their position points to some connection with the process of generation, which is also the opinion of L. Dufour and others; while they have also been thought to be intended to brush away obstructions from the spiracular orifices and other parts; but as in no case are they long enough to reach more than the first pair (out of four) of these orifices, and every consideration of structure is against their being used to clean other parts, this conjectured use is scarcely probable. The spiracular orifices are situated on the under side of the abdomen in four pairs—one pair in a transverse line on each of the third, fourth, fifth, and sixth segmental plates, and are in general easily seen.

The *eyes* (six, eight, ten, or twelve in number) are placed on the fore part and upper side of the cephalo-thorax,—two, generally large ones, in a transverse line near the middle of the upper part of the caput, the rest (much smaller and varying in size in different genera and species) in two symmetrical groups, one on each side near its fore corners. The *falces* form, as in other Arachnids, the upper side of the mouth; they are strong, cylindrical, and didactyle, the outer jaw-like terminal claw being articulated in opposition to the inner one; both are toothed, the denticulations varying in number size and form. Below the falces (and forming with the before-mentioned coxal appendages a complete lower boundary to the mouth) are two strong *maxillæ*, from each of which (as a basal joint) springs a long strong *palpus* of four joints, the last (digital) joint being more or less bulbiform at its base and didactyle at its extremity. The outer claw is movable and (like the fixed one) serrate or denticulate on its inner edge. The size and form of this didactyle joint vary in different species and genera; in some it is of enormous size, and its denticulations very strong, while in others it is scarcely larger than the joint which precedes it. It is the possession, the position, and the office of the exact counterpart of this palpus, which, apart from other considerations, so plainly stamp the affinity of the two sub-orders of the Scorpionidea, in spite of the differences of their respective internal anatomy. Within the mouth parts above noted is a pointed tongue (*languette*) tipped with hairs.

INTERNAL STRUCTURE.—The *Muscular System* of scorpions is similar to that of other Arachnids. It is well detailed by L. Dufour (*Savants étrangers*, xiv. pp. 609–611), who divides the muscles into *thoracic*, *abdominal*, and *caudal;* those of the abdomen being also subdivided into *tegumentary*, *perforant*, and *cardiac*.

The *Organs of Digestion* consist of a straight narrow intestine, with little or no dilatation, running from the mouth to the anus, which has its external opening at the lower extremity of the fifth or last segment of the tail. At the junction of the stomachal and intestinal portions the biliary vessels are inserted, and from each side of the former (stomachal part) there issue five narrow cæca running into a mass of fatty matter on either side.

The *Respiratory Organs*, or pulmo-branchiæ, have their external orifices or stigmata (as before mentioned) in four pairs on the ventral surface of the abdomen; the pulmo-branchiæ, of which one is connected with each stigmatic opening, are hollow sacs, the walls of which are folded into delicate laminæ, each being duplex,[1] and all lying one upon another like the leaves of a book; the air is admitted to these through the external openings, which are closed by movable horny lips as in insects. (Jones, *Animal Kingdom*, 2d ed., 416.) According, however, to L. Dufour (*l.c.*, p. 617), the lips of the stigmata are immovable, and have a varied direction in different species. The air is admitted to the pulmo-branchiæ by the action of a linear opening in a supple membrane or diaphragm within the space between the lips and the laminæ (L. Dufour, *l.c.*)

Organs of Circulation.—These, according to Newport (*Philos. Trans.* 1843, pp. 286–298), consist of an elongated, dorsal muscular vessel (or heart) divided into eight chambers, separated from each other by valves, and with auricular openings or valvular orifices, at the division of each chamber, on its dorsal surface. From both sides, and at each end of the dorsal vessel, arteries convey the vital fluid for distribution to different parts of the body.

This dorsal vessel apparently acts in a manner analogous to that of the heart in vertebrate animals. The vital fluid is conveyed back to the "heart" from the pulmo-branchiæ, where it has been oxygenated by means of a great number of slender canals, formed by the collection together of vessels that have their origin at the hinder part of the inner side of the pulmo-branchiæ. These canals pass round the sides of the body in the hinder part of each segment, and pour their contents into the dorsal vessel through the valvular orifices above mentioned. The conveyance of the fluid from the general circulation to the pulmo-branchiæ is effected by means of an intricate system of anastomosing pulmonic and capillary vessels, situated chiefly below the nervous chord on the ventral surface of the body.

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[1] L. Dufour, *l.c.*

From the above L. Dufour (*l.c.*) dissents. According to his researches, which appear to have been pursued under the great advantage of having fresh as well as living examples to observe and dissect, the heart (or dorsal vessel) is not divided into chambers at all; its chambered appearance, which misled Newport and others, arising from inevitable changes in the form of the organ after death, and long immersion in spirit of wine. Dufour gives very exact figures and descriptions of these changes. According to him the heart is a simple, undivided vessel running throughout the whole body, only narrowing at the fore part of the caput, and in its passages through the tail; and from this tube various lateral veins and arteries issue, those from the hinder or tail portion being profusely branched. He dissents entirely from Newport, Blanchard, and others, with regard to the mode above mentioned in which the vital fluid is conveyed to and from the pulmo-branchiæ, but he confesses that he has not been able to find out how it is actually effected, though he believes that the pulmo-branchial laminæ are permeated by vascular ramifications spread out over every one of their leaves, and that in these ramifications the fluid receives the benefit of the air admitted to the laminæ. Siebold, however, says that no traces of blood-vessels have been found in the pulmonary lamellæ of another order, Araneidea; and it is hard to believe but that, if such details as those given by Newport in regard to the scorpion actually existed, Dufour, with the advantage of fresh examples to dissect, should have been unable to discover it. On the whole, it seems too soon, even yet, to dogmatise on the position of the scorpions from their respiratory and circulatory systems. That they have these two systems, the first by means of a dorsal vessel, with lateral branches, the latter by a kind of pouch containing a modification of tracheæ, is certain; and that their system is different from that of some other groups is also certain, but in the absence of a more perfect knowledge of the real nature of the difference, its true value cannot well be yet ascertained.

Nervous System.—A longitudinal row of nine—according to Newport, eight—ganglia, connected by a double nervous chord, is situated in the median line of the body, below the intestinal canal. The first ganglion consists of two lobes, the upper one of which, occupying a position somewhat analogous to that of the brain in the Vertebrata, is so called (*cerveau*) by Dufour. From these lobes the optic and other nerves issue, some of them being connected with the various parts of the mouth and the legs. A nervous-collar, according to some authors, surrounds the œsophagus. Dufour, however, disputes the existence of this collar, and explains how the idea of it arose, *l.c.*, pp. 556, 557. Of the remaining ganglia four are, according to Dufour, situated in the abdomen, and from these four there spring on each side and underneath, branching nerves, which run to each of the pulmo-branchiæ respectively and their adjacent parts, as well as to the viscera and tissues of the abdomen. The first abdominal ganglion is in close connection with the large thoracic one, and is in some instances so little developed that Newport and others, overlooking it, derived the nerves running to the first pair of pulmo-branchiæ from the thoracic ganglion itself, and thence allowed but three to the abdomen.

The caudal ganglia, four in number, do not correspond to the number of segments, which are five, or counting the terminal bulb, six. From each caudal ganglion two lateral nerves only issue, except from the last, whence there issue three pairs; the extra ones, running back, and branching out into the muscles of the poison bulb, doubtless add greatly to its sensibility and irritability.

The *Organs of Reproduction* occupy, both externally and internally, a similar position in both sexes. The external aperture is duplex, situated between the first and second segments of the abdomen, in front of and, in a manner, between the comb-like appendages, and covered by an operculum. Internally those of the male consist of a duplex set of vessels for the elaboration, collection, and conveyance of the seminal fluid to the external orifices, each orifice having its own set. The vessels, answering to testes, in which the seminal fluid is secreted, consist each of a tube forming three large quadrilateral, flexuose, and free, anastomosing meshes placed longitudinally; those of one set sometimes communicating with the other at the lower mesh by a short, strong connecting tube. According to Treviranus the three meshes on either side anastomose with each other, having, in fact, a common connection throughout, but this L. Dufour considers to be an abnormal case; the vessels for the collection of the seminal fluid, *vesiculæ seminales*, are three for each set, and all open into the channel of emission; this is produced backwards in the form of a long, fusiform, sheath-like channel, lying along the flanks of the abdominal cavity, and attenuated at both extremities; within this channel is another slender, corneous sheath-like organ, prolonged to the genital aperture, where it is exceedingly fine. This is "le fourreau et l'armure de la verge" (Dufour), and within it is the intromittent organ itself, having a whitish cartilaginous, thread-like appearance. No recorded observations have yet decided the mode in which these parts of generation are used: the Scorpionides being nocturnal in their habits makes such observations very difficult, but all analogy is in favour of copulation by the exsertion and introduction of the thread-like organs above described into the female parts of generation. These consist of two ovaria, each composed of a membranous tube, forming four large quadrilateral meshes in a longitudinal line on each side, anastomosing with each other and with those of the other side; each of these ovaria ends in a simple oviduct (sometimes with, sometimes without ovisacs) leading to the vulva or external orifice. The general similarity of these female organs with those of the male is at once apparent. A curious point noticeable in these parts in the Scorpionides is their *duplex* character, and hence the question as to their mode of operation becomes of greater interest. It is remarkable that the only other Arachnids in which an intromittent organ is as yet known are among the Phalangides, a group widely separated from the Scorpionides in other characteristic details, though approaching much nearer to the pseudo-scorpions. Scorpions are ovo-viviparous, and, according to Dufour (*l.c.*), their period of gestation is of great length, extending even to fifteen or sixteen months; but for five of these months, which occur in the winter season, Dufour concludes, from frequent observations, that the whole genital apparatus is, like the animal itself, in a dormant state, and that therefore no progress in the development of the ova takes place during this period. On the very important branch of this subject—the *embryology of the scorpion*—reference only can be made to the works of Heinrich Rathke, *Reisebemerkungen aus Taurien* (contained also in Burdach's *Physiology*, Bd. ii. p. 242, *et seq.*) and to that of Dr Elias Metschnikoff, "Embryologie des Scorpions," *Z. Wiss. Zool.*, Bd. xxi. pp. 204–232, taf. xiv.–xvii.; also separate, Leipzig, 1870.

General Observations.—The sub-order Scorpiones forms a remarkably homogeneous group. It has been divided, however, into several families by Koch (*Die Arachn.*); and various genera, based principally on the number and distribution of the eyes, the form of the fore margin of the cephalo-thorax, and the structure of the comb like appendages attached to the under side of the abdomen, have been characterised. The species are tolerably numerous, but the whole group greatly needs revision, both in respect to its family and generic divisions, as well as in regard to the identification and determination of the species. Those found in Europe are of comparatively small dimensions, and are confined to the southern parts of the Continent; the majority are tropical, attaining their greatest size—nine or ten inches in length—in Central Africa and South America. They are nocturnal in their habits, living by day underneath stones, behind the loose bark of trees, among the ruins and debris of old walls and buildings, and preying upon insects and other Arachnida: they are said to be very partial to the eggs of spiders and insects. It does not appear that they are able to inflict any great injury with the, often formidable looking, crab-like claw with which their palpi terminate, though they can gripe and hold on firmly with them. The wound inflicted by the sting at the end of the tail is certainly more or less venomous; the amount of venom is probably dependent on the age of the scorpion, and the season of the year; and the effect of the sting is no doubt dependent upon the state of health, constitution, or predisposition of the person injured. Experiments, tried by Maupertuis, upon poultry and dogs stung by exasperated scorpions, resulted in their almost entire immunity from bad effects, while in Redi's experiments, the sting proved fatal in some instances to pigeons. These experiments were tried with European species of scorpion, which would probably be less venomous than those living in tropical countries. For a recent memoir on the poison of the scorpion, and the mode in which it acts, see Dr Jousset, *Ann. Ent. Soc. France*, 1872, p. 151; also *Comptes Rendus*, 1870, pp. 407–411. According to Jousset, the venom acts directly upon the red globules of blood, paralysing them, so that becoming agglutinated together, they obstruct the entrance to the capillaries and stop circulation. The peasant inhabitants of Tuscany are said to handle scorpions without fear; but this may be chiefly from a skilful mode of handling them. A scorpion does not appear to be able to move its tail or its sting in a lateral direction, nor does it strike downwards. The present writer has seen natives of Egypt handling large, and it is believed very deadly ones with impunity, but then they always held them tightly by the last joint of the tail. It was a common practice so to catch these creatures, and after breaking off the tip of the sting, to let them loose again; but this infliction generally appeared to produce a kind of paralysis of the whole tail, and probably the poor animal would soon die.

Though the well-known tale of the scorpion, when surrounded by fire, stinging itself to death, has been perpetually repeated, and has even been related to the present writer with some very minute and extraordinary details, it must be held to be merely a "traveller's story." Cross-examination, in the special instance noted, very much nettled the narrator at the incredulity which led to it, but it threw more than a doubt over the conclusiveness of the experiment narrated. Probably in some instances the poor scorpion has been burnt to death; and the well-known habit of these creatures, to raise the tail over the back and recurve it so that the extremity touches the fore part of the cephalo-thorax, has led to the idea that it was stinging itself. Perhaps, under the pain of scorching, there may have been convulsive efforts and movements of the highly nervous and sensitive tail in this position, and the point of the sting may even have been inserted between the articulation of the cephalo-thorax and abdomen; and what more would be wanting to make a wonder-loving traveller believe that it had really committed suicide? The progress of scorpions is neither rapid nor graceful; they are unable to run without elevating the tail to an erect position, which seems to be necessary to enable them to preserve their balance.

CLASSIFICATION OF THE SCORPIONES.—The following is Koch's systematic division of the scorpions.[1]

Order SCORPIONES.

Fam. I. With six eyes, *Scorpionides.*—One genus only, *Scorpius* (Ehrb.)

Fam. II. Eight eyes, *Buthides*.—Five genera: *Buthus* (Leach); *Opistophthalmus* (Koch); *Brotheas* (*Id.*); *Telegonus* (*Id.*); and *Ischnurus* (*Id.*)

Fam. III. Ten eyes, *Centrurides.*—Two genera: *Centrurus* (Ehrb.); and *Vaejovis* (Koch).

Fam. IV. Twelve eyes, *Androctonides*.—Three genera: *Androctonus* (Ehrb.); *Tithyus* (Koch); and *Lychas* (*Id.*)

One hundred and twenty two species, distributed variously among the above eleven genera, have been described by Koch (*Die Arachn.*); but many others also have since been added to these, in isolated papers by other authors. For another systematic arrangement, as well as on the group generally, with descriptions of seventy-eight species, see Walckenaer, *Ins. Apt.*, iii. pp. 14–75, where other works are also referred to. Scorpions have been found in a fossil state, as well as in amber, in which substance a species of Tithyus (*T. eogenus*) has been described by Menge.

[1] L. Koch, *Uebersicht des Arachniden Systems*, Nuremberg, 1850, pp. 86–92.

Order VI.—THELYPHONIDEA.

The last group, Scorpiones, seems to be the culminating point of the Arachnids in a certain plane, and it presents the arachnidous type in its highest and most complex state of development. The group now to be considered gradually lowers, so to speak, this type again through its three well-marked families, to the last order Araneidea.

As has been before observed, there is seldom or never in nature exactly the same hiatus between one group and another, as there may be between either of them and others; or, in other words, some groups are far more nearly allied to the one next to it than others are to that next to them, although, perhaps, all of those groups bear the same apparent value in a systematic arrangement. Thus, for instance, the groups A, B, C, D may all be equal in a systematic arrangement, and yet A and B may be far more nearly allied than B and C; or again, C and D may be more closely united than either B and C or A and B. So the two orders of Arachnids—Scorpionidea and Thelyphonidea—are certainly far more nearly allied to each other than, for instance, the Solpugidea and Scorpionidea, or the Thelyphonidea and Araneidea are to each other respectively. So obvious is the affinity of the family Thelyphonides of the present order to the Scorpiones, that Walckenaer and others have included them in the same order, making a separate order of its other family, Phrynides; but the latter family certainly seems nearer to Thelyphonides than even the Thelyphonides to the Scorpiones; and so, while the Thelyphonides and the Phrynides must go together, these last could scarcely with any propriety be included in the same order as the scorpions. This will, we think, be evident when we consider presently their structural characters. From these and other considerations, it has therefore been thought best to separate the Thelyphonides from the Scorpionides, and include them in another order with Phrynides.

In the order Thelyphonidea, the *cephalo-thorax* is similar in the general nature and condition of its integument to that of the scorpions, being hard, granulose, and sometimes tubercular, bearing also visible traces of its soldered segments.

The *abdomen* is segmented, and united to the cephalo-thorax by a pedicle of greater or less strength, but never, as in the Scorpiones, throughout its entire breadth; it terminates in one family (Thelyphonides) with three post-abdominal segments, to which is attached a long multi-articulate setiform tail; in another (Tartarides) with a short tail of different form according to the species; and in the third family (Phrynides) the abdomen terminates with a simple button-like segment.

The *legs* of the first pair are much longer than the rest (in the Phrynides of most inordinate length) and antenniform; the tarsi, and generally the metatarsi, multi-articulate, ending without any terminal claw; the legs of the other three pairs are seven-jointed, with the last, or tarsal joint, subdivided.

The *eyes* when present (as in two families), are eight in number, placed on the fore part of the cephalo-thorax in three groups, and forming a triangle with the apex (more or less acute) directed forwards; the base of the triangle is formed by two lateral groups, each of three contiguous eyes; the apex by the third group of two eyes near together, but not generally contiguous to each other.

The *falces* are monodactylous, or terminating with a simple movable fang. The *palpi* are four-jointed, monodactylous, or rather didactyle in a modified form. The *sternum* is more developed than in the scorpions, but not so fully as in the next order, Araneidea. The *labium* is either entirely wanting or very rudimentary in one family, in another fairly developed, and in another altogether absent. In any case, it is probably of small economic importance compared to the labium in the Araneidea.

Such knowledge as is at present attainable in regard to the internal anatomy of this order will be noted in the separate descriptions of each family. These families are three in number,—*Thelyphonides*, *Tartarides*, and *Phrynides*,—and being very distinct, it will be well to give a short diagnosis of each.

Family I.—*Thelyphonides.*

EXTERNAL STRUCTURE (figs. 21, 22).—The *cephalo-thorax* is sometimes of a tolerably regular oval form, more or less

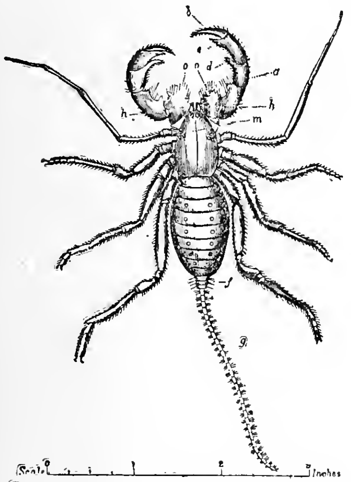

FIG. 21.—*Thelyphonus giganteus*, Koch. *a*, palpus; *b*, movable fang or claw, forming with *c*, claw on fourth joint, a *didactyle* claw; *d*, claw on third joint; *f*, segmental elongation of abdomen, supporting tail; *g*, tail; *h*, *h*, falces; *m*, eyes; *o*, *o*, first palpal joint, with characteristic denticulations.

blunt-pointed before, but often it is of an oblong quadrate shape, also pointed in front, and making not only the hinder part but also the fore part somewhat angular,—the latter having two obtuse lateral angles, and one acute and apical; it is of a flattened form, and destitute of hairs and spines, but is generally granulose, and sometimes covered with more marked, but still minute, tubercles. Marks of segmental soldering are visible, as also a longitudinal groove in the medial line of the caput, similar to, but less marked than, that noted in regard to the scorpions. Beneath the cephalo-thorax are two pieces, which may be regarded as small sternal plates, perhaps the terminal remains representing the complete sternum of the Araneidea, or anticipating its complete form in that order. One of these sternal plates is of a somewhat triangular form, and has its longest or apical angle directed backwards between the basal joints of the first two pairs of legs; the other more heart-shaped, and with the apical angle reversed, is situated between the basal joints of the legs of the fourth pair. In some species a minute corneous patch may be seen between the coxæ, or basal joints, of the third pair of legs, affording still further evidence of the remains of a sternal plate. At the centre of the fore margin of the foremost of these sternal plates is a small point which seems to represent the labium. Beneath the fore part of the cephalo-thorax are two not very powerful *falces*, terminating with a long, powerful, movable, curved fang, somewhat resembling what we find in the Araneidea, and hinting at a transition to that order from the didactyle falces of the Scorpiones. Beneath, and opposed to, this fang is a fixed tooth-like claw; these parts of the mouth are thickly clothed and fringed with hairs. Immediately in front of the fore sternal plate, beneath the anterior part of the cephalo-thorax, are articulated two enormous *maxillæ* of a subtriangular form, the apex being at the articulated part, and the inner basal angle prolonged into a larger or smaller tapering, pointed apophysis, which is now and then denticulate. From the extremity of each of the maxillæ springs a proportionately strong and massive four-jointed *palpus*, powerfully armed with spines, denticulations, and claw-like projections; the inner extremity of the last, or digital, joint terminates like the radial (or the joint next before it), with a strong, claw-like, sharp-pointed projection, in imperfect opposition to which there is a stronger movable claw, of the same nature, articulated to the outer extremity; the fixed claw of the digital joint, with the joint itself, appears capable of being opposed at will to the fixed claw of the radial joint, thus giving the palpi a duplex kind of didactyle claw,—didactyle, that is, in a modified sense, differing as it does considerably from the terminal claw of the scorpion's palpus, which is more properly spoken of as didactyle. The movable finger of this claw would, perhaps, be more correctly reckoned as a *substantive joint*, terminating with a more or less sharp corneous nail; and this joint, opposed to a pointed apophysis of the one to which it is articulated, forms the so-called *didactyle* claw; in fact, the terminal palpal claw of the Scorpiones (including the Pseudo-Scorpiones) as well as that of the Phalangidea, appears to be similarly constructed. In the present family, however, the basal portion of the joint, bearing the fixed claw, being far less developed (seldom stronger or more bulbous than the other joints), and the two fingers being always of unequal length, the didactyle nature of the whole is less real, and less apparent; while in the scorpions its bulbous form is generally apparent, and often inordinate, the equal length of the two fingers and their evidently purposed opposition to each other making the claw, in the fullest sense, didactyle.

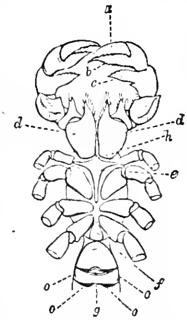

FIG. 22.—*Thelyphonus* —— ? portion of under side. *a*, movable claw of palpus *b*, fixed ditto; *c*, claw on third palps joint; *d*, *d*, maxillæ supporting palpi *e*, *f*, sternal plates; *g*, orifice of sexual organs; *h*, place of labium; *o*...*o* orifices of respiratory organs.

If this view (that the movable finger of this claw is a substantive joint) be correct, the palpi in the present order, as well as in the orders Phalangidea and Scorpionidea, must be considered to have five instead of four joints, thus bringing them to an equality in this respect with the

Araneidea. The palpi in the third family of this order—Phrynides—bear out this idea strongly.

The *legs* are long, slender, and seven-jointed, except those of the first pair, which have but six, the genual, or fourth, joint being absent. The tarsi of the first pair are divided into eight short articulations, while those of the rest have but three. There is probably some variation in the number of these articulations in different species, since Walckenaer describes the tarsi of the three hinder pairs as *five*-jointed; the first pair are far more slender than the rest, palpiform, and without any terminal claw; they appear, as it were, to be thrust out of their position by the great size of the maxillæ, and their basal joints seem to be jammed in over those of the second pair. The tarsi of the three hinder pairs terminate with three claws, of which those of the superior pair are the strongest and curved.

The *abdomen* is of a long-oval form, composed of nine quasi segments, formed by a covering, both above and below, of so many transverse articulated corneous plates; while the cartilaginous membrane on each side, between the lateral margins of the upper and lower plates, is continuous, not folded or articulate as in the Scorpionidea. This is a point to be noted, as it marks a transition to the abdominal type of the Araneidea. The first plate on the upper side forms a protective covering to the pedicle by which the abdomen is united to the cephalo-thorax, and makes the pedicle look broader than it really is. There is a double longitudinal row of impressed circular spots on the upper side, two (in a transverse line) on each corneous plate, except the first and last; these impressed spots are perhaps points of attachment for muscular fibres.

Beneath the abdomen, on the fourth and three following segmental plates, are eight stigmata in as many largish, shallow, circular impressions; they are, however, imperforate, and are probably, like those mentioned above, points for the attachment of muscles. The spiracular stigmata are four in number, two being placed beneath the hinder margin of each of the first and second sub-abdominal plates, one on each side of the median line; the genital aperture is under the hinder margin of the first plate, between the first two spiracular openings. Joined to the posterior extremity of the abdomen are three small cylindrical, post-abdominal segments, to which is attached a long setiform tail, variable in length, composed of a number of small articulations, and, like the legs and palpi, sparingly furnished with hairs; at the extremity of the third post-abdominal segment, beneath the tail, is the anal opening.

The *eyes* are eight in number: two placed transversely, near to each other, on the fore margin of the caput in the medial line, and three others in a triangular group on each side at its lateral angles, just above the insertion of the legs of the first pair

With regard to the INTERNAL STRUCTURE of the Thelyphorids but little appears to have been ascertained. The respiration is pulmo-branchial; the spiracular apertures being, as above stated, four in number, and situated in the position already mentioned Their mode of reproduction is probably like that of the scorpions, ovo-viviparous, but this is conjecture only

GENERAL OBSERVATIONS.—The family Thelyphonides is exceedingly homogeneous, and comprises but a single genus, *Thelyphonus* (Latr), of which twenty-nine species only have been recorded and described,—twenty-six in one of the latest works upon them, by A. G. Butler, *Ann. and Mag. N. H* 1872, vol. x. pp. 200-206, and *Cistula Entomologica*, 1873, part vi. pp. 129–132; and three others in a still more recent paper by the late Dr Stoliczka, *Journ. As. Soc. Beng*, part ii. No. 2, pl. xii.

All the species of this small but remarkable group are confined to the tropical regions of Asia, America, and Australasia, no species having yet been recorded from Africa. In size they vary from rather more than half an inch to 2 or 3 inches in length. Among other characters useful in the identification of the species, are the number and differential development of the various processes and denticulations of the palpal joints. Of their habits little is known, and much of that little is of a very recent date. Dr Stoliczka (*l.c.*) gives a short account of them, from which it appears that they are nocturnal or crepuscular, living by day in damp places under the bark of old trees; when disturbed they hold up the palpi, as if for defence, and beat a rapid retreat, with the tail in an erect position. In this position of the tail we see a curious relationship to the scorpions, but apparently without the same necessity, in the present instance, for such a position. They lie still when uncovered, evidently simulating (though of course unconsciously) a fragment of old bark or fungus. The first pair of legs act more as feelers than as organs of locomotion. In the presence of a sternal plate, the mode in which the abdomen is united to the cephalo-thorax, and the structure of the falces, Thelyphonids approach nearer than the scorpions to the structure of the true spiders, and, as we shall see, the family Phrynides is a transitional group bridging over some part of the gap between the two, while in the massive palpi (though imperfectly didactyle), and in some other respects, they show an unmistakable alliance to the scorpions.

Family II.—*Tartarides.*

This family is nearly allied to the former—Thelyphonides—but has a more elongated form. The *cephalothorax* is beak-like in front, and is also divided into two parts or segments; the first comprises the caput, and the coalesced thoracic segments belonging to the first two pairs of legs; the hinder part is the smallest, and comprises the second thoracic segments belonging to the third and fourth pairs, but no grooves or indentations mark the union of the segments, its surface being smooth and glossy. The *abdomen* is united to the cephalo-thorax by a stout pedicle, and is covered above and below, as in Thelyphonides, with eight or nine transverse, corneous, articulated plates, the upper series separated from the lower by a narrow divisional space, covered with a continuous cartilaginous integument. Beneath the fore part, at the hinder margin of the first sub-abdominal segment, a line-like fissure in the median line probably represents the opening to the reproductive organs; near the fore margin of each of the fourth, fifth, and sixth plates, in a transverse line, are two small elongated stigmata, thought at first to belong to the respiratory apparatus, but further examination seems to prove them to be, like the eight analogous stigmata in Thelyphonides, imperforate, and probably due to the same cause conjectured in regard to them. Two (or four) narrow slits, placed two and two symmetrically on each side of the genital aperture at the fore margin of the first and second segments, but very difficult to be correctly ascertained, are probably the external openings to the respiratory organs; these points, however, can hardly yet be said to be satisfactorily determined. Two or three very narrow corneous rings, or post-abdominal articulations, support a caudal appendage, either slender, cylindrical, and bi-articulate, or of a largish, peculiar, sub-triangular form, articulated to a small foot-stalk. *Eyes* none, no traces even of eyes being visible. The *falces* are strong, of a flattened cylindrical form, deeper than broad, projecting in the plane of the cephalo-thorax, and terminating with a sharp, curved, movable fang at their upper extremity, the lower extremity being rather pointedly prominent.

The *palpi* are very strong, five-jointed, and each issues from a long, strong, nearly cylindrical basal joint or *maxilla*, the inner fore corner of which is prolonged into a sharp, strong point; the other joints are armed variously with teeth, and the final, or digital, joint in one species has a longish, but not very strong, spine beneath it, terminating with a small, apparently movable, curved claw. In these palpi we see a marked transition from the more apparent didactyle nature of those of Thelyphonides to those of the Phrynides, removing them further than the former, in this respect, from the Scorpiones.

The *legs* appear very similar to those of Thelyphonus; they are seven-jointed; those of the first pair are slender and evidently palpiform; their tarsi are composed each of several (apparently ten) minute articulations, and devoid of terminal claws. Those of the other three pairs are apparently inarticulate, and each ends with three simple curved claws, of which the inferior one is the smallest and most sharply bent; the femora of these three pairs are all strong, those of the fourth pair inordinately so. The *sternal plates* are very similar to those of Thelyphonus, but the hinder one is not so much developed, and the central corneous spot is not visible.

This family, of small but exceedingly interesting blind Arachnids, contains but one at present known genus—*Nyctalops* (Cambridge), and two species—*N. crassicaudata* (Id.) and *N. tenuicaudata* (Id.); both are of a uniform pale yellow-brown colour, differing from each other, among other characters, in the markedly different form of the tail; the length of the largest (probably, but not certainly ascertained to be, in the adult state) is but 2½ lines. They are found under decayed leaves in Ceylon; but nothing is yet known of their habits, nor of their internal structure and anatomy; analogy, however, points to a similarity in this latter respect to Thelyphonus.

Family III.—*Phrynides.*

This is also a remarkably homogeneous family, and although, undoubtedly, a near ally of the Thelyphonides, yet in its form it presents many typical characters of the Araneidea (figs. 23, 24, 25).

With respect to EXTERNAL STRUCTURE, the *body* is short and broad instead of elongated, as in Thelyphonus and Nyctalops. The *cephalo-thorax* is flattened, of a round oval form, hollowed on the hinder margin, and often of a short heart or kidney shape; its integument is hard, horny, granulose, and often tuberculose; near the centre is a deep fovea, or pit-like indentation, from which other grooves and indentations radiate, showing the, now soldered up, junctional lines of the caput and thorax, and thoracic segments. In these characters of the cephalo-thorax the affinity of Phrynid_ to the Araneidea is very plainly indicated, as it is also in the eternal plate, around which the legs are articulated.

The *falces* are strong and somewhat cylindrical in form. They project in a line parallel to that of the cephalo-thorax, and each terminates with a strong curved denticulated fang, which is articulated to its upper extremity. The falces are toothed also on their under sides; the denticulations of the falces and their fangs differ a good deal in different species, and form one of the best and most tangible characters for the determination of the species (see a paper on "Phrynus," by A. G. Butler, in *Ann. and Mag. N. H.*, Aug. 1873, pp. 117-125, pls. 6, 7). In the usual position are two strong divergent *maxillæ*, each with a broad obtusely rounded apophysis at the fore extremity on the inner side; from the extremity of each maxilla springs a long, strong *palpus*, in some species of great length, consisting of four or (reckoning the large terminal movable claw as a substantive joint) five joints. This palpus is armed variously with tubercles, spines, and denticulations, especially on the cubital and radial joints, where several long, strong spines, opposed by the terminal claw (or digital joint), form a powerful grasping or raptorial organ, but one considerably further removed than the analogous portion of structure in

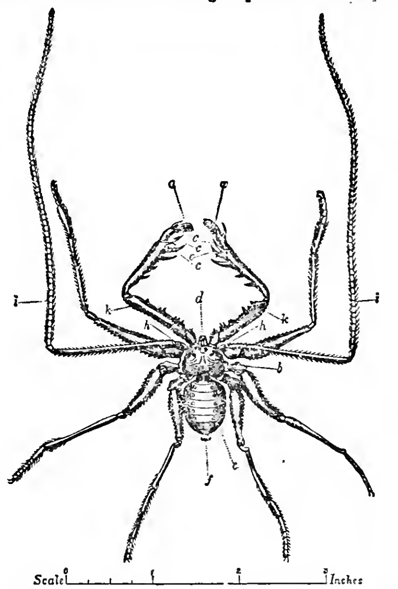

FIG. 23.—*Phrynus medius*, Koch. *a, a*, movable fangs or claws on fourth joint of palpi; *k, k*, forming, with claws, *c c*, on third joint, modified didactyle claw; *b*, cephalo-thorax; *d*, falces; *e*, abdomen; *f*, button at end of ditto; *h, h*, eyes; *i, i*, long palpiform legs.

Thelyphonus from the didactyle claw of the Scorpionidea. Between the maxillæ, and issuing from the fore margin of

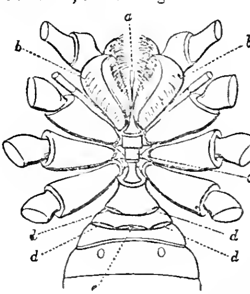

FIG. 24.—*Phrynus* —— ? portion of under side. *a*, labium *b, b*, maxillæ; *c*, sternum; *d...d*, orifices of respiratory organs; *e*, genital aperture.

the sternum, is a narrow, elongated tapering *labium*, in some species bifid at its extremity; the presence of a distinct sternal lip, or labium, is another mark of affinity to the Araneidea.

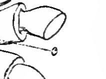

FIG. 25.—Falx and fang of *Phrynus reniformis*. Pallas.

The *legs* (seven-jointed) are long and generally slender, though the coxal joints of the three hinder pairs are long and strong, and articulated laterally to the sternum. The legs of the first pair are palpiform, and of great length and tenuity, the three terminal joints forming one long slender tapering portion, which is however subdivided into a great number of minute homogeneous articulations without any terminal claw; each tarsus of the remaining three pairs is divided into three articulations, ending with two curved claws; and in some species the tibial joint of the fourth pair is also tri-articulate. Probably the subdivision of the fourth pair of legs varies in other species also. The coxal joints of the first pair are, as it were, crushed in behind the maxillæ and above the coxæ of the second pair, as in Thelyphonus. The extreme articulation of each tarsus has a peculiarity never (it is believed) noticed before; its upper side being covered, throughout its length, with a separate integumental plate, prolonged at its fore extremity into a corneous, slightly bent, claw-like apophysis, forming a kind of third claw above and between the two ordinary ones. These latter spring from a supernumerary or heel joint, which has a short, conical, tooth-like spur beneath it, representing the usual third claw in other groups.

The *eyes*, eight in number, are placed in three groups, forming a very obtuse angled triangle on the fore margin of the caput. Two eyes, seated transversely, and near together in the medial line, constitute the apex of the triangle, which is directed forwards; the other two groups are of three eyes each, closely grouped in a triangular form, one on each side, about parallel with the second pair of legs.

The *abdomen* is oval, of a somewhat flattened form, and joined to the cephalo-thorax by a narrow pedicle, showing, in this also, a near approach to the Araneidea; it consists of ten quasi-segments, or articulations, formed, as in the other families of the order, by a series of upper and lower transverse corneous plates, having an, apparently continuous, cartilaginous integument between the two series of plates, and terminating with a button-like joint, or process, at its extremity. On the under side are two parallel rows of impressed spots, two, in a transverse line, in each of the fourth and three following sub-abdominal plates; but, apparently, like the corresponding marks in Thelyphonus, imperforate. The *organs of generation* have their external orifice beneath the posterior margin of the first sub-abdominal plate; and the external openings to the *respiratory organs*, four in number, are situated, two beneath the posterior margin of the first, and two others beneath that of the second of these plates. The *sternum* is oval, and often superficially divided into several portions by various ridges and indentations.

With regard to the INTERNAL STRUCTURE of the Phrynides, the *respiratory system* is pulmo-branchial, the orifices to these organs being four in number, and placed as above mentioned.

The *nervous system*, according to Van der Hoeven, appears to be very simple, consisting of a large thoracic bi-lobed ganglion, from which four pairs of lateral nerves issue, while a double nervous chord runs back through the connecting pedicle into the abdomen, where it divides into two divergent branches, from which the various nerves are distributed to the different parts of the abdomen.

GENERAL REMARKS.—The family Phrynides comprises but one genus, *Phrynus* (Olivier), which, according to the most recent publication upon it (A. G. Butler, *l.c. supra*), includes twenty species only, all confined to the tropical regions of the world. The individuals of most of these species appear to be of rare occurrence, or, at least but rarely observed, and the family has, comparatively speaking, received but little attention. It is, however, one of great interest and importance, and deserves more elaborate and careful treatment, especially in regard to its habits and internal anatomy, for it undoubtedly forms a plain passage from the Scorpionidea (through Thelyphonus and Nyctalops) to the true spiders (Araneidea). The main external marks of affinity with this order have been noticed in speaking of the different portions of external structure of the Phrynides.

Order VII.—ARANEIDEA.

We have come now, by an easy transition from the Phrynides, to the last order of Arachnids—*Araneidea* or True Spiders (figs. 26, 27, 28). And first, with regard to

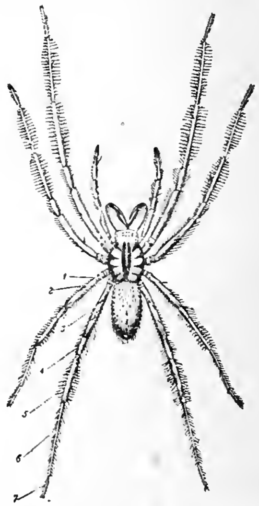

FIG. 26.—Spider (*Cambridgea fasciata*, Koch). Adult male.

their EXTERNAL STRUCTURE, they consist, like others of the sub-class Arachnida, of a body divided into two parts—cephalo-thorax and abdomen; but these are united only

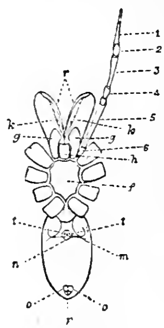

Fig. 27.

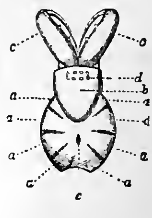

Fig. 28.

FIG. 27.—*Cambridgea fasciata*, adult male, under side, with legs and one palpus truncated. *f*, sternum; *g*, *g*, maxillæ; *h*, labium; *k*, *k*, falces, with *r* fangs of ditto; *m*, one of ordinary spiracular orifices (the corresponding one on opposite side not lettered); *n*, genital aperture, leading, in the male, only to spermatic vessels; *o*, *o* spinners; *p*, anal orifice; *t*, *t*, extra pair of spiracular openings; 1, digital joint of palpus, 2, palpal organs; 3, radial joint; 4 cubital; 5 humeral 6, axillary.

FIG. 28.—The same, upper side of cephalo-thorax. *a*...*a*, coalesced thoracic segments; *b*, caput; *c*, *c*, falces; *d*, eyes; *e*, central indentation.

by a slender pedicle, and neither is segmented, ringed, or articulated, nor (in respect to the abdomen) covered with horny plates, except in two instances—*Liphistius desultor* (Schiödte) and (but partially only) *Tetrablemma medioculatum* (Cambridge), both exceedingly rare and remarkable species. The *cephalo-thorax*, though undivided, yet shows by its various, and more or less strongly marked, converging grooves and indentations, that it is composed of the ordinary cephalic and thoracic segments soldered together; and, although these segments form but one undivided portion of structure, it is necessary to speak of it frequently by the names of its two portions—caput and thorax. The caput is almost always easily traced, forming a kind of wedge-shaped portion, jammed (as it were) into the first of the thoracic segments, and giving one the idea, in most cases, of its fore part having been to a greater or less extent truncated or lopped off (fig. 28, *b*). Similarly the last of the four thoracic segments has the appearance of having been driven in to meet the caput, all the segments thus converging, on the upper side, towards a common fovea, or more or less deep central indentation (fig. 28, *e*), and on the under side forming a sternum (or sternal plate), in which, however, no appearance of segmentation is generally visible beyond small eminences opposite to the articulation of the legs, with which the number of the thoracic segments, as seen above, agrees. The integument of the cephalo-thorax is either hard, horny, or coriaceous, generally more or less clothed with hairs and bristles, and sometimes, though more rarely, with tubercles and spines; occasionally it is perfectly smooth and glabrous. The *eyes*, when present, are two, four, six, or eight, and are very variously, but always symmetrically, disposed on the fore part of the caput (figs. 28, 29, 30). The number and general position of the eyes form valuable characters for the formation of genera; while their relative size is strongly characteristic of species. The eyes of spiders, like those of other Arachnids, are always simple.

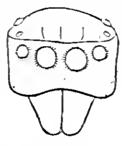

Fig. 29 —Caput of *Attus* —— ? showing position of eyes.

The *legs*, eight in number, are articulated to the sternal plate (mentioned above) which forms the under side of the cephalo-thorax; in one genus, however (*Miagrammopes*, Cambr.), found in Ceylon and Australia, no sternum properly so called exists, the legs being articulated to the continuous under side of the cephalo-thorax. Except in one or two species the legs are seven-jointed, and variously furnished with hairs, bristles, and spines. Many spiders have a kind of pad of closely set papillæ-form hairs beneath the extremity of the tarsi of some or all the legs, and often extending along the whole of the under side of the joint. This pad enables the spider to run over smooth vertical surfaces, acting as a kind of sucker, partly by atmospheric pressure, and partly (Mr Blackwall thinks wholly) by means of a viscid secretion from the papillæ-form hairs. Each tarsus ends with either two or three more or less curved or bent claws, commonly (but not always) pectinate or finely denticulated; these (with other opposed serrated claws, in some groups) are used in traversing their webs, and as hooks to give a tension to the line of their snares by alternately pressing and straining upon them; the spines and bristles are used also in many cases in the actual construction of the silken snares in which spiders entrap their prey. The spines on the legs of some spiders which excavate cylindrical holes in the earth (lined with silk and closed with a hinged lid) are very strong, and well suited for digging out the soil. The males of some species, again, have a curious row of short, closely set, curved, spiny bristles along a portion of the upper side of the metatarsi of the fourth pair of legs; the use of this row of bristles (called the *calamistrum*) is alluded to further on. The length of the legs in spiders (both actual and relative) is very various; and the differences between them, as well as their armature and terminal claws, furnish valuable characters, often generic, and always important in the determination of species.

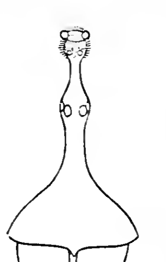

Fig. 30. — Caput of *Walckenaëra acuminata*, Blackw., showing position of eyes.

The *falces*, two in number, are articulated immediately below the fore margin of the caput; their direction is various, ranging from a line parallel to the plane of the cephalo-thorax to one perpendicular to it; they are in general opposed to each other, and in most cases are armed with teeth on their inner surface, especially towards the extremities; each also terminates with a movable curved fang, which, when not in use, is (according to its mode of articulation) folded down either across the inner side of the extremity of the falx, or (as in one extensive family, *Theraphosides*) backwards along its length; by means of these fangs, which are internally channelled and perforated at their extremities, a poison secreted within the caput is instilled into the wound made by them, proving, no doubt, fatal to the spider's prey, and often nearly so to human beings. Not to dwell upon the, probably exaggerated, accounts of the Tarantula, there are well-authenticated instances of recent date in regard to the very deadly nature of the poison of quite a small spider, *Lathrodectus Katipo* (Ll. Powell), found in New Zealand (*Trans. N. Z. Instit.* iii. p. 56; also *Id.* ii. p. 81, and iii. p. 29). A larger European species of the same genus, *L. oculatus* (Walck.), also bears the reputation of being venomous.

The *maxillæ* are a conspicuous, as well as an important, portion of structure in the Araneidea; they are two strong pieces situated immediately behind the falces, exceedingly varied in form and strength, and articulated to the fore side of the sternum between the basal joints of the first pair of legs. Their real direction is always divergent, *i.e.*, outwards from each other, but as in most cases the inner extremity is produced into an apophysis of greater or less size (sometimes following the direction of the maxilla, sometimes curved so that its extremity almost touches that of the opposite maxilla), the maxilla itself often seems lost in the part which projects from it. Owing to this, the palpus which springs from each maxilla, although really always springing *from its extremity*, appears more frequently to issue from *its outer side*; and, in fact, it can hardly in those cases be described (without leading to some confusion) as issuing in any other way. The form of the maxillæ, together with the apparent point of palpal issue, constitutes one of the most valuable characters for the establishment of genera.

The *palpi*, issuing from the maxillæ as just described, are two (in both sexes of *many*, and in the female sex of *most* species, leg-like) limbs, of five or (counting the basal joint—maxilla—to which each is articulated) six joints; in the female spider the palpi generally end with a single, and sometimes denticulate, curved claw; in some instances, however, there is no terminal palpal claw; but in the male, the third (*cubital*) and fourth (*radial*) joints of the palpi are (the former often, the latter always) characterised by prominences, spiny apophyses, or protuberances, which furnish some of the strongest, as well as most tangible, specific characters of that sex; the last (or *digital*) joint of each palpus (in the male spider) is generally more or less concave, and always includes, either within its concavity or articulated to its under side, a (frequently complex) congeries of corneous lobes, spines, and spiny processes, in some instances articulated to each other so as to be capable of being opened out as by hinges. These are not developed until the spider arrives at maturity. Up to that period the digital joint has a tumid and somewhat semi-diaphanous appearance, and, although commonly smaller, bears the same general form that it has after maturity. These processes, or, as they are called, *palpal organs*, are connected with the process of reproduction—the fecundation of the female. This subject, however, we shall have occasion to refer to again. The palpi are generally furnished more or less with hairs, bristles, and spines, like the legs; and like them, also, are reproduced after accidental loss.

The *labium* is also another important portion of structure; it is situated at the fore extremity of the sternum, between and in front of (or rather beneath) the maxillæ; it is of varied form and size, and stopping the gap between the maxillæ, it completes with them the inferior and lateral boundaries of the mouth, the falces forming its upper limits. The labium is always present, except in a new and very remarkable Brazilian spider, *Aphantochilus Rogersii* (Cambr.), in which the labium is wanting, and yet not wanted, because the maxillæ, in this instance, close up to each other, leaving no gap between them.

Between the labium and falces is another portion of structure, the *tongue*; it is, no doubt, by the aid of this that the act of swallowing the juices of insects, when expressed by the falces and maxillæ, is effected; that, in fact, the spider eats without being choked. No use hitherto has been made of the tongue in spiders for purposes of classification, but the form of the *labium* is very useful for the characterisation of genera. These parts —falces, maxillæ, labium, and tongue—thus complete the mouth-parts of a spider.

The *sternum* has already been mentioned; its form varies from oval to heart-shaped, and sometimes somewhat pentagonal; its convexity also varies considerably; its use in classification is rather limited, but with its clothing of hairs, bristles, or pubescence, or its sometimes glabrous nature, it generally has some specific importance. In one known genus only, as mentioned above, is the sternum wanting.

The *abdomen* is exceedingly varied in form in different families; it is united to the cephalo-thorax by a short narrow pedicle, and generally terminates with organs for spinning; in one species, *Liphistius desultor* (?) (Schiödte), the spinners are placed near the anterior part of the under side of the abdomen; and in another, *Mutusca mammosa* (Cambr.), one pair only are so placed, the rest occupying the ordinary position. The number of spinners varies—two, four, six, or eight; they are placed in pairs, and when a fourth pair is present it is, usually as a single one, united throughout its length (but with often a line of division visible), and occupying a transverse position in front of the rest. It is but very lately that spiders have been observed with two spinners only; see "Spiders of Palestine and Syria," O. P. Cambridge, *Proc. Zool. Soc.* 1872, p. 260; *Ann. and. Mag. N. H.* 1870, pp., 414–417, *Ibid.*

The *spinners* consist of from one to three joints, and vary greatly in size and structure, as well as in number, but their use in classification has not hitherto been as great as might have been expected; generally they are separate, but in *Tetrablemma* (Cambr.) they are enclosed in a kind of corneous sheath. Those of the fourth pair when present (which they are in both sexes) are correlated, but in general only in the female sex, with the calamistrum, or double series of curved bristles before mentioned, on the metatarsi of the fourth pair of legs. The function of the calamistrum has been proved by Mr Blackwall to be the carding, or teasing and curling, of a peculiar kind of silk, secreted and emitted from the fourth pair of spinners; when thus prepared this silk becomes adhesive, from its minutely divided and elastic fibres; and, disposed about the lines of the spiders' snares, it renders more easy the entanglement and capture of their prey. Immediately above the spinners is a small nipple-like prominence which indicates the anal orifice.

The abdomen is covered with a continuous integument neither annulate nor segmentate; in one species, however (before mentioned), *Liphistius desultor* (Schiödte), the upper side has a longitudinal series of transverse corneous plates, like those of the Phrynides; and something of a similar kind, but less marked, is observable in *Tetrablemma medioculatum* (Cambr.), a very rare and remarkable little spider found in Ceylon. The epidermis of the abdomen is of various kinds and consistency in different groups, sometimes excessively thin and tender, at other times tough and coriaceous, and sometimes hard and horny, with a varied armature and clothing of hairs, bristles, pubescence, tubercles, and spines, sometimes being, however, perfectly bare and glabrous; its colours, also, and the patterns produced by their distribution, vary exceedingly. Underneath the fore extremity of the abdomen are placed the external openings to the respiratory organs; these apertures consist of a narrow slit or orifice under the fore edge of round or oval scale-like plates, placed on each side of the median line; such plates are in some spiders four in number, but for the most part only two. Other spiracular openings also exist in many spiders, both at the anterior part of the under side (fig. 28, *t*, *t*) and near the spinners (Siebold), but these are usually far less perceptible than the others before mentioned, and often discoverable with great difficulty. The ordinary pair of spiracular plates are in general very conspicuous, commonly differing in colour from the surrounding surface, and sometimes slightly pubescent. They occupy each side of the median line at the extreme fore part of the under side of the abdomen; and between them is, in the male spider, a very minute orifice which leads to the seminal organs; while in the same situation in the female is an aperture usually rather conspicuous, always of characteristic form, and often furnished with a corneous process of greater or less development. This aperture is the vulva, and the process (when present) probably has the function of an ovipositor. The form and structure of this aperture is of great use in the determination of species, but until the female spider attains maturity no aperture at all is visible. The orifices to the breathing organs are fringed with hairs or lashes, and open and close by an internal muscular arrangement. The other pair of spiracular plates, when present, are in some cases close behind those just above mentioned, but more commonly at some distance further towards the hinder extremity of the abdomen.

On the upper side of the abdomen may be seen in many spiders several impressed spots or dots, differing in number and position in different genera and species, but always placed symmetrically. These, considered by Treviranus as stigmatic openings, are probably indicated points of fixture for muscles beneath the integument, being apparently imperforate. Smaller puncture-like marks are also often visible on the under side, and are perhaps similarly caused. The hairy clothing of the abdomen (as well as of the cephalo-thorax and other parts), variously tinted and coloured, gives the specific pattern to the spider from its diversified distribution; and when such clothing is absent, the pattern is often equally distinct and varied, arising in such cases from a pigment in the coats of the integument itself.

Internal Organisation.—The *Muscular System* of spiders is very similar to that of the rest of the Articulata. The muscles are formed of numerous parallel fibres traversed by very marked striæ; these muscles are attached to the different portions of the tegumentary system, and move the various parts of the body by the contraction of their fibres. Those which set in motion the falces, the maxillæ, and the coxæ of the legs, are attached to the thorax, and radiate to all these parts from a centre, marked externally by what has been before spoken of as the *thoracic indentation*, or *fovea*. The other joints of the legs move, one after the other, by means of small and exceedingly fine muscles, of the two kinds ordinarily known as *extensors*, to raise the joint, and *flexors*, to lower it. All these muscles act with great rapidity, and enable the legs to move in every direction according to the mode in which the various joints are articulated. The differences in the relative strength and volume of the muscles are very great; those, for instance, by which the fangs of the falces are moved are exceedingly powerful; the abdomen being generally soft, its integument does not furnish such firm points of attachment as that of the thoracic region, and yet the spider can move its abdomen with the greatest ease in every direction. Beneath the integument, at the fore part of the under side, two ligaments are attached to a membranous plate, situated under the branchial operculum, and at the hinder part, round the ring which encircles the spinners and the anus. The fore half of these ligaments is cartilaginous, while the hinder half is composed of contractile muscular fibres, and by means of those muscles the spider moves its abdomen. Two other pairs of muscles may also be particularly mentioned,—one pair inserted under the membrane in the junctional pedicle, the other leading round the respiratory organs: the office of these is to open or close the branchial opercula, and to draw the sexual organs backwards or forwards. The spinners are moved by special muscles similar to those of the legs. (Simon, *Hist. d. Araign.*)

The *Organs of Digestion* consist of a large sac, or stomach placed in the cavity of the cephalo-thorax, and fastened to its arch by a strong muscle; this muscle passes round and through the stomachal sac; *into* the stomach a tube (œsophagus) leads from the mouth, and *from* it ten lateral branches or cæca (five on either side) issue, passing down the sides to the origin of the legs, and, curving round, end in a reservoir placed below the stomach. This reservoir is connected with the stomach by the muscle mentioned above, and divided from it by a solid plate into which this muscle is inserted; it, in fact, forms a kind of second or lower stomach into which the juices forming the spider's food are forced from the upper one by muscular action.

Out of the stomach the alimentary juices go into a tube or intestine, which is much contracted in size in passing through the junctional pedicle into the abdomen, but enlarges a little within the latter; this tube curves over for some distance in a line parallel with the dorsal integument; it then drops down suddenly, forming a large loop, and so passes into a large rounded pouch (rectum), in which the undigested portions of food collect, and thence pass out through the anus, situated, as before observed, at the extremity of the abdomen just above the spinners. The abdominal intestine is imbedded in a mass of fatty globules, from which bile is secreted; the bile passing by means of biliary ducts (into which urinary organs also pour their contents) into the rectum. Digestion is effected by means of a gastric juice secreted by appropriate glands between the lateral cæca, and thence poured into the stomach (Simon, *l.c.*, after Dugès).

Walckenaer, *Ins. Apt.*, following Treviranus, gives a slightly different account of the digestive apparatus of *Tegenaria domestica* (Walck.) Probably a certain amount of variation would be found in the details of form and structure of the stomach and intestinal canal, and other organs of digestion, in different species; but the general plan of the digestive arrangement is the same. It is an undecided question whether the œsophagus of spiders can pass any substance except the juices of their prey. See O. P. Cambridge in *Entomologist*, May, 1870, pp. 65–67; and *Ann. and Mag. N. H.*, Dec. 1872; and F. Pollock, *Id.*, Oct. 1872.

Organs of Circulation.—As in some other groups of Arachnids a strong muscular tube or vessel (divided into four chambers)[1] runs along beneath the dorsal integument of the abdomen, following the integumental curve; this dorsal vessel (or heart) varies in form in different species, and is enveloped in a fine fibrous tissue, which forms a *pericardium*.[2] The several chambers of the heart communicate with the pericardium by means of small elongated orifices (auriculo-ventricles) placed at the constrictions where the chambers are separated from each other; through these orifices the vital fluid passes *into*, but cannot pass *out of*, the heart. This latter operation is effected by the contraction of the heart, which forces the fluid forwards into a tube or artery issuing from the first chamber; this tube—aorta—passes through the junctional pedicle, and entering the thorax, divides into three pairs of arteries. The upper pair follow the dorsal line and give off blood-vessels to the eyes, the falces, and other parts of the mouth; the second pair, intended to give nourishment to those parts, pass over the stomach; and the third are imbedded beneath that organ, and emit arteries to the legs, extending to the very extremity of each. These three pairs of arteries reunite forwards and form a collar round the cerebral ganglion; and from thence a tube[3]—abdominal or posterior aorta—passes backwards under the ganglia through to the abdomen, continuing quite to the spinners; this tube furnishes numerous branches to the organs which it passes in its course. From the general circulation the vital fluid is brought into two large longitudinal reservoirs within the lower face of the abdomen, by means of sinuses or canals formed by the interstices of the muscles; these anastomose and pour their contents into the reservoirs just above mentioned; from them the fluid[4] penetrates the branchial organs, and being there reoxygenated, is carried back to the pericardium by four brancho-cardiac vessels; from thence it passes into the dorsal vessel or heart through the auriculo-ventricles[5] above named. Muscular contractions and dilatations appear to be the means by which the fluid is propelled through the sinuses that bring it to the branchial organs for oxygenation (Simon, *l.c.*, after Emile Blanchard, and Dugès).

As has been already observed in several notes, there is some difference between the above account of the circulatory system and that given by Claparède; probably the organs of circulation vary, somewhat in different species. One point of difference, however, between the above and Claparède's description is of importance, that is, the difference which is mentioned in note (4) below. The idea that the blood "penetrates" the branchial organs may have been led up to by the apparently unfounded, but confidently pronounced opinion that these organs were true analogues of the lungs of the Vertebrata; whereas, if the blood does not penetrate them, but is merely oxygenated in its general passage by and round them, their real tracheary nature (as seems to be the better opinion now) is strongly confirmed; and hence the hitherto widely-received division of Arachnids into *pulmonary* and *tracheary*, based upon the idea of the distinct nature of the pulmo-branchiæ from the tracheæ, falls to the ground; the more especially since, whatever the difference may be between the ordinary tracheæ and the pulmo-branchiæ, both are found in the same individual, in the order we are now considering—Araneidea.

Organs of Respiration.—From what has just been said, it seems hardly proper to base any definition of the respiratory organs of spiders on the supposed essential distinction between the pulmo-branchiæ and tracheæ. Such difference as there is, and it is indeed an important one, seems to be this, that whereas the tracheæ are lengthened tubes, which convey the air in very small volumes to different parts of the body, and so oxygenate the vital fluid in its passage, the pulmo-branchiæ are modified tracheæ, localising, so to speak, within a peculiarly furnished sac, a considerable volume of air in the immediate course of the large sinuses, in which the used-up vital fluid is re-collected previous to its return to the dorsal vessel. This arrangement, no doubt, marks a higher state of organisation than is possessed by those Articulata furnished with merely simple tracheæ; it is a progress from a diffused to a localised system, but still it seems essentially distinct from the lungs of vertebrates, in which the *blood is carried to the air and permeates every portion of the air-vessels*, and not the air to the blood, as is really the case in regard to both the pulmo-branchiæ and tracheæ of spiders. It is not a matter, perhaps, of prime importance, but if the above views be correct, it would seem better to relinquish the name of pulmo-branchiæ, since there is not only no real analogy to the lungs of

[1] Claparède (*Etudes sur la circulation du sang chez les Aranées du genre Lycosa*), in describing the dorsal vessel of a young Lycosa, says that at that age no such chambers exist, and questions whether or not the chambered form such as Newport and Blanchard have described in the scorpion, does or does not exist in the adult Lycosa. *Vide supra*, p. 285, on the heart of the scorpion.

[2] The existence of this is also questioned by Claparède, who speaks of the heart as placed "not in a distinct organ—pericardium—but in a certain indefinite space—lacune péricardique," (*l.c.*)

[3] Claparède could not find this in Lycosa, (*l. c.*)

[4] Claparède (*l. c.*) says, on the contrary, that the blood "never penetrates between the leaves (*feuillets*) of the respiratory organs," but is reoxygenated in its close passage by them.

[5] Claparède says that *all* the fluid which comes from the respiratory organs passes into the heart through the *foremost pair* of these openings.

mammal, but just as little to the gills of a fish. We would propose, therefore, to distinguish these modified and localised tracheal sacs by the name of *sac-tracheæ*, the ordinary ones being designated *tube-tracheæ*.

In some spiders, Theraphosides (including the giant spiders of the family better known as Mygalides), the respiratory organs are solely sac-tracheæ; these are in this case four in number, and placed in two pairs on the lower side of the abdomen. Their external orifices are protected by spiracular plates (as before noticed); in other spiders there is, close in front of each of the fore-pair of sac-tracheæ, an orifice leading to tube-tracheæ. In some few spiders a kind of supernumerary spiracular slit or opening is visible near to the ordinary one, but not always similarly placed. A pair of others are also visible close behind the sexual aperture in *Cambridgea fasciata* (L. Koch) (fig. 27, *t*, *t*). These openings probably lead to other tube tracheæ. We have also noticed slit-like openings similar to those above mentioned in some undescribed species of Drassides, and some also exist in the well-known European spider, *Argyroneda aquatica.*[1] Tracheal openings also exist, according to Siebold, near the spinners. The sac-tracheæ of spiders are of the same construction as the organs described as pulmo-branchiæ in the family Scorpionides. The following short description is abstracted from E. Simon, *l.c.*, following Emile Blanchard :—"The respiratory apparatus is contained in sacs beneath the stigmata; these sacs are globular and flattened, formed by a silvery white membrane. Each of them contains a body not fastened to the walls of the sac, but lodged as in a chamber; this body is composed of sixty or seventy plates (lamellæ) lying one upon another like the leaves of a book. Each one of these apparent *plates* is in fact itself a flattened sac, with an opening on its lower side communicating with the outer air admitted through the spiracular orifices. The walls of these numerous sacciform lamellæ consist of two membranes of different composition, the inner one hard, the other soft, and between them is a very fine strong network analogous to the spiral thread of the tracheæ of insects."

The inspiration and expiration of air in these sac-tracheæ are effected in a very simple manner. To the outer wall of the sac a broad and strong ligament is attached; this ligament ascends across the abdomen, and is fixed to the walls of the heart. 'Each movement of this organ, diastole or systole, strains or slackens the ligament, which in its turn raises or lowers the tracheal sac, and by these means the air is either drawn into or expressed from it (E. Simon, *l.c.*, after E. Blanchard).

According to Treviranus, *l.c.* (*vide* Jones, *Anim. Kingdom*, p. 416), who, however, makes them four pairs on each side, there are, in the Araneidea, four pairs of spiracles (four on each side of the cephalo-thorax) situated immediately above the insertions of the legs. He also notes four stigmata (in two pairs) on the upper side of the abdomen, and a pair on the under side; the former undoubtedly exist, in some species at least, but the latter appear to be imperforate, and are probably only points of muscular attachment. It does not appear that the tracheæ leading from the thoracic spiracles have ever been traced; they are, perhaps, exceedingly delicate in their walls, and probably of no great length, and hence after death, when the air has left them, they would be exceedingly difficult to detect. There remains much, doubtless, to be yet discovered in regard to these and other minute details of the internal organisation of spiders.

The Nervous System.—In the order *Acaridea*, as it has been above observed, the nervous matter is concentrated into one large mass or ganglion, whence it branches out to the rest of the body. In the *Pycnogonidea* the nervous system consists of a longitudinal series of large ganglia, of which the four abdominal ones are sessile. In the *Scorpionides*, also, it consists of a longitudinal series of eight ganglia distributed throughout the whole body, and united by a triple nervous chord; and now in the *Araneidea* (as in the *Solpugidea*, *Thelyphonidea* (*Phrynides*), and indeed in the *Phalangidea* also), we seem to have a compound of these two modifications. Thus, in the *Araneidea* the nervous matter is, in general, concentrated into two masses, one placed within the fore part of the cephalo-thorax, just above the œsophagus; this (the cephalic or so-called cerebral) ganglion sends out fine nervous threads to the eyes, falces, and labium; the other mass (thoracic ganglion) is situated just behind the former, and occupies a large portion of the thoracic cavity; it is of a flattened disc shape, and is united to the cephalic ganglion by short but broad connectors, forming a narrow collar round the œsophagus. This thoracic ganglion is formed by an approximation and soldering together of the different ganglia which exist separately in the scorpions. A proof of this is furnished by the fact, that in the young of some of the Araneidea, furrows of greater or less depth show the junctional points of the different ganglia.

From the thoracic ganglion lateral nerves issue to the legs and palpi; besides which a fascia of nerves runs backwards through the pedicle into the abdomen, and these subdividing, branch out to all its different organs (Simon, *l.c.*) A modification of the above exists in the Theraphosides, where there is a special enlargement, or ganglion, just within the fore part of the abdomen, before the nervous fascia subdivides and branches out into that part of the body; probably this modification would be met with also in many other spiders (Cuvier's *An. Kingdom*, pl. 2, Arachnides; and Treviranus, *l.c.*, pl. 5, fig. 45).

The *Organs of Reproduction* in the *female* consist of two long ovaria placed longitudinally within the ventral surface of the abdomen; these unite and form a short broad oviduct, having an external opening of various form beneath the upper end of the abdomen between the spiracular orifices, as before noted under the head of external structure.

In the *male* the organs for the secretion of the seminal fluid consist of two long narrow convoluted tubes, occupying the same relative situation as the ovaria in the female, and also opening outwardly through a common but exceedingly minute orifice in a similar position. No intromittent organ has been discovered in any instance; and it is not long since that the probable way in which the impregnation of the female takes place (at least in some cases) has been at all certainly noted. It has been before remarked that the peculiar corneous lobes and spiny processes connected with the digital joint of the palpi—palpal organs[2]—in the male, are used in the course of copulation; but araneologists were not (and probably are not now) agreed as to their real office in generation. A distinguished author, Mr John Blackwall, went so far as to prove, as he believed, by a series of carefully conducted experiments, that the seminal organs of the male spider, above described, are in some cases wholly unnecessary for the impregnation of the female—at least so far as any external use or application is concerned—and that the palpal organs are the efficient agents in the impregnation of the female spider (*Report of Brit. Assoc.* 1844, pp. 68, 69). This, however, seemed to be contrary to all reason and analogy, and led to the hypothesis that there was some communication by a duct or ducts between the spermatic vessels in the abdomen and the palpal organs (Hermann, 1868; *Verhandlung d. Zool. Bot. Gesellsch. in Wien*, xviii. pp. 923, *et seq.*) This idea, however, appeared to be negatived by the failure of Dugès and other eminent anatomists to discover any duct in the palpus, where, if present, it would be comparatively easy to find. Another hypothesis—grounded on the fact that the palpal organs have in some cases been observed to be applied repeatedly to the mouth between their numerous applications to the vulva—was, that there might be some duct through which the spermatic fluid could pass into the alimentary canal, and so be conveyed to the œsophagus, and thus be taken from the mouth by means of the above-mentioned application to it of the palpi. The discharge of the spermatic fluid in birds into the lower intestine appeared to support the possibility of this hypothesis being true (O. P. Cambridge, *Trans. N. Z. Instit.*, vol. vi. 1873, p. 190). Another opinion, long since, and even now, held by some arachnologists, is that the male spider collects the seminal fluid with its palpal organs into the concavity of the digital joint from the minute orifice above noted; but no instance has ever been noticed in which a spider has been detected in such an employment of its palpi. An instance has been recorded in which there were *during copulation* (?) repeated embraces, and at each embrace a perfect apparent coition was effected between the sexual apertures of the male and female spider, the palpi not being used at all (O. P. Cambridge, *l.c.*, p. 191). Other arachnologists, again, have recently observed that the male spider before the act of copulation "emits from the sexual aperture a drop of sperma on a kind of small web made for the purpose, which drop he then takes up in the genital bulb of the palpi" (A. Menge, *Ueber die Lebensw. d. Arachn.* p. 36; and A. Ausserer, *Beob. ueber die Lebensw. der Spinnen*, p. 194). This would appear to settle the question; but while, at the same time, it is remarkable that an observer so accurate in observation and so painstaking as Mr Blackwall should never have observed male spiders taking the spermatic fluid from the abdominal aperture, as stated by Menge some thirty years ago, it is also remarkable that Mr Blackwall should unconsciously afford the strongest evidence in favour of the facts mentioned by Menge and Ausserer.

Dugès, in suggesting, long since, that the male spider took the seminal fluid from the aperture in the abdomen with its palpi, asked whether the palpal organs may not alternately act as an absorbing siphon and an ejaculatory organ. Mr Blackwall (*Jour. Linn. Soc.*, vii.) mentions this question of Dugès, and then states a fact which at once answers the first part of it in the affirmative, and tends to confirm

[1] In a recent paper, "Ueber die Respirationsorgane der Araneen," by Philipp Bertkau," *Arch. f. Nat.*, xxxviii, pp. 208-233, pl. 7, recorded, *Zool. Record.*, ix. p. 206, which the present writer has not had an opportunity of studying, the author appears to have come to the same general conclusions on the respiratory system of spiders as those above mentioned, and also to have discovered, in some spiders, other orifices leading to tube-tracheæ in front of the spinners.

[2] These organs are not developed until the last moulting of the spider's skin, and their development (unmistakable when complete), is an unerring sign of the spider's sex and maturity. Until this period the digital joint is more or less rounded and tumid, but it can even then seldom be mistaken for that of a female spider.

Menge's and Ausserer's statement: "A male *Agelena labyrinthica* confined in a phial, spun a small web, and among the lines of which it was composed I perceived that a drop of white milk-like fluid was suspended; how it had been deposited there I cannot explain, but I observed that the spider, by the alternate application of its palpal organs, speedily imbibed the whole of it."

That the spermatic fluid is conveyed to the female parts of generation by the male palpi is thus pretty certain; and it seems not improbable that there are more modes than one by which the palpi are supplied with the fluid. See also critical observations on this subject by Dr. T. Thorell, 1873, *Synonyms of Europ. Spid.* pp. 591–595.

Before concluding our remarks on the internal structure of the Araneidea, two of their special properties must be shortly noticed—the secretion of the poison injected into the wounds made by the fangs of the falces, and the secretion of the matter emitted as silken threads through the spinning organs.

The *poison* is secreted in two small elongated sacs (one for each of the falces), situated within the cephalothorax on either side of the alimentary canal; the sacs are connected with a membranous channel in each of the falces, the channel running completely through the fang, from an orifice near the end of which the poison is pressed out by the spider in the act of wounding its prey On the venomous nature of the poison some remarks have already been made. As to its venom in British spiders, see "Blackwall's Experiments," *Trans. Linn. Soc.*, xxi. pp. 31–37. The result of these interesting experiments is contrary to the generally received idea as to the great virulence of spider poison.

The *external spinning organs* have been mentioned above; they are usually called *spinners*, and are various in size, both actual and relative, in form and in structure, as well as in number. From the extremity of each of these organs the silk matter issues through numerous movable papilla, or *spinnerets*, which are similar to hollow bristles with enlarged bases; the papillæ vary both in form and number in different species, and from each spinneret or papilla issues an exceedingly fine thread; this, uniting with threads from all the other papillæ, forms the ordinary silk line, which though to ordinary observation simple, is composed of numberless threads from some one, or all, of the spinners. The matter from which the silk is formed is secreted in organs (silk-glands) situated within the ventral surface of the hinder part of the abdomen. These glands vary in number, size, and form in different species; they differ also in size and shape in the same species, for the secretion of different qualities of silk-matter; and each gland has a distinct duct terminating at the extremity of the spinners. The emission of silk matter appears certainly to be a voluntary act on the part of the spider; but it is a disputed question among arachnologists, whether spiders have the power forcibly to expel it, or whether it is merely drawn from the spinnerets by some external force or other. Mr Blackwall (*Trans. Linn. Soc.*, xv. p. 455; *Researches in Zoology*, pp. 242–248, and *History of Spiders of Great Britain and Ireland*, p. 12) is of the latter opinion; while Mr R. H. Meade (of Bradford, Yorkshire), in *Report of British Assoc.*, 1858, pp. 157–164, pl. 16, thinks that (from microscopic anatomical investigations which he has himself made) there is good evidence of spiders having the power to expel it, for he finds a certain muscular arrangement which would apparently suffice to give this power, and observers have actually seen the lines propelled. Mr Meade, however, need not be assumed to assert an indefinite power to expel threads of silk to any indefinite distance. The truth probably is, that spiders have, and do exercise, a general power not only of *emitting* silk matter from the secreting glands merely to and from the external orifices of the silk-tubes, but also of *propelling* it when necessary to some short distances; and that external causes (such as the movement of the spider while the end of its line is fixed, or when a current of air takes an emitted line and carries it in a direction contrary to that of the spider) also serve to draw the threads out. In all these ways, no doubt, are produced the gossamer lines which often cover the surface of the ground and herbage in autumn. In the formation of their snares spiders use the hinder or fourth pair of legs for drawing the threads tight, and apparently for ascertaining their power of tension. The third, or inferior tarsal claw, being usually strongly bent, no doubt enables spiders to perform these operations very readily. Some large groups of spiders do not spin any snares, and in them we usually find this third claw absent; while in one group, Epeïrides, whose snares are marvels of beauty and ingenuity, the third claw is very highly developed.

The snares of spiders have been made the basis of some of the primary divisions of the order. Characters, however, taken merely from habits and modes of life, can hardly be considered those on which systematic classification should be based, not to mention that those characters fail when we come to extensive groups spinning no snares at all. Short of such a use of the snares of spiders, this part of the subject is of extreme interest and importance. The Latreillian divisions of snares is fairly and generally accurate; by this method they are divided into—*Orbitelariæ*, where the plan is that of a circle or a portion of one, with lines radiating from a centre; *Retitelariæ*, where a thin sheet of web is suspended among the branches of shrubs or in angles of buildings, and held up and down by lines in all directions above and below; *Tubitelariæ*, where the snare is a silken tube, inserted in crevices, and fissures, and casual holes, and with an open mouth more or less guarded or armed with insidious lines; and *Territelariæ*, in which a tube is spun in a hole formed by the spider itself, and closed sometimes by a close fitting cork-like, or sometimes by a scale-like or wafer lid, sometimes left open, and at other times closed by the falling over of a portion of the tube which protrudes from the surface of the ground (see *Trapdoor Spiders*, by J. T. Moggridge, Lovell Reeve, London, 1873–4). With respect to the economic or mercantile value of spider silk, the idea seems to have been entertained, from a remote period, that it might not only be turned to practical use in the manufacture of silk fabrics, but also be made to pay as a mercantile speculation. The possibility of making it into articles of wear is undoubted, as instances of it are on record. Upwards of 150 years ago Le Bon of France (Languedoc) obtained, from spiders, silk which was afterwards woven into gloves and stockings; but Réaumur, appointed by the French Academy to investigate the matter, reported unfavourably, doubting the possibility of rearing the spiders together owing to their voracious and cannibal propensities. In 1777 and 1778 a Spaniard, Raimondo Maria de Termeyer, published, in Italian periodicals, two memoirs on the subject; and afterwards, 1810, at Milan, another called *Ricerche e Sperimenti sulla Seta de Ragne*, in which he takes an opposite view to that of Réaumur. The latter work is of great rarity (*vide* B. G. Wilder in Harper's *New Monthly Mag.*, xxxiv. p. 455). Termeyer constructed a small kind of stocks, in which the spider was fixed by the body, while with a little winding-machine he drew out and wound up the silk threads from the spider's spinnerets; but evidently nothing came of this further than an additional proof of the possibility of procuring and making use of spider silk, as well as of its strength and lustre; this last, however, as well as other qualities of the silk, would probably be found, as with that of various silk worms, to vary according to the species. Other experiments, with a similar general result, have been made since (*Zoologist*, 1857, p. 5835), the latest being those made by Dr B. G. Wilder, professor of anatomy in the

Cornell University at Ithaca, United States (*l.c., supra*), with *Nephila plumipes* (Koch), a large epeïrid abundant in South Carolina. His experiments appear to have been unconsciously, though surprisingly, similar, and with a similar result, to those of Termeyer; but the question as to the mercantile importance of spiders' silk appears to have hitherto elicited only an unfavourable answer. Dr Wilder, however, is still sanguine upon the point (*vide* B. G. Wilder, *l.c.*, and also in *Proc. Boston. N. H. Soc.*, October 1865, with other references there noted, as well as in *The Galaxy*, July 1869, pp. 101, 112). In *Zoologist*, 1858, p. 5922, a correspondent, speaking of the strength of the silk threads of *Nephila clavipes*, says that small birds are sometimes entangled in its webs, and that the ladies of Bermuda use the threads for sewing purposes. See also *Phil. Trans.* 1668.

Before leaving this part of the subject we must notice the office of the *calamistrum*, mentioned before in speaking of the armature of the legs of spiders. This instrument is found in the females of various genera and families; it consists usually of a closely set double row of curved spine-like bristles on the upper sides of the metatarsi of the fourth pair of legs, forming a kind of comb, whence Mr Blackwall, by whom it was first discovered and its use perceived, gave it the name it bears. Its office is to card, or curl, or tease a particular kind of silk emitted from the supernumerary spinners, mentioned above as always, in the female, correlated with this instrument; the silk so curled and carded is, owing to the fineness of its fibres, exceedingly prehensile, and being disposed about the lines of the spider's snare, serves to entangle the insects which come in contact with it (*vide* Blackwall, *Linn. Trans.*, vol. xvi. p. 471, pl. 31, 1831). *Amaurobius similis* (Bl.) and *A. ferox* (Koch) are common house spiders whose webs are thus furnished with carded silk from the supernumerary spinners. Doubts have been entertained quite lately by an eminent araneologist as to whether the supernumerary spinners are indeed true spinning organs (T. Thorell, *Synonyms of European Spiders*, p. 595, 1873). It is therefore interesting to find in *Science Gossip* (Hardwicke, London, Sept. 1874), a short article by H. J. Underhill, in which the anatomy of these spinners is described and figured from original microscopic investigations, proving the recorded observations of Mr Blackwall, and others also, as to their being true spinners, to be correct.

The white flake-like flocculi often seen floating in the air on a calm autumnal afternoon are composed of spider silk emitted by numerous immature spiders, of many species and genera, passing through the air on their lines, which being so much lighter than the atmosphere, serve to bear them away with every breath of wind. The flocculi appear to be agglomerations of fine lines, adhesive from their fineness and fibrous nature. In this respect they differ from the ordinary gossamer lines, which are merely the threads left by small and immature spiders (chiefly of one or two families) as they pass from blade to blade and plant to plant. It seems probable that nearly all spiders leave a line or lines, which proceed from one or more of their spinners, whenever and wherever they move about; and the setting in of fine weather being the signal for a spontaneous restlessness, we can hence better understand the almost sudden appearance of myriads of lines stretching over the surface of the earth, and often extending high up into the air. Numerous papers have been written on gossamer, chiefly by German and French writers, with the latter of whom the subject has been sometimes treated on the basis of the marvellous and superstitious. These lines are called by them *fils de la Vierge*.

Our space does not permit of any great detail respecting the various kinds of snares, nor regarding the way in which different spiders construct them. Accounts may be found, by Mr Blackwall, in *Zool. Journ.* 1830, pp. 181–189; as well as in the *Report of the British Association for the Advancement of Science for* 1844, pp. 77–79; *Researches in Zoology*, 1st ed. 1834, pp. 253–284; *Linn. Trans.* 1831, pp. 471–479; and *A History of the Spiders of Great Britain and Ireland*, 1861–64, all by the same author; and the exceedingly interesting details on this subject in Kirby and Spence's *Entomology*, pp. 227–267 (7th ed.), are within every one's reach. The following notes, however, gathered from the works of Mr Blackwall and others, as well as from the writer's own observations, may be of interest:—

The geometric spiders (*Orbitelariæ*) are almost the only ones whose method of forming a snare have been at all minutely recorded. When the situation for the snare has been chosen, the area intended to be filled up by it is enclosed by various circumferential boundary lines, fixed to adjacent objects, the exact shape of the area being influenced by the situation and surrounding circumstances. A diagonal thread is then spun across it, and from about the central point of this thread another is carried to the marginal line; returning to the central point along the line just spun from it, the spider carries another line to the margin, and fixes it at a short distance from the first. In this way the whole area is gradually filled up, the spider always returning to the centre along the last line spun, and starting again thence fixes a fresh one to the boundary line of the snare. The form of the snare is now that of a wheel; the next operation is to cross the radii of the wheel with ladder-like lines; this the spider does, beginning from the centre and working towards the circumference, with a single spiral line, which is fixed, or glued, with a minute portion of viscid matter, to each of the radii as it crosses by an application of the spinners; at some distance from the centre this spiral line is discontinued and another is begun; this is formed of quite a different kind of silk matter, being viscid, and retaining its viscidity in the form of "minute dew-like globules closely studding the line." It appears that when the viscid lines, intended for the capture of its prey, are completed, the spider cuts away the first, or unadhesive line, which is of no service in the entanglement of insects, its office appearing to be chiefly to strengthen the snare while the viscid line is being spun, and to enable the spider to traverse the parts with greater ease. Modifications of the above method are, no doubt, adopted by some species, but, substantially, it is believed that most orbicular snares are thus constructed.

The mode of formation of the snares of the *Retitelariæ* does not appear to have been observed, probably owing to their being made almost wholly during the night. The snare of one of these spiders, *Linyphia marginata* (Bl.), is an exceedingly perfect one of its kind, and abundant in most localities; it consists of a thin horizontal sheet of web, suspended among the branches of low evergreen trees and shrubs, by a maze of intersecting lines above, and held down firmly, on the under side, by some short, tightly-strained perpendicular lines, fixed below to others, which traverse each other in all directions; beneath the horizontal sheet of web, head downwards, the spider remains patiently watching for such insects as may become entangled in the upper maze of lines. The mode in which the horizontal web is suspended and braced down, would, without doubt, if it could be observed, prove to be a point of great interest.

Among the *Tubitelariæ* we have the observations of Mr Blackwall, directed chiefly to the formation by *Amaurobius atrox* of the peculiar fibrous and adhesive flocculus, drawn from the fourth pair of spinners by the "calamistrum," and disposed about the irregularly intersecting lines of the snare which is spun in the angles of walls, in crevices, between portions of detached rock, and other similar situations. The adhesive flocculus serves to entangle insects, and makes them an easy prey to the spider who lies in wait not far off, having formed a funnel-shaped tube of slight texture from its place of concealment to its snare.

With regard to the formation of the snares of the *Territelariæ*, Mr Gosse has an interesting passage in *A Naturalist's Sojourn in Jamaica;* it is, however, too long for quotation here. Mr Moggridge also (*l.c. infra*) has some details respecting the formation and repair of their nests by trapdoor spiders in confinement. The chief point of interest, however, in regard to trapdoor snares, is whether the hinged lid is formed in one continuous piece with the tube, and then cut out, leaving a portion unsevered to form the hinge, or whether the lid is made separately, except in that part intended for the hinge. Neither Mr Gosse nor Mr Moggridge enter into this question, though Mr Moggridge indeed speaks (*l.c*, p. 118) of his belief that, when all is completed, the spider cuts away certain threads by which the door is supported on either side of the hinge. The present writer was once told by a gentleman who had formerly resided in the West Indies, that trapdoor spiders there invariably make the tube and lid of one continuous, solid, homogeneous piece, and then cut out the lid with the falces. This account, especially as coming from a non-naturalist, seemed improbable—a spider's falces being in no way, apparently, fitted for such an operation; if, however, the fact be that the lid, instead of being of one solid piece with the tube, is merely connected with it by a few supporting threads (in accordance with Mr Moggridge's belief), these could easily be torn away by the spider's falces, and the lid would be left free, except at the point where the hinge is formed.

CLASSIFICATION.—It is impossible within our remaining space to go into detail upon this wide portion of the subject; it must suffice to say that the order Araneidea may at present be divided into about thirty-two families. These are—Theraphosides, Colophonides, Filistatides, Œcobiïdes, Tetrablemmides, Dysderides, Drassides, Palpimanides, Dictynides, Agelenides, Hersilides, Scytodides, Pholcides, Theridiides, Phoroncidides, Epeïrides, Gasteracanthides, Uloborides, Miagrammopides, Pultides, Thlaosomides, Arcydes, Stephanopides, Eripides, Thomisides, Podophthalmides, Lycosides, Sphasides, Dinopides, Salticides, Myrmecides, Aphantochilides. In these families are comprised about two hundred and sixty[1] genera based upon special details of structure; principally the position of the eyes, the form of the maxillæ and labium, the number and structure of the spinners, and some other details. The species are very numerous; probably not a tithe of the existing ones are yet described. In one family alone, *Salticides*, nearly a thousand are known.

As in all other creatures, differences of colour and markings, as well as integumental clothing and armature, serve to distinguish the species—the latter, too, are at times of generic value; but with regard to spiders particularly, in order to determine their species, it is very essential to obtain comparative dimensions from different portions of structure; thus the position of the eyes on the fore part of the caput furnishes us with the *facial space* (or the space between the margin of the caput just above the falces and the posterior eyes nearest to the medial line), and the *clypeus*, or the space between the same (fore) margin of the caput and the anterior eyes nearest to the medial line. The comparative extent of these parts is of great importance as specific characters, and they are easily observed; that part of the facial space occupied by the eyes is concisely described as "*the ocular area.*" The relative and comparative lengths, again, of the legs, and of their different joints, are strong specific characters, the first also generic. *Male* spiders when adult may, with few exceptions, be certainly distinguished in regard to their species, by the form and structure of the palpi and palpal organs, the development of the latter being an infallible criterion of maturity. *Female* spiders, again, may, in numerous cases, be as certainly distinguished by the form and structure of the genital aperture, situated in the medial line beneath the fore extremity of the abdomen; this aperture is never externally "perforate" until the last moult of the spider, and its full development is therefore an unerring criterion of the maturity of the female sex. With respect to the senses of spiders—smell and hearing—nothing appears to have been certainly ascertained; but the late Mr Richard Beck has an interesting paper upon the subject in *Entomologist*, Lond. 1866, vol. iii. p. 246. He suggests that the fine and delicate hairs of some spiders' legs may convey sounds to them. With regard to the sense of *taste* we may well conclude that spiders have this sense in considerable perfection, in the possession of a well-developed membranous tongue.

GENERAL REMARKS.—Spiders are to be found more or less abundantly in every part of the world and in almost every conceivable position; even subterranean caves, such as those of Adelsberg and the Island of Lesina, are tenanted by species peculiarly adapted by the absence of eyes to their dark and gloomy abodes. Less repulsive and forbidding in appearance than most others of the Arachnida, the Araneidea are often extremely interesting in their habits. Being almost exclusively feeders on the insect tribes, they are consequently endowed with proportionate craftiness and skill; this is shown remarkably in the construction of their snares and dwellings. The "trapdoor spider" has always been one of note in popular works on spiders' habits, and certainly the details of several different types of the trapdoor tubular nest, with the habits of the several species to which they belong, lately published by Mr Traherne Moggridge,[2] are of the greatest interest and importance. The typical trapdoor nest is a cylindrical hole in the earth excavated by the spider itself, lined with silk and closed by a lid, which fits like a valve or cork into the opening at the surface and opening by a strong elastic silken hinge, the spring of which closes it again with some slight force. Many spiders, however, live a vagabond life, and capture their prey without the aid of a snare, by springing on it unawares, or, in some cases, running it fairly down in open view; yet craft and skill are equally apparent, whatever be their mode of life and subsistence.

To say that spiders are less repulsive and forbidding in appearance than other Arachnids, is to do them but scanty justice, for numbers of species of various genera—notably among the Salticides, or jumping spiders—are unsurpassed by insects of any order, in respect both to brilliancy of colouring and the designs formed by its distribution. Some of the curious and delicate little species of the genera *Argyrodes* and *Ariamnes* are perfect marvels of metallic brilliancy and beauty. These little spiders are found living as quasi parasites, in the outskirts of the webs of the larger exotic epeïrids, and appear to live on the smaller insects caught in them; probably also spinning irregular snares of their own among the lines of the larger snare. In external appearance the young of spiders do not differ greatly from the adults, except in being generally more distinct in colour and markings; in some species the characteristic markings can seldom be well traced except in immature examples. The cocoons or nests in which some spiders deposit their eggs are very beautiful, as well as varied and characteristic in form; that of *Ero variegata* (Bl.), a little spider not uncommon in England, would arrest the attention of even an indifferent person; it is of an elegant pear shape, formed of a strong yellow-brown silk network, and attached by a long elastic stem, of the same material, to stalks of dead grass, sticks, or other substances, in shady places. Another, made by a larger spider, *Agroëca brunnea* (Bl.), is of a truncated pear shape, formed of a continuous white silk fabric, and attached to blades and stalks of living grass and rushes, by a short pedicle; it must, however, be seen

[1] No general work exists in which the families and genera of spiders are brought down to the present time, or in any degree near to it. The works of Walckenaer, *Ins. Apt.*, and Koch, *Die Arachniden*, are out of date altogether in this respect, though still of great value and importance in themselves. The work of Dr Thorell, *On the Genera of European Spiders*, Upsala, 1870, is exceedingly valuable, but it only touches incidentally upon the exotic groups.

[2] *Harvesting Ants and Trapdoor Spiders*, Lovell Reeve, 1872, with supplementary vol. 1874, illustrated with numerous plates.

soon after it is made, for the maker, as if prescient of the attraction of such a beautiful little object, hastens to daub it over thickly with a coat of mud or clay, which completely conceals its structure and beauty.

Spiders vary greatly in their relative fertility; probably many species are rare owing to a limited fecundity. The egg sac of *Agroëca brunnea* (Bl.) contains about forty or fifty eggs, that of *Xysticus claveatus* (Walck.) about twenty, that of *Ero variegata* (Bl.) not so many, while that of *Oonops pulcher* (Templ.) contains usually no more than two. Some spiders, however, perhaps most, construct more than one cocoon.

From their mode of life spiders attain (as we should naturally suppose) their largest size, and are found in their greatest profusion, in the tropical regions; while in more temperate climates, where the members of the insect tribes are smaller and their species fewer, we find spiders in general of comparatively smaller dimensions and less numerous in species. One of the largest known spiders, *Eurypelma Klugii* (Koch),—Fam. Theraphosides—found in Brazil, measures upwards of two and a half inches in length, with legs nine inches and upwards in span; while the smallest known spider, *Walckenaëra diceros* (Cambr.), found in England, is but $\frac{1}{28}$th of an inch in length. Tropical countries, however, although some of their spiders are giants, have numbers of small size. Numerous species have been procured from Ceylon measuring no more than from $\frac{1}{12}$th to $\frac{1}{20}$th of an inch in length.

Spiders, besides being skilful and crafty, are very cleanly; one of our common Saltici, *Epiblema histrionica* (Koch), may often be seen brushing and cleaning its forehead and eyes with its hairy palpi, as a cat uses its paws for a similar purpose. Probably most spiders, like the Crustacea, have the faculty of reproducing a lost limb. Instances of this are numerous (see Mr Blackwall's experiments, *Report of British Association* before cited), but a reproduced limb is seldom or never equal to the original one in size; this accounts for the frequency of examples captured with one or more legs, or a palpus, of dwarfed and stunted dimensions. Many spiders show great attachment to their eggs and young. The female Lycosa will seize her egg sac again and again if it be taken from her, only relinquishing it at last when apparently convinced of the hopelessness of retaining it. A pretty little spider, not rare among weeds and garden plants, *Theridion carolinum* (Walck.), carries its egg cocoon within its legs, and searches for it anxiously if compelled to drop it. Many also of the genus *Clubiona*, as well as others, brood over their eggs and tend upon their young until they disperse to find their own means of subsistence. The food of very young spiders is probably wholly derived from the moisture of the atmosphere. Spiders are great drinkers, and suffer severely from drought. Mr Blackwall relates that an emaciated, half-dead example of *Micaria nitens* (Bl.) grew immediately plump and strong after a draught of water.

In speaking of the better qualities of spiders, their attachment to their young, and the frequent fondness for each other evidenced by the apparently happy life of the male and female of some species in the same web, we must not overlook the other side of the picture. It has been well authenticated that in some species of Epeïrides the female will seize and devour the male even immediately after the exercise of his natural office, which indeed he has to undertake with great circumspection and care to be able to accomplish at all. From this propensity of the female, we may account for the gradual lessening in size of some male spiders in comparison with that of the females, by a kind of sexual selection, since it is obvious that the smaller the male the better his chance of escape (see O. P. Cambridge in *Zoologist*, 1868, p. 216, and in *Proceedings Zool. Soc. Lond.*, 1871, p. 621, and also Vinson's *Spiders of Bourbon and Mauritius*), and thus selection would operate until the males became so small as only just to be able to fulfil the office of impregnating the female. The male, nearly always the smallest, is in the case of some epeïrids and Thomisids not $\frac{1}{10}$th or even $\frac{1}{15}$th of the length of the female, and sometimes not more than $\frac{1}{1300}$th part of her weight, and less then $\frac{1}{1800}$th part of her volume (A. W. M. Van Hasselt, *Arch. Neerland*, tom. viii.) As a rule, however, the difference in size between the male and female spider is not nearly so great. Spiders are unable to fly, and the mode adopted by many species, and myriads of individuals, to make up for this by sailing away on their silken lines, has been mentioned; but lately a beautiful species of Salticides, *Attus volans* (Cambr.), *Ann. and Mag. N. H.*, September 1874, found at Sydney, N.S.W., has been described and figured, with large flaps or lateral extensions of the abdominal integument, by means of which the spider can sustain itself in leaping from plant to plant; it has power to elevate and depress these flaps at will.

The voracity of spiders is well known, and the propensity above noticed of the female to devour the male is but one instance of general voracity; but though thus voracious, spiders can endure extreme fasting with impunity. A small spider enclosed in a glazed case, lived and appeared healthy for eighteen months without food; if it had any nourishment at all during this time, it could only have been the very slight moisture that might exude from the skin of a lately stuffed bird in the case, *Zoologist*, 1853, p. 3766. Other instances are also on record of fasts, almost or quite as long, and borne equally well.

ENEMIES OF SPIDERS.—Preying upon all the insect tribes, and occasionally upon lizards (F. Pollock, *Ann. N. H.*, October 1872) and earth-worms (E. Simon in *Ann. Soc. Ent. France*, 1873, 5 sér. tom. iii. p. 114—and *Zoologist*, 1856, p. 5021), spiders are also themselves preyed upon by both lizards and insects. More than one species of parasitic hymenoptera tend to keep spiders within due bounds; but little has yet been done towards working out these parasites. Three species are figured in Blackwall's *Spid. Great Britain and Ireland*, pl. xii.; two of them prey upon *Agroëca brunnea* (Bl.); while the third, *Pompilus sepicola* (F. Smith), pierces large spiders, paralysing, but not killing them; they are then dragged to its nest, in a hole in the earth; eggs are laid in the spider, which retains sufficient vitality to furnish fresh food to the parasitic larvæ until the time for their change to the pupa state arrives. Full grown females of *Lycosa campestris* (Bl.) have been found by the writer in the grasp of this powerful ichneumon. From the outskirts of a single web of *Epeïra opuntiæ* (Duf.), on the shores of the Sea of Galilee, the writer collected, in April 1865, many truncated pear-shaped egg cocoons belonging to the beautiful little *Argyrodes epeïræ* (Sim.); and from each of these cocoons a single hymenopterous parasite shortly issued. The egg cocoons of various epeïrids in England are likewise often preyed upon by numerous minute parasites of the same order. Several species of *Theridion*—*T. simile* (Koch) especially—are subject to a larval parasite, often as large as the spider itself, adhering to the outside of the abdomen. Various attempts to rear the perfect insect from this parasite have hitherto failed. A wide field of great interest is open to any one who should take up the investigation of the various insect parasites of spiders, with their mode of attack and subsequent victory.

Other foes, common to all the Articulata, spiders also have in abundance—birds, small mammals, and reptiles. Doubtless we are indebted to such enemies for the development, through natural selection, of many spiders protected by horny integuments, and often armed with spines to an extent that would make them a painful meal to any bird or other creature that should set itself to dine upon them. *Phoroncidia Thwaitesii* (Cambr.), found in Ceylon, and *Pycnacantha Meadii* (Bl.), found in Africa, and indeed all the Gasteracanthides, are notable examples of this protective armature. *Protective "mimicry"* is also seen in spiders, some so exactly resembling ants, that placed side by side with species of ants found in the same localities, even a practised eye would not detect the spider at first sight. Of this nature are the *Myrmecides* (fig. 31) and some of the *Saltici*, and, notably, *Aphantochilus*

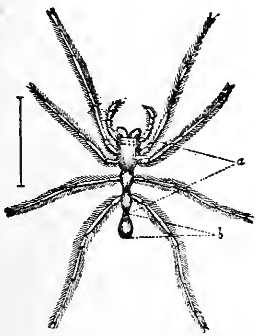

FIG. 31.—Ant-spider (*Myrmecia fulva*, Latreille). *a*, cephalo-thorax; *b*, abdomen.

Rogersii (Cambr.), found in Brazil. Other spiders, again (Genus *Eurysoma*, Koch, and *Cyrtarachne*, Thor.), closely resemble some species of phytophagous coleoptera; one of the latter genus found in Ceylon, but yet undescribed, resembles a small mollusc. Of the former some are very like a minute crab (fig. 32). And lastly, to sum up the enemies of spiders, they prey on each other, and are preyed upon also by other Arachnids; but on the whole they have, as by their office they should have, the best of it, for they are against *all* the Articulata, but only comparatively a *few* of the Articulata are against them.

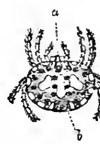

FIG. 32.—Crab-spider (*Eurysoma cabindæ*, Capello). *a*, cephalothorax; *b*, abdomen.

Spiders are not creatures which belong solely to the present geologic era of the earth, for fossil spiders, with other Arachnids, as well as spiders in amber, have been found; the oldest in the coal formation. See on this subject a late resumé by Dr T. Thorell, *On European Spiders*, pp. 220-233, with other works there quoted.

PRESERVATION OF SPIDERS.—Beautiful as are the colours and markings of numbers of spiders, especially of those found in the tropics, and elegant and curious as are many of their forms and structures, it has yet been found a matter of difficulty to make them good-looking, sightly, cabinet objects. By ordinary care and skilful manipulation, however, most of them can be preserved and displayed very satisfactorily. So much of the comparative neglect of Arachnids in general is owing to this difficulty, that it may perhaps be worth the space of a few lines to remark, that many whose abdominal integument is strong, or pretty thickly clothed with hairs and pubescence, may be pinned, set out, and dried like insects. Others may have the abdomen opened from below, and after the contents are carefully extracted, be stuffed with fine cotton wool. Others again have been most successfully treated by inflating the abdomen (after the contents have been pressed out) with a blow-pipe, and then subjecting them to a process of rapid desiccation, which in general preserves the colours and markings very well indeed. But the best and most useful way for *all* purposes is to immerse and keep them in tubes filled with spirit of wine. To make spiders in spirit sightly objects, they should, when drugged with chloroform, or some other stupifying agent, be secured, but not transfixed, by pins to a piece of cork, sunk in a vessel of spirit, in a natural position, until rendered rigid by the action of the spirit, which will be in a fortnight or so; the pins are then removed, and the spiders are placed in glass test tubes, large enough to receive them without too much compression of the legs. A bit of white card is slipped in under the specimen to keep it in position, the tubes are filled with spirit, stopped firmly with a pledget of cotton wool, and inverted round the inner side of a wide mouthed glass-stoppered bottle; this bottle is filled also with spirit, and the spider is then seen in its natural position, and with all its colours and markings perfectly visible. It is also capable of examination with an ordinary pocket lens, even without removal of the tube from the large bottle. Large spiders with a largely developed abdomen should be kept in pill-boxes for a fortnight or so before being placed in spirit; during this time the crudities of their food contents are discharged, and preservation without injury or obliteration of colours and markings is thus rendered far more certain; the beauty of many of our large and handsome epeïrids can only be certainly retained, even in spirit, when treated after the above method. See further on this subject, as well as on the mode of search and capture of spiders (O. P. Cambridge, *Trans. New Zeal. Instit.*, vol. vi. pp. 194-200).

It is not necessary to give here a list of works on Arachnids, many having been already quoted in speaking of the different orders. The following, however, on *Araneidea* may be mentioned:—

N. Westring, "*Araneæ suecicæ*," Gothenburg, 1861; E. Ohlert, *Die Araneiden oder Echten Spinnen der Provinz Preussen*, Leipzig, 1867; A. Menge, "Preussiche Spinnen," in *Schr. Ges. Danz.* (*N. F.*), 1866-1873, Danzig (still in course of publication); H. Lucas, in *Exploration de l'Algérie*, Paris, 1849; H. Nicolet, in Gay's *Hist. Fis. Pol. de Chili*, vols iii.-iv., Paris, 1847; Eugene Simon, *Les Arachnides de France* (vol. i. only is yet published), Paris, 1874; L. Koch, *Die Arachniden Australiens*, Nuremberg, 1871-74 (still in continuation). Nothing has been said in the foregoing pages respecting the "Embryology" of spiders; for information in regard to this important and interesting but recondite part of Araneology, it must suffice to refer the reader to Herold, *De Generatione Aranearum in Ovo*, Marburg, 1824, and Edouard Claparède, *Recherches sur l'evolution des Araignées*, Utrecht, 1862.

These, with other works quoted on the different points that have arisen in the course of the foregoing article, will be found sufficient to guide the student and collector. The general works on Arachnida, or on any of its separate orders, are exceedingly few, and none, except that of M. Simon, *Hist. des Araignées*, Paris, 1864, are of recent date, beyond the merest abstracts. The literature on the subject is scattered up and down, in isolated papers, in numberless Transactions and Proceedings of various societies, and in scores of periodical volumes and journals for the record of natural and scientific investigation. It has been attempted to give in the foregoing pages as fair a general view of the whole subject as the limited space, and great difficulty of getting access to important papers treating upon it, would permit. The object of such articles as the present is rather to *excite* an appetite for the obtaining more detailed information, than to satisfy fully the appetite already excited. (O. P. C.)

ARAD, Old, a city of Hungary, in the county of Arad, situated on the Maros, 145 miles S.E. of Pesth. It is a well-built town, with a fortress of considerable strength, erected in 1763, which occupies an advantageous position between two branches of the river. It is the seat of a Greek bishop, and has a Greek theological seminary. Its chief manufacture is that of tobacco; and, besides carrying on a large trade in corn, it possesses one of the most celebrated cattle fairs in Hungary. In 1849 the fortress of Arad was captured by the Hungarian rebels, who made it their head-quarters during the latter part of the insurrection. It was from it that Kossuth issued his famous proclamation, and it was here that he handed over the supreme military and civil power to Görgey. The fortress was recaptured shortly after the surrender of Görgey to the Russians at Vilagos. The population of Old Arad is 32,725, many of whom are Jews, while many belong to the Greek Church. New Arad, situated on the left bank of the Maros, opposite to Old Arad, is a place of some trade, with a population of about 4000, including many Germans.

ARAFAT, or Orphat, a mountain near Mecca, a visit to which constitutes a necessary part of the great Mahometan pilgrimage. (See Mecca.) It consists of a granite rock about 200 feet high, which is ascended by staircases partly cut in the rock, and partly composed of solid masonry. On this hill Adam is said to have met his wife Eve after being separated from her for 120 years, and it is thence called Arafat, *i.e.*, Gratitude. On the summit is a chapel, which the Mahometans believe to have been built by Adam. The interior was destroyed in 1807.

ARAGO, François Jean Dominique, one of the most popular physicists belonging to the first half of the present century, was born on the 26th February 1786, at Estagel, a small village near Perpignan, in the department of the Eastern Pyrenees. His father was a licentiate in law, and, being appointed treasurer of the mint for the department, removed with his family to Perpignan about the beginning of the century. Arago has left an autobiographical sketch, drawn with great vivacity, though touched occasionally with somewhat high colouring; and to this we are indebted for the incidents of the earlier portion of his life. From boyhood he had decided military tastes, inspired by constant contact with troops at his native village, which was a halting station for soldiers on their way to Perpignan, or to the army of the Pyrenees. François was sent as an out-door pupil to the municipal college of Perpignan, and began to study mathematics with an eye to the entrance examination to the Polytechnic school. Here he was soon beyond the depth of his master's knowledge; but, with that undaunted spirit which carried him through many hardships and difficulties in after life, he sent to Paris for the works of Legendre, Lacroix, and Garnier, and studied them assiduously in private. Within two years and a half he had mastered all the subjects prescribed for examination, and a great deal more; he had read Euler's *Introduction à l'Analyse Infinitesimale*, Lagrange's *Théorie des Fonctions Analytiques* and *Mécanique Analytique*, and Laplace's *Mécanique Céleste*. He does not indeed pretend to have understood at the time all he read in these works, but he had been early encouraged by D'Alembert's maxim, "Go on, and the light will come to you," and he had carried it into practice. On going up for examination at Toulouse he completely astounded his examiner, M. Monge, by his knowledge of Lagrange, and received the highest commendation from him. Towards the close of 1803 he entered the Polytechnic school, with the artillery service as the aim of his ambition. We have in the autobiography many amusing instances of the inefficiency of some of the Polytechnic professors at that time, of the peculiarly French familiarity existing between professors and pupils, as well as of the political passions absurdly allowed to distract the school. In 1804, through the advice and recommendation of Poisson, with whom he had become very intimate, Arago received the appointment of secretary to the Observatory of Paris, a valuable post for a young man of science, as it brought him in contact with the most eminent philosophers of the day. He now became acquainted with Laplace, and he had as fellow-worker in the laboratory the celebrated Biot. Through the influence of Laplace with the Government, Arago and Biot were commissioned to complete the meridional measurements which had been begun by Delambre, and interrupted since the death of Méchain in 1804. The object of this survey was to determine, with as great nicety as possible, the ten-millionth part of a quadrant of the meridian through Paris, which had been agreed upon by the National Convention as the standard unit of length, and named the *mètre*. To measure an actual quadrant from the north pole was, of course, an impossibility; but the plan adopted was to measure the arc of the meridian from Dunkirk to Barcelona, and from their known difference of latitude to deduce the length of the quadrant. For this purpose they left Paris in 1806, to commence operations among the mountains of Spain—operations attended with the greatest personal privation, fatigue, and danger. Biot returned to Paris after they had determined the latitude of Formentera, the southernmost point to which they were to carry the survey, leaving Arago to make the geodetical connection of Majorca with Ivica and with Formentera.

The adventures and difficulties of the latter were now only beginning. The political ferment caused by the entrance of the French into Spain extended to these islands, and the ignorant populace began to suspect that Arago's movements and his blazing fires on the top of Mount Galatzo were telegraphic signals to the invading army. They became ultimately so infuriated that he was obliged to cause himself to be incarcerated in the fortress of Belver in June 1808. On the 28th July he managed to escape from the island in a fishing boat, and after an adventurous voyage he reached Algiers on the 3d August. Under the disguise of a strolling merchant he procured a passage in a vessel bound for Marseilles. A journey, however, of eleven months was before him ere he was destined to reach that port, for the vessel fell into the hands of a Spanish corsair on the 16th August, just as it was nearing Marseilles. With the rest of the crew, Arago was taken to Rosas, and imprisoned first in a windmill, and afterwards in the fortress of that seaport, until the town fell into the hands of the French, when the prisoners were transferred to Palamos. After fully three months' imprisonment they were released on the demand of the Dey of Algiers, and again set sail for Marseilles on the 28th Nov., but when within sight of their port they were driven back by a southerly wind to Bougia on the coast of Africa. Transport to Algiers by sea from this place would have occasioned a weary stay of three months; and with his usual courage, Arago set out for it by land under conduct of a Mahometan priest, reaching it on Christmas day, after encountering many perils from lions, and having uncomfortable squabbles with natives on the way. A six months' stay in Algiers gave him opportunity to note the manners and habits of the people, of which he gives some amusing and graphic accounts. Once again, 21st June 1809, he set sail for his native land; and, as by some strange perversity of fortune, he had to undergo a monotonous and inhospitable quarantine in the Lazaretto at Marseilles before his difficulties were over. The first letter he received, while in the Lazaretto, was from Humboldt at Paris, sympathising with him, and congratulating him on the termination of his laborious and perilous enterprise; and this was the origin of a connection which, in Arago's words, "lasted over forty years without a single cloud ever having troubled it."

Through all the vicissitudes of this long campaign Arago had succeeded in preserving the records of his survey; and his first act on his return home was to deposit them in the Bureau de Longitude at Paris. As a reward for his adventurous conduct in the cause of science, he was shortly afterwards (17th Sept. 1809) voted a member of the Academy of Sciences, in room of the deceased Lalande, at the remarkably early age of twenty-three, being, to the vexation of Laplace, elected by a large majority of votes over his friend Poisson. Before the close of the same year (1809) Arago was chosen by the council of the Polytechnic school to succeed M. Monge in the chair of analytical geometry; and about the same time he was named by the emperor one of the astronomers of the Royal Observatory, which was accordingly his residence till his death. He was also made one of the examiners in connection with the *Ecole d'Application* for engineers and artillery at Metz. In all these situations he rapidly attained very great popularity, gaining the esteem of his pupils by the charming clearness of his style in lecturing and the personal interest he showed in their progress.

In 1816, along with Gay-Lussac, Arago commenced a monthly journal of science, the *Annales de Chimie et de Physique*, which soon acquired that high scientific reputation which it has always maintained. In the same year the two philosophers visited England, and made the personal acquaintance of some of the most eminent men of that country, meeting among others Dr Thomas Young, a memoir of whom was afterwards written by Arago. In 1818 or 1819, Arago proceeded along with Biot to execute, on the coasts of France, England, and Scotland, the geodetic operations which the Board of Longitude had directed. They also measured the length of the seconds' pendulum at Leith, and in Unst, one of the Shetland isles; the results of the observations being published in 1821, along with those made in Spain. He was elected a member of the Board of Longitude immediately afterwards, and proved a valuable addition to the society, contributing to each of its *Annuals*, for about twenty-two years, most important scientific notices on astronomy and meteorology, and occasionally on civil engineering, as well as interesting memoirs of members of the Academy.

After his appointment to the Observatory, Arago had commenced, at the request of the Board of Longitude, a series of popular lectures on astronomy, which were continued from 1812 to 1845. His success as a lecturer was almost unparalleled, and can only be compared to that of Faraday. All ranks flocked to hear him, fascinated by his graceful eloquence and his crystalline clearness of explanation. He used to remark, what many lecturers often forget, that "*clearness is politeness in public speakers.*" His manner in lecturing is said to have been to fix his eye on some one of his audience, whose intellect had apparently the minimum of development, and to keep it fixed till the face should brighten up with intelligence.

When Buonaparte's hopes of empire in Europe had begun to wane, and he was turning to America as a land of refuge, where he might still have scope for his ambition, he suggested to M. Monge that, with a scientific guide, he should explore the new continent from Canada to Cape Horn, study the great physical wonders of that territory, and leave behind him works and discoveries worthy of himself. Monge named Arago as the proper associate and assistant in the enterprise, and had even negotiated with Napoleon for a handsome allowance to be granted to Arago, and for a fund to be devoted to the purchase of a complete set of astronomical and physical instruments. But Arago would not for a moment entertain the proposal. He pointed the emperor to the march of the English and Prussian armies on his capital as a matter demanding more pressing consideration, and declined to leave the Old World to study science in the New, "when France might perhaps lose its independence and disappear from the map of Europe." Subsequent events prevented a renewal of Napoleon's scientific negotiations and projects.

After the Restoration Arago took no very prominent part in the politics of the day, though he at all times maintained with boldness and ardour liberal opinions of the extreme republican type. By the revolution of 1830, however, he was summoned from the studies of the observatory and the laboratory to the field of political strife in the Chamber of Deputies, and in the Municipal Council of Paris. Elected a member of the Chamber of Deputies for the Lower Seine, he employed his splendid gifts of eloquence and scientific knowledge in all questions connected with public education, the rewards of inventors, and the encouragement of the mechanical and practical sciences. Many of the most creditable national enterprises, dating from this period, are due to the advocacy of Arago—such as the reward to Daguerre for his wonderful invention of photography, the grant for the publication of the works of Fermat and Laplace, the acquisition of the museum of Cluny (one of the sights of Paris), the development of railroads and electric telegraphs, the improvement of the navigation of the Seine, and the boring of the Artesian wells at Grenelle.

The year 1830 was a remarkable epoch in his life on account of several other offices to which he was appointed. He now received the chief direction of the Observatory, and from his position in the Chamber of Deputies he obtained grants of money for the rebuilding of part of the Observatory and for the addition of magnificent instruments, which raised it to be a model, in place of a public disgrace, as it had been before. In the same year, too, his zeal in the cause of science was rewarded with the highest honour any philosopher might aspire to—the perpetual secretaryship of the Academy of Sciences, in room of the distinguished Fourier. On the 7th June (1830) he was elected by 39 out of 44 votes. This appointment inspired new life into the Academy. Arago threw his whole soul into its service, and by his pleasing faculty of securing friendship and life-long attachments, he gained at once for himself and for the Academy a world-wide reputation. As perpetual secretary it fell to him to pronounce historical *éloges* on the decease of resident or foreign members of the Academy; and for this duty his rapidity and facility of thought, his happy piquancy of style, and his extensive knowledge peculiarly adapted him. Some of his *éloges* are masterpieces of elegant biography. When M. Flourens pronounced Arago's own funeral eulogy, he said, "In the eulogies of the eloquent secretary are found all the qualities of his spirit, *d'une verve brillante, de la vigueur, de l'elan, un certain charme de bonhomie.*"—(*Comptes Rendus de l'Academie*, t. xxxvii. p. 513.)

In 1834 Arago visited England for the second time, to attend the third meeting of the British Association, held that year in Edinburgh. From this time till the stirring events of 1848, Arago led a life of comparative quiet,—not the quiet of inactivity, however, for his incessant labours within the Academy and the Observatory produced a multitude of contributions to all departments of physical science, which make him one of the most voluminous of authors in this subject. But the change came. Louis Philippe, having failed to satisfy the extreme republican party, and to grant them those social advanteges that they imagined a republic alone could yield, was swept from his throne, and Arago left his laboratory to join in forming an extempore government. His popularity was so great that he was entrusted with the discharge of two most important functions, that had never before been united in one person, viz., the Ministry of War and of Marine. Energetically and faithfully the philosopher of forty years' standing applied himself to his new duties; and however ignominious may have been the ultimate failure of the Provisional Government, there can be little question that Arago struggled honestly in the cause of social liberty and improvement. While Minister of Marine he effected some salutary reforms, such as the improvement of rations in the navy and the abolition of flogging; he abolished political oaths of all kinds, and, against an array of monied interests, he succeeded in procuring the abolition of negro slavery in the colonies.

During the insurrection of June, Arago's courage was conspicuously displayed in his entreaties to the mob to stop their murderous outrages. For the first time in his life Arago failed, and he himself narrowly escaped with his life. With his mental and physical energies shattered by fatigue and disappointment, he terminated here his active political career, though he continued to the last to take an interest in the affairs of his country, and to watch for the dawn of a brighter future. Failing eye and trembling hand could now be of little use in the service of science; but warned by the disease (diabetes) that had attacked him, he determined to occupy his few remaining years in preparing for the press some MSS. of original researches which his political duties had prevented his communicating to the Institute.

In the beginning of May 1852 proclamation was made that the oath of allegiance to the Government of Louis Napoleon would be required from all its functionaries, including the Board of Longitude. Arago peremptorily refused, choosing to sacrifice his office and home of nearly half a century rather than violate the dictates of his conscience, which he would be doing if he complied, seeing that, as a member of the Provisional Government of 1848, he contributed to the abolition of all political oaths. In a letter to the Minister of Public Instruction, he intimated his resignation of his post as astronomer at the Bureau de Longitude, at the same time stating the services he had rendered to his country in the cause of science, and the grief which this separation from the scene of his labours of so many years would impose. To the credit of the Prince President, he respected the sentiments so boldly declared by the half-blind old philosopher, and made "an exception in favour of a savant whose works had thrown lustre on France, and whose existence his Government would regret to embitter."

The tenure of office thus granted did not prove of long duration. Arago was now on his death-bed, under a complication of diseases, induced, no doubt, by the hardships and labours of his earlier years. In the summer of 1853 he was advised by his physicians to try the effect of his native air, and he accordingly set out for the Eastern Pyrenees, accompanied by his affectionate niece, Madame Langier. But the change was unavailing, and he returned to Paris to die. After a lingering illness, in which he suffered first from diabetes, then from Bright's disease, and lastly from dropsy, he breathed his last on the 2d Oct. 1853, at the age of 67. The day before his death he had been visited by Lord Brougham, his old and intimate friend, and the interview had excited him much. M. Biot also had an interview with him only three hours before his death. Arago said to his veteran colleague and *collaborateur*, "I intend to resign my situation of perpetual secretary to the Academy, since I can no longer discharge its duties." Biot's reply must have smoothed the pillow of the dying savant, "If you do, we will all come to you in a body to bring it back to you, and reproach you for your ingratitude." A public funeral was, with good taste, decreed to Arago by the emperor, notwithstanding his refused allegiance to the Imperial Government, and it took place on the 5th Oct. with all the pomp and parade of an Imperial act. A beautiful and eloquent eulogy was pronounced over his tomb by the distinguished M. Flourens, who succeeded him as perpetual secretary of the Academy, while M. Barral performed the duty entrusted to him by the young philosophers of the public schools of the metropolis of giving utterance to their last adieu.

Thus closed perhaps the most singular career in the annals of science. Of Arago's moral character it is difficult to form a true estimate, extolled as it is on the one side by his countrymen, and too severely criticised as it often is on the other side by British writers. Allowance must be made for the Spanish blood that flowed in his veins. The ardour of his temperament, his quick and far darting intellect, the powerful love of country which his youthful vicissitudes had only intensified, all combined to produce a consciousness of power, which, in the Academy of Sciences or in the management of the Observatory, might stamp his bearing as dictatorial, and which, in questions of national priority of invention, might render his judgment partial. With the imperiousness, perhaps, of a powerful intellect, Arago was free from that selfishness that has so often been exhibited by men who have enjoyed such high offices of trust during times of national disorder. He cared for money only as it supplied the wants of his experimental researches and the means of educating his family; he lived a simple and a frugal life; his income never exceeded £500 a year; and, refusing to accept any reward for his four months' services as Minister of Marine, he sacrificed fortune for the sake of his country and of science.

From the personal history of Arago we turn to his literary and scientific labours and discoveries. It has been already shown that, as editor of the ***Annuaire*** or Almanac of the Board of Longitude, he commenced, in 1822, a series of regular contributions of scientific articles to that Annual, remarkable for their lucidity of style, united with mathematical accuracy of detail; that, as perpetual secretary of the Academy of Sciences, his *éloges* alone would have secured him lasting reputation; and that, as director of the Observatory, he rapidly restored its efficiency and completely remodelled it. He has, indeed, been often accused of doing little or nothing for the practical advancement of astronomy; and of shrinking from the steady and regular drudgery of observation as too tame to be congenial to his versatile mind. To reproach a man who has done much, because he has not done more, or because he has not followed in the beaten track, is, to say the least, far from generous criticism. His applications of physics to astronomical research—such as to his photometric measurements of lunar and stellar brightness, of the polar snows of Mars, and of the belts of Jupiter and Saturn, to the structure of the sun as revealed by his spots, to the effect of atmospheric refraction on astronomical observations, to irradiation and variable stars—are surely in themselves not despicable contributions to the science. But apart altogether from his labours in the Observatory, he has rendered vastly greater service to astronomy by his popular expositions of it than hundreds of the most assiduous observers put together. Few have had, in such a degree as he, the gift of reducing the abstract conceptions of pure science to the level of the popular apprehension without descending to the puerile and frivolous.

In 1820, when the subject of steam boilers was attracting attention, Arago was employed by Government to execute, along with Dulong, a series of experiments on the elastic force of steam at different temperatures. This difficult and most hazardous task, where they were exposed to the bursting of a boiler at any moment, they accomplished with the greatest ability and coolness. Of these experiments, as well as of others,—on the density of air, on the velocity of sound, on the pressure of gases being proportional to their density, &c.,—there will be found elaborate memoirs in the *Comptes Rendus* of the Academy, and in the *Annales de Chimie et de Physique.*

It is, however, on his contributions to Magnetism and Optics that Arago's fame as an experimenter and discoverer rests. By employing the method of oscillating needles, he established the universal influence of magnetism on all substances, though it was left to Faraday to make the grander generalisations of diamagnetism. Arago found that a magnetic needle, made to oscillate over non-ferruginous surfaces, such as water, glass, copper, &c., falls more rapidly in the extent of its oscillations according as it is more or less approached to the surface. Over ice, for example, an oscillation of 53° on each side of the magnetic meridian, fell to 43° after 60 oscillations at a distance of $52\frac{1}{2}$ millimetres from the ice; while, at a distance of 7 mm., it fell by the same amount after 26 oscillations. Over glass there was a fall from 90° to 41° in 221 oscillations, at a distance of 4·01 mm., and in 122 oscillations at a distance of ·91 mm. For this discovery Arago was awarded the Copley medal by the Royal Society of London in 1825; and he has the honour of being the first foreigner to whom this distinction was accorded. This discovery was followed by another. It occurred to him to try, conversely, the effect of oscillating or rotating a plate of non-ferruginous metal near a magnetic needle at rest. He caused a plate of pure copper to revolve by clock-work, which was also of copper, under a magnetic needle within a glass-receiver, and with a sheet of paper between the needle and the revolving plate to prevent air currents. Gradually the needle was drawn from the magnetic meridian, till finally, on a very rapid rotation of the plate, it fairly swung round and continued in constant rotation. An account of these experiments he read before the Academy of Sciences, on the 7th March 1825, and they were exhibited in London in the following April by Gay-Lussac, exciting universal interest among the philosophers of this and other countries. This phenomenon of *rotatory magnetism,* as it is termed, is indissolubly linked with the name of Arago; but it was reserved for the genius of Faraday to offer the true explanation of it, after it had long occupied the attention of Herschel, Babbage, Barlow, Nobili, and other distinguished men, as well as of its discoverer.

Arago is also fairly entitled to be regarded as having proved the long suspected connection between the aurora borealis and the variations of the magnetic elements. He established, too, the fact of an hourly variation of these, traceable, no doubt, to the influence of the sun as an enormous magnet at a distance. It is worth mentioning that Arago was the first to employ the galvanic current for the permanent magnetisation of steel, though in the field of electro-magnetism his discoveries and researches as a whole are not to be compared with those of the profounder Ampère.

It is, however, his investigations in Optics that form the most marked feature and the crowning glory of Arago's scientific career. We owe to him not only important optical discoveries of his own, but the credit of stimulating the genius of Fresnel, with whose history, as well as with that of Malus and of Young, this part of his life is closely interwoven. Shortly after the beginning of the present century the labours of the three philosophers last named were shaping the modern doctrine of the undulatory theory of light. Malus had made in 1808 his discovery of the polarisation of light by reflection, identifying it with the effects of double refraction; Young had devised his beautiful theory of interferences; and Fresnel had been simultaneously conducting elegant experiments in the very same field as the English philosopher. It was the communication to the French Academy of Sciences of a paper on this subject by Fresnel that led to his intimacy with Arago. Fresnel's arguments in favour of the undulatory doctrine found little favour with Laplace, Poisson, and Biot, the champions of the emission theory; but they were ardently espoused by Humboldt and by Arago, who had been appointed by the Academy to report on the paper. This was the foundation of an intimate friendship between Arago and Fresnel, and of a determination to carry on together further researches in this subject. These investigations were rewarded by a remarkable discovery, in 1811, the very year that Malus terminated his career so auspiciously begun. After Huyghens's time, when Iceland spar and rock crystal were alone supposed to have the property of double refraction, mineralogists had suspected the same property to exist in a number of other crystals, though it was often almost impossible to determine its existence. But Arago discovered that a plate of any doubly refracting crystal, such as selenite or mica, when interposed between two similar polarising prisms or piles of glass plates, displays splendid tints, varying in colour with the thickness of the plate and with its inclination to the transmitted beam, and varying in intensity as the plate of mica or selenite is turned round in its own plane. By this simple means double refraction may be detected in the smallest plate of a crystal. The explanation of this remarkable phenomenon was a difficult problem, and for some time perplexed both English and Continental investigators. Dr Young, in 1814, ascribed the cause generally to interference; but Arago saw that this explanation was incomplete. The clue to it was, however, found in the law, established by the joint labours of Arago and Fresnel, *that two polarised rays cannot interfere unless polarised in the same or parallel planes.* This involved the idea of *transverse vibrations* of the ether across the direction of propagation, an idea which at first seemed a stumbling-block to the theory of undulations, and which Fresnel and Arago did not venture for some time to embrace. Once expressed, however, this theory of transverse vibrations reduced the whole phenomena of polarisation to a simple mechanical effect, a *resolution of rectilinear motion into two rectangular components;* and so far from upsetting the wave theory, it has by its very simplicity and comprehensiveness but helped to establish it on a sure foundation.

Arago applied his discovery to the construction of a *polariscope,* for estimating the feeblest amount of polarisation; and he used this instrument for some very interesting experiments on the polarisation of the light of the sky (which is sunlight polarised by reflection from the atmosphere), and on that of different incandescent and reflecting surfaces. He also found that the moon and the tails of comets send light to the eye which is slightly polarised, thus betraying its borrowed origin. But that of the sun, being absolutely neutral, is only comparable (according to Arago) to the light arising from incandescent vapours, thus distinguishing the sun from a solid or liquid globe.

We cannot do more than allude to Arago's other optical papers and experiments. He was, probably, the only Frenchman of his time who was well acquainted with Young's discoveries. The explanation by the doctrine of interference of the colours of Newton's rings received an important confirmation from an experiment of Arago's, which proved them to arise from the mixture of the pencils of light reflected at the two neighbouring surfaces. He pressed a lens of glass against a plate of metal, in which case the central spot is white or black when light polarised perpendicularly to the plane of incidence is reflected at an angle greater or less than the polarising angle for glass; and the rings vanish altogether at the polarising angle — results which Airy subsequently proved conformable to the undulatory theory.

To Arago is also due the discovery of the power of *rotatory polarisation* exhibited by quartz. He found that a beam of polarised light transmitted along the axis of a crystal of quartz becomes depolarised, and produces colours varying with the thickness of the crystal. If the polarised light be homogeneous, and the analysing plate be placed athwart this polarised beam so as to reflect none of it, the interposing of a quartz crystal will turn round the polarised beam in its passage, so that when it falls on the analysing plate it is no longer athwart it, and the light is partly reflected. The researches in this field were taken up by Biot, Fresnel, Herschel, Seebeck, Airy, and others; and the phenomenon was first explained by Airy to be due to the fact that along the axis of a quartz crystal the beam consists of two circularly polarised portions, while in other directions it consists of two elliptically polarised portions. In some substances the rotation is to the right hand, and in others to the left.

Last of all, among the many contributions of Arago to the support of the undulatory hypothesis, comes the *experimentum crucis* which he proposed to carry out for comparing directly the velocity of light in air and in water or glass. On the emission theory the velocity should be accelerated by an increase of density in the medium; on the wave theory, it should be retarded. Wheatstone's experiment, in 1835, of measuring the velocity of the electric discharge had suggested the idea to Arago; and in 1838 he communicated to the Academy the details of his apparatus. Owing to the great care required in the carrying out of the project, and to the interruptions to his labours by the events of the revolution, it was the spring of 1850 before he was ready to put his idea to the test. But, as fate would have it, just at that time his eye-sight suddenly gave way. With a melancholy resignation he consoled himself with having merely laid down the problem and having indicated the means of its solution, and with the hope that other experimenters would follow in his steps and add a new proof in favour of the undulatory system. Arago lived to see his wishes realised in the beautiful experiments of Fizeau and Foucault, which, with improvements of detail in the apparatus, were based on the plan proposed by him. These, as all the scientific world knows, confirmed the deductions from the wave theory, and established the retardation of the velocity of light in denser media. With this ended those brilliant labours which have in no small degree contributed to render the arguments in favour of the undulatory doctrine all but unanswerable.

Arago's *Œuvres* were published after his death under the direction of M. J. A. Barral, in 17 vols., 8vo, 1854 to 1862; also separately his *Astronomie populaire*, in 4 vols.; *Notices biographiques*, in 3 vols.; *Notices scientifiques*, in 5 vols.; *Voyages scientifiques*, 1 vol.; *Mémoires scientifiques*, in 2 vols.; *Melanges* (Miscellanies), in 1 vol., and *Tables analytiques et documents importants* (with portrait), in 1 vol. English translations of the following portions of his works have appeared:—*Treatise on Comets*, by C. Gold, C.B., London, 1833; also translated by Smyth and Grant, London, 1861; *Hist. éloge of James Watt*, by James Muirhead, London, 1839; also translated, with notes, by Lord Brougham; *Popular Lectures on Astronomy*, by Walter Kelly and Rev. L. Tomlinson, London, 1854; also translated by Dr W. H. Smyth and Prof. R. Grant, 2 vols., London, 1855, *Arago's Autobiography*, translated by the Rev. Baden Powell, London, 1855, 1858; *Arago's Meteorological Essays*, with introduction by Humboldt, translated under the superintendence of Colonel Sabine, London, 1855; and *Arago's Biographies of Scientific Men*, translated by Smyth, Powell, and Grant, 8vo, London, 1857.

ARAGON, a captaincy general, or, as it is usually called by the Spaniards, a kingdom, of Spain, situated between lat. 40° and 42° 51′ N., and between long. 2° 10′ W. and 1° 45′ E., is bounded on the N. by the Pyrenees, which separate it from France, E. by Catalonia and Valencia, S. by Valencia, and W. by Navarre and the two Castiles. It has an area of 14,726 English square miles, and a population of 925,773—calculated for 1867 on the basis of the census of 1860. It is divided by the river Ebro, which flows through it in a south-easterly direction, into two nearly equal parts, known as *Trans-ibero* and *Cis-ibero*. The north is occupied by a portion of the Pyrenees, which here attain in Monte Perdido, or as it is variously called Mont Perdu, Las Tres Sorores, almost their highest altitude (11,430 feet); and in the south and west are various sierras of considerable elevation. The whole surface, indeed, is very irregular. The large and fertile plain in the middle, bordering on the Ebro, is broken by offshoots from the north and south, while the mountain ranges, on the other hand, are interrupted by numerous valleys of great beauty. The central pass for carriages over the Pyrenees is on the line between Saragossa and Pau, and bears the name of Port de Confranc. The Ebro is the principal river, and receives from the north in its passage through the province, the Arba, the Gallego, and the united waters of the Cinca, the Essera, the Noguera Ribagorzana, and the Noguera Pallaresa—the last two belonging to Catalonia; and from the south the Xalon and Xiloca and the Guadalupe. The Imperial Canal of Aragon, which was commenced by Charles V. in 1529, but remained unfinished for nearly two hundred years, extends from Tudela almost to Sastago, a distance of 80 miles; it has a depth of 9 feet, and an average breadth of 69, and is navigable for vessels of about 80 tons burthen. The Royal Canal of Tauste, which lies along the north side of the Ebro, was cut for purposes of irrigation, and gives fertility to the district. Two leagues N.N.E. of Albarracin is the remarkable fountain called Cella, 3700 feet above the sea, which forms the source of the Xiloca; and between this river, and the Sierra Molina is an extensive lake called Gallocanta, covering about 6000 acres. The climate of Aragon is, as might be supposed, of a very varied character, rigorous in the north and among the sierras, but mild and even oppressive in the south, especially towards the Mediterranean. Its vegetable products are necessarily affected by a similar variety. The hills are clothed in many places with oak, pine, and beech, which, if utilised, would furnish a good supply of timber. The flora is exceedingly rich, but has been slightly explored. Wheat, maize, rice, wine, oil, flax, and hemp, of fine quality, are grown in considerable quantities; as well as saffron, madder, liquorice, sumach, and a variety of fruits. Swine and sheep are reared in considerable numbers, the merino wool supplied by the latter being one of the chief productions of the province; but little attention is paid to other descriptions of cattle. The manufactures are comparatively insignificant, being in great measure supplementary to the agricultural and pastoral pursuits of the people. The silk manufacture has declined, and woollen and linen cloth is only produced in small quantities. The mineral resources of the country consist of iron, lead, copper, sulphur, cobalt, asphalt, lignite, alum, rocksalt, jet, marble, and jasper, which are all found in abundance, but they are very inadequately wrought. Aragon is divided into three provinces, HUESCA, TERUEL, and SARAGOSSA, accounts of which will be found under these headings. The capital is Saragossa, and the other towns of importance are Jaca, Huesca, and Barbastro to the north of the Ebro, and Tarazona, Calatayud, Daroca, Calamocha, Albarracin, Montalban, Teruel, and Alcañiz to the south. Saragossa is an archbishopric, and Huesca, Tarazona, Barbastro, Jaca, Teruel, and Albarracin are episcopal sees. In 1867 there were 2257 priests in the kingdom.

Previous to the reign of Ferdinand and Isabella the political constitution of Aragon was the most liberal in Europe. Formally monarchical, its genius and maxims were purely republican. The kings, who were long elective, retained only the shadow of power; while the real exercise of it was in the hands of the Cortes, an assembly consisting of the nobility, the equestrian order, the representatives of the cities and towns, and the clergy. No law could pass without the assent of every member who had a right to vote. Without the permission of the Cortes, no tax could be imposed, war could not be declared, nor peace concluded. Besides these, and other extraordinary privileges enjoyed by the Cortes, the Aragonese possessed another safeguard against despotic power in the election of a *Justicia*, or supreme judge, who acted as the guardian of the people, and the controller of the prince. He was the supreme interpreter of the laws, and was accountable to the Cortes alone for the manner in which he discharged the duties of his office. See Robertson's *History of Charles V.*, vol. i. § 3.

The history of Aragon after its union with Castile by the marriage of Ferdinand and Isabella, when it was merged in the kingdom of Spain, will be found in the general history of that country. It had, before this epoch, a succession of twenty sovereigns, from the year 1035 to 1516. See Zurita, *Annales de Aragon; Viaje* de Ponz; *Geografia* de Don Isidoro de Antillon; *Historia de la Economia Politica de Aragon*, por Don. Ignacio de Asso.

ARAGONA, a town in Sicily, 7½ miles N.N.W. of Girgenti. It has an old castle with a fine collection of paintings and antiquities. Almonds are largely grown in the neighbourhood; and not far off is the famous mud volcano of Maccaluba. Population, 11,424.

ARAGUAYA, or ARAGUIA, a river of Brazil which rises in the Sierra Sciada, and flows north between the provinces of Matto Grosso and Goyaz till it joins the Tocantins at San Joao das duas Barras, about lat. 6° S. It divides into two branches in lat. 18° 30′, and unites again about lat. 9° 30′, thus forming the large island of Santa Anna or Bannanal. The eastern branch, called the Furo, is the one principally navigated. The most important tributaries are the Cristalino, the das Mortes, and the Caja, on the west, and the Claro, the Vermelho, the Cruxas, and the Chavantes, from the east. The whole course of the river is about 1000 miles, and it is navigable a long way up.

ARAHAL, a town in Spain, 7 miles from Seville. Situated on the level summit of a hill, it enjoys a beautiful prospect. In the wars against the Moors, it assisted the mother-city of Moron, and received its civic independence in 1555 by charter from Charles V. Its church is of Gothic architecture. The country around produces wheat, barley, beans, pease, tares, and olives. Population about 9287.

ARAKÁN, a division of British Burmah, and within the jurisdiction of the chief commissioner of that province. It consists of a strip of country running along the eastern seaboard of the Bay of Bengal, from the Náf estuary, on the borders of Chittagong, to Cape Negrais. The division is situated between 16° 2′ and 21° 33′ N. lat., and between 92° 10′ and 94° 50′ E. long. It is bounded on the N. by the Bengal district of Chittagong; on the E. by the Yumadoung mountains, which separate it from independent Burmah and the British district of Pegu; and on the S. and W. by the Bay of Bengal. Length from northern extremity to Cape Negráis, about 400 miles; greatest breadth in the northern part, 90 miles, gradually diminishing towards the south, as it is hemmed in by the Yumadoung mountains, until, in the extreme south, it tapers away to a narrow strip not more than 15 miles across. The coast is studded with islands, the most important of which are Chedubá, Ramrí, and Sháhpurá. The division has its headquarters at Akyab and consists of four districts — namely, Akyab, Northern Arákán hill tracts, Ramrí, and Sandoway. Total area estimated at 18,530 square miles, of which only 740 square miles were actually under cultivation in 1871–72. The population at the time of the British accession in 1826 did not exceed 100,000. In 1831 it amounted to 173,000; in 1839 to 248,000; and in 1871 to 461,136, or 24·9 souls per square mile. It consisted of 365,131 Buddhists, 53,289 Mahometans, 9029 Hindus, 33,337 aborigines, and 350 Christians—total, 461,136. The principal rivers of Arákán are—(1.) The Náf estuary, in the north, which forms the boundary between the division and Chittagong; (2.) the Myu river, an arm of the sea, and running a course almost parallel with the coast for about 50 miles; (3.) the Koladyne river, rising near the Blue mountain, in the extreme north-east, and falling into the Bay of Bengal a few miles south of the Myu river, is navigable by vessels of from 300 to 400 tons burden for a distance of 40 miles inland; and (4.) the Lemyu river, a considerable stream falling into the bay a few miles south of the Koladyne. Further to the south, owing to the nearness of the range which bounds Arákán on the east, the rivers are of but little importance. These are the Talak and the Aeng, navigable by boats; and the Sandoway, the Toungoop, and the Gwa streams, the latter of which alone has any importance, owing to its mouth forming a good port of call or haven for vessels of from 9 to 10 feet draught. There are several passes over the Yumadoung mountains, the easiest being that called the Aeng route, leading from the village of that name into independent Burmah. The staple crop of the province is rice, along with cotton, tobacco, sugar, hemp, and indigo. The forests produce abundance of excellent oak and teak timber. During 1871–72 the sea-borne trade of Arákán amounted to £1,345,417, the exports of rice alone being returned at £105,894. The three maritime ports of the division are Akyab, Kyoukphoo, and Sandoway; and since June 1871 steam communication has been kept up once a fortnight between all these ports and Calcutta, except in the south-west monsoon, when communication is maintained with Kyoukphoo only. The revenue of Arákán Division in 1871–72 amounted to £199,756, of which 37·29 per cent., or £74,490, was derived from the land revenue. Throughout the whole division there were only two Government and three other schools in 1870–71, attended by 251 pupils. The police force, for the protection of person and property, consisted of a total of 115 of all ranks, the proportion being one man to every 15 square miles, or one to every 385 of the population. The only town in the division with a population exceeding 5000 souls is Akyab, which has 15,281 inhabitants.

The natives of Arákán trace their history as far back as 701 A.D., and give a lineal succession of 120 native princes down to modern times. According to them, their empire had at one period far wider limits, and extended over Ava, part of China, and a portion of Bengal. This extension of their empire is not, however, corroborated by known facts in history. At different times the Mughuls and Pegus carried their arms into the heart of the country. The Portuguese, during the era of their greatness in Asia, gained a temporary establishment in Arákán; but in 1783 the province was finally conquered by the Burmese, from which period until its cession to the British in 1826, under the treaty of Yandaboo, its history forms part of that of Burmah. The old city of Arákán, formerly the capital of the province, is situated on an inferior branch of the Koladyne river. Its remoteness from the ports and harbours of the country, combined with the extreme unhealthiness of its situation, have led to its gradual decay subsequently to the formation of the comparatively recent settlement of Akyab, which place is now the chief town of the province. The old city of Arákán lies about 50 miles north-east of Akyab, in 20° 42′ N. lat., and 93° 24′ E. long. The Maghs, who form nearly the whole population of the province, follow the Buddhist doctrines, which are universally professed throughout Burmah. The priests are selected from all classes of men, and one of their chief employments is the education of children. Instruction is consequently widely diffused, and few persons, it is said, can be found in the province who are unable to read. The qualifications for entering into the priestly order are good conduct and a fair measure of learning—such conduct at least as is good according to Buddhist tenets, and such learning as is esteemed among their votaries.

ARAL, a vast lake or inland sea, in the west of Asia, situated between lat. 43° 42′ and 46° 44′ N., and long. 58° 18′ and 61° 46′ E. It was known to the Persian geographers as the Sea of Khuwârizm or Khwarezm, from the neighbouring district of the Chorasmii, and derives its present name from the Kirghese designation of *Aral Denghis*, or Sea of Islands. Its length, from north to south, is 265 miles, and its breadth, from east to west, about 145. It is the greatest body of water in the steppes of Asia, next to the Caspian Sea, and is one of the largest lakes in the world. Its level is 117 (or, according to recent explorations, which, however, require verification, 250) feet above the Caspian, which is 84 feet below the Black Sea. It is bounded on the N. by the Ural steppes; on the W. by the rocky plateau of the Ust-Urt, which separates it from the Caspian; on the S. by the alluvial district of Khiva; and on the E. by the Kysyl-Kum, or Red Desert, and the Kara-Kum, or Black Desert. In the north the shore is comparatively low, and the coast-line is broken into a number of irregular bays, of which the most important are those of Sary-Chaganak and Paskevitch; and on the west an almost unbroken wall of rock extends from Chernycheff Bay southwards, rising towards the middle to a height of 500 feet. The southern coast is occupied by the delta of the Oxus (Jihûn, Amu-Daria, El-Jiryan), which divides into a number of channels, the most important of which, beginning from the west, are the Aibugir or Laudan, the Ulu- or Ulkun-Daria (Great River), and the Kuvan-Jarma, Kuk, or Yangy Su (New River), as it is variously called. The Laudan forms a vast swamp, 80 miles long, and about 20 broad, before it disembogues into the sea; and the whole of the neighbouring reaches are extremely shallow. The only other tributary of any size is the Jaxartes (Sîhûn, Syr-Daria, Shâsh), which enters towards the northern extremity of the east coast, and is suspected to be shifting its course and embouchure more and more to the north. The whole eastern coast is fringed with multitudes of small islands, and a number of considerable size are situated in the open towards the north and west. Kug-Aral, which is the largest of all, lies across the northern portion opposite the mouth of the Syr-Daria, and cuts off what is called the Kitchkine Dengis, or Little Sea. Proceeding south we find in succession, Barsa-Kilmas, Nicholas Island, Bellinghausen, Lasaroff, and, near the mouth of the Taldyk, Takmakdty. Upon some of these islands the Russian explorers found large numbers of antelopes, which showed by their perfect fearlessness, combined with their curiosity, that they had hitherto been undisturbed by man. For the most part the Sea of Aral is comparatively shallow, the depth towards the west coast being 37 fathoms, and towards the centre only 15. Navigation is rendered dangerous by the frequency and violence of the storms, and the almost total absence of shelter for ships. The north-east wind is the most prevalent, and sometimes blows for months together. The only other craft, except the steamships of the Russians, that venture on the waters, are the flat-bottomed boats of the Kirghese. The first vessel ever known to have been launched on the Aral was conveyed across the desert in pieces by the Russian Admiral Boutakoff, about 1848. The sea abounds with fish of various kinds, as the sturgeon, silurus, carp, and especially a species of herring; thus agreeing in its ichthyology with the Caspian, from which it is distant 150 miles. The water is only slightly brackish. During winter the northern portion is completely frozen, but towards the south it is very seldom that ice is formed to any extent. The Aral has no visible outlet; and to account for there being no increase in its size, it was supposed that there might be a subterraneous communication with the Caspian Sea or the Sea of Khuzar; but the evaporation is so great as not only to maintain an equilibrium, but even, it has been thought, to produce, as in the case of the Caspian, a gradual diminution. In regard to the period of the formation of the Aral there are two theories, each supported by high authority. According to Sir H. Rawlinson (*Proceedings of the Royal Geographical Society*, March 1867) the disturbances which produced the present lake took place in the course of the Middle Ages; while Sir Roderick Murchison contends (*Journal of Roy. Geog. Soc.* 1867, p. cxliv., &c.) that the Caspian and Aral have existed as separate seas before and during all the historic period, and that the main course of the rivers Jaxartes and Oxus was determined in a prehistoric period. The former bases his opinion largely on historical evidence; and the latter trusts principally to geological data. The whole subject has been recently reviewed in *Die Aralseefrage*, by Robert Roesler, Associate of the Imperial Academy of Sciences, Vienna, 1873.

ARAM, Eugene, was born of humble parents at Ramsgill in Yorkshire, in 1704. He received little education at school, but manifested an intense desire for learning. While still young, he married and settled as a schoolmaster at Netherdale, and during the years he spent there, he taught himself both Latin and Greek. In 1734 he removed to Knaresborough, where he remained as schoolmaster till 1745. In that year a man named Daniel Clark, an intimate friend of Aram, after obtaining a considerable quantity of goods from some of the tradesmen in the town, suddenly disappeared. Suspicions of being concerned in this swindling transaction fell upon Aram. His garden was searched, and some of the goods found there. As, however, there was not evidence sufficient to convict him of any crime, he was discharged, and soon after set out for London, leaving his wife behind. For several years he travelled through parts of England, acting as usher in a number of schools, and settled finally at Lynn, in Norfolk. During his travels he had amassed considerable materials for a work he had projected on etymology, to be entitled, a *Comparative Lexicon of the English, Latin, Greek, Hebrew, and Celtic Languages.* In February 1759 a skeleton was dug up at Knaresborough, and some suspicion arose that it might be Clark's. Aram's wife had more than once hinted that her husband and a man named Houseman knew the secret of Clark's disappearance. Houseman was at once arrested and confronted with the bones that had been found. He affirmed his innocence, and, taking up one of the bones, said "This is no more Dan Clark's bone than it is mine." His manner in saying this roused suspicion that he knew more of Clark's disappearance than he was willing to admit. He was again examined, and confessed that he had been present at the murder of Clark by Aram and another man, Terry, of whom nothing further is heard. He also gave information as to the place where the body had been buried in St Robert's Cave, a well-known spot near Knaresborough. A skeleton was dug up here, and Aram was immediately arrested, and sent to York for trial. Houseman was admitted as evidence against him. Aram conducted his own defence, and did not attempt to overthrow Houseman's evidence, although there were some discrepancies in that; but made a skilful attack on the fallibility of circumstantial evidence in general, and particularly of evidence drawn from the discovery of bones. He brought forward several instances where bones had been found in caves, and tried to show that the bones found in St Robert's Cave were probably those of some hermit who had taken up his abode there. He was found guilty, and condemned to be executed on the 6th August, three days after his trial. While in his cell he confessed his guilt, and threw some light on the motives for his crime, by asserting that he had discovered a criminal intimacy between Clark and his own wife. On the night before the 6th August he attempted to commit suicide by opening the veins in his arm; but he was discovered before life was extinct, and suffered the last penalty of the law. The story of Eugene Aram has been made the subject of a powerful ballad by Hood, *The Dream of Eugene Aram, the Murderer*, and of a romance by Bulwer Lytton, entitled *Eugene Aram.*

ARAMAIC LANGUAGES are so called from *Aram*, a geographical term, which in old Semitic usage designates nearly the same districts as the Greek word Syria. Aram, however, does not include Palestine, while it comprehends Mesopotamia (*Heb.* Aram of two rivers), a region which the Greeks frequently distinguish from Syria proper. Thus the Aramaic languages may be geographically defined as the Semitic dialects originally current in Mesopotamia and the regions extending S.W. from the Euphrates to Palestine. Philologically these dialects form a distinct group of Semitic languages (North Semitic), separated by grammatical and lexical peculiarities alike from the Middle Semitic (Hebrew, Phœnician) and from the South Semitic (Arabic, Ethiopic). Babylonia is not part of Aram, and the Semitic language of the Assyrian and Babylonian arrowhead inscriptions is not Aramaic.

All Aramaic dialects are characterised by poverty of vowels, by the disappearance of many of the forms of internal declension so characteristic of the original genius of Semitic speech, and by a tendency to analytical construction by the aid of relative particles in place of the earlier usage of the construct state. Along with these marks of degradation they retain some antique features lost in Hebrew and Arabic, and in particular, generally present the oldest consonantal forms, having mutes instead of sibilants and aspirates, in a way quite analogous to the relation of Low to High Dutch. A special Aramaic peculiarity is the enclitic use of the article as in modern Danish.

The tribes of ancient Aram never possessed political unity, their settlements being intersected by strips of desert with Arabian population. Thus, there must have been from an early time considerable diversity of dialect within the group, and apart from differences due to the very various ages of the extant literature, we are able to divide Aramaic into two main branches, commonly known as Chaldee and Syriac respectively, and distinguished partly by differences of pronunciation and vocabulary, but more conclusively by differences of grammatical flexion, especially in the verb. In comparison with the great age of this branch of Semitic, the whole Aramaic literature is of comparatively late date, and presents the languages in an advanced and in some sense exhausted stage of development.

The historical and geographical relations of Syriac and Chaldee respectively are involved in some obscurity. As the entire Chaldee literature is of Jewish origin, Hupfeld and others have attempted to refer the whole difference of this language from Syriac to an infusion of Hebrew elements. This view, however, is now generally given up, and it is agreed that Chaldee is no corrupt dialect, but a genuine Aramaic development. But where and when did the Jews give up their old language and adopt a foreign tongue? The explanation formerly adopted and embodied in the name Chaldee, which from the days of Jerome has been commonly used to designate the Jewish Aramaic, is that the change took place in Babylon. That the so-called Biblical Chaldee, in which considerable portions of the books of Ezra and Daniel are written, was really the language of Babylon, was supposed to be clear from Dan. ii. 3, where the Chaldeans are said to have spoken to the king in Aramaic, and accordingly the writer in the following verse passes from Hebrew to that language. But the cuneiform inscriptions show that the proper language of the Chaldeans was not Aramaic; and an examination of the very large part of the Hebrew Old Testament written later than the exile seems conclusively to prove that the substitution of Aramaic for Hebrew as the vernacular of Palestine took place very gradually. Under the Persian empire Aramaic was a sort of official language for the western provinces, and the Hebrews were in constant contact with Aramaic populations, so that the language of the many could not fail ultimately to supersede the language of the few. Hence most scholars are now agreed in holding that the term Chaldee is a misnomer, and that the dialect so called is really the language of the South-Western Arameans, who were the immediate neighbours of the Jews. Probably this doctrine would be no longer disputed but for the connection between the question before us and that of the date and authorship of Daniel In any case, the substitution of Aramaic for Hebrew as the vernacular of Palestine was completed before the time of Christ, and it is this dialect (not the language of the Old Testament Scriptures) which is designated in the New Testament as "Hebrew." The old Hebrew Scriptures were understood only by the aid of interpretations, which, at first oral, were set down in writing in the early centuries of our era, and form after the Biblical Chaldee the second main element of Chaldee literature, the so-called Targums. These versions or paraphrases arose partly in the Palestinian, partly in the Babylonian schools, and accordingly display considerable variety of dialect—the Palestinian Targums approaching most nearly to the Aramaic of Daniel and Ezra. But the Aramaic of the Targums is again very different from the language of every day life, as presented in the Talmuds of Babylon and Jerusalem. The Talmudic dialects show extreme phonetic and grammatical decay, but have hitherto been very inadequately investigated. The Aramaic of the Babylonian Talmud is more nearly allied to the Aramaic of the East than to the language of Palestine.

Of much greater historical importance than these Jewish dialects is the Aramaic of the north and east, which rose to a literary language under the name of Syriac, in the Chrstian schools of North Mesopotamia. Like so many other languages, the Syriac first received stable literary form by the translation of the Bible, the so-called Peshito. On this basis the language was assiduously cultivated for many centuries, especially in the renowned schools of Edessa and Nisibis, and possesses a very large literature, in which theology has a leading place, but which is also strong in other forms of composition, as history and poetry, and even extends into the domain of Occidental philosophy and science. The treatment of the latter subjects in a Semitic speech was rendered possible by the very great infusion of Greek elements (not merely technical terms, but even particles and the like) brought into the language by long centuries of Greek domination and culture. The period during which Syriac literature was most flourishing extends from the 4th to the 10th Christian century. From the later date onward, the language began to give way to Arabic, though some very distinguished authors, *e.g.*, Barhebræus, wrote as late as the 13th century. Even now the Syriac is used to some extent as the ecclesiastical language of various bodies of Christians, Jacobites, Nestorians, and Maronites. The systematic study of Syriac by grammars and lexicons was commenced pretty early. Of native grammarians, may be mentioned Jacob of Edessa (7th century) and Barhebræus; of lexicographers, Bar-Ali and Bar-Bahlul (9th and 10th centuries respectively). By the Maronites the study of Syriac was transplanted to Europe in the 16th century. A corrupt dialect (Neo-Syriac) is still spoken in some districts near Mosul, in Antilibanus, &c., and has been grammatically handled by Stoddart, Nöldeke, and others. Besides the two main branches of Aramaic already discussed, several minor Aramaic dialects claim to be noticed. The Samaritan dialect, spoken by the mixed population introduced into Northern Palestine after the deportation of the Ephraimites, has long been superseded as a living tongue by Arabic, but is still the sacred language of the Samaritan communities. The most important literary monument of this dialect is the Samaritan translation of the Pentateuch; but we possess also Samaritan liturgies and other remains. Another written dialect is the Mandean, the language of a mystical sect on the Euphrates and Tigris, whose *Book of Adam* has been edited by Norberg. Other dialects are known only from inscriptions, as the dialect of the Hauran, and that of certain Egyptian monuments.

Helps to the Study of the Aramaic Dialects.—There is as yet no good Grammar of the Chaldee dialects. That most commonly used is Winer's *Grammatik des biblischen und targumischen Chaldaismus*, which has passed through several editions, and of which there is an American translation by Riggs. Luzzato's *Elementi grammaticali del Caldeo Biblico e del dialetto Talmudico Babilonese* (Padua, 1865) is in some respects preferable to Winer. The *Chaldäische Grammatik* of Fuerst (Leipsic, 1835) is unfinished. The best Chaldee Lexicon is still the old *Lexicon Chaldaicum Talmudicum et Rabbinicum* of Buxtorf (Basil, 1640). The worthless modern reprint by Fischer is to be avoided, but the *Chaldäisches Wörterbuch* of J. Levy, 2 vols. Leipsic, 1867–68, may be used with caution. On the controversy as to the real character of the Chaldee dialects, the student may be referred to the books of introduction to the Old Testament, especially to Schrader's edition of De Wette, which gives full references to relevant literature. Of recent Syriac Grammars may be mentioned those of Hoffmann (*Grammaticæ Syriacæ Libri III.*, Halæ, 1827) and Uhlemann (*Grammatik der Syrischen Sprache*, 2 Aufl., Berlin, 1857) in Germany, and of Cowper (London, 1858) in English. An elaborate and pretentious reconstruction of Hoffmann's Grammar by Professor Merx of Tübingen, treats all the Aramaic dialects, but is not yet finished (part i. 1867, part ii. 1870). The Grammar of Amira (Rome, 1596) is still referred to. There is no complete Syriac Lexicon adequate to modern requirements. Michaelis's edition of Castellus (Göttingen, 1788), and Schaaf's *Lexicon Concordantiale* to the New Testament (Leyden, 1708), are valuable; and a great Thesaurus, compiled from numerous sources, and from the collections of several scholars, is now being published by the Clarendon Press under the editorship of Dr Payne Smith. On the Samaritan literature see the introduction to Nutt's *Fragments of a Samaritan Targum*, London, 1874. There is a Samaritan Grammar by Uhlemann (Leipsic, 1837), and an Essay on the Mandean dialect by Nöldeke (Gottingen, 1862). The Aramaic inscriptions have been investigated by Gesenius, De Vogüé, Noldeke, and others. (W. R. S.)

ARAN ISLANDS, South, three islands of carboniferous limestone, which lie across Galway Bay, on the west coast of Ireland, in a south-easterly direction, forming a kind of natural breakwater. They are called respectively—beginning with the most northern—Inishmore (or Aranmore), the Great Island; Inishmaan, the Middle Island; and Inisheer, the Eastern Island. The first has an elevation of 354 feet, the second of 259, and the third of 202. These islands are remarkable for a number of architectural remains of a very early date. In Aranmore—which has been sung by Moore—there stand, on a cliff 220 feet high, large remains of a circular cyclopean tower, called Dun-Aengus, ascribed to the Fir-bolg or Belgæ; and seven other similar structures are found in the group. Aranmore also bears the name of *Aran-na-naomh*, Aran-of-The-Saints, from the number of religious recluses who took up their abode in it, and gave a celebrity to the holy wells, altars, and shrines, to which many are still attracted. No less, indeed, than twenty buildings of ecclesiastical or monastic character have been enumerated in the three islands. The total area is 11,287 acres.

ARANDA, Pedro Pablo Abarca y Bolea, Count of, a descendant of a noble family in Aragon, was born at Saragossa, 21st Sept. 1718. He served for several years in the army, and, after retiring with the rank of lieutenant-colonel, spent some time in travelling through France, Italy, and Prussia. He seems to have fallen under the displeasure of Ferdinand VI., but on the accession of Charles III. in 1759, he was appointed ambassador to the court of Poland, an office which he held for several years. On his return he took the command of the army sent against the Portuguese, and gained some successes. He was then appointed captain-general of Valencia, from which place, two years later, in 1765, he was summoned to Madrid to assist in quelling an insurrection. His success was rewarded by the appointment to the Presidency of the Court of Castile. While holding this office he induced the king to give his consent to an order for the banishment from Spain of all the Jesuits. His further intention of abolishing the Inquisition was prematurely disclosed, and great indignation was excited against him. He was dismissed from the presidency of the council, and sent as ambassador to Paris. Here he was instrumental in bringing about peace between Spain and Britain. The presidency from which Aranda had been dismissed was held for a short time by his political adversary, Grimaldi, who was succeeded by the count of Florida Blanca. On the dismissal of the latter in 1792, Aranda was recalled to his former position, but from it he was again quickly driven by the influence of Godoy, the queen's favourite. Soon after he obtained permission to retire to his own estates, where he died in 1799.

ARANJUEZ (*Ara Jovis?*), a town in Spain, in the province of Madrid, situated 1640 feet above the sea, in a beautiful valley on the left bank of the Tagus, near its junction with the Jarama, 28 miles S.S.E. of the capital, and 22 E.N.E. of Toledo, and united by rail with both these cities. The master of the Order of Santiago had a country seat at Aranjuez in the 14th and 15th centuries, which passed, along with the mastership into the possession of the crown of Spain in the reign of Ferdinand and Isabella (1522). It became a favourite resort of the Spanish court during the spring months; and its successive occupants, from the Emperor Charles V. down to Ferdinand VII., modified it according to their respective tastes. The larger palace, a building in the French style, due to Philip V., stands at the meeting of the rivers, and is surrounded with the luxuriant foliage of oaks and sycamores and elms. Many of the elms, which were originally brought from England in the reign of Philip II., have attained an extraordinary size. The *Casa del Labrador*, or Farmer's House, as it is called, is a smaller palace built by Charles IV., and full of elaborate ornamentation. The inhabitants of the town continued to live for the most part in troglodytic fashion in excavations in the hill-sides, till the reign of Charles III. (1759–1788), whose minister, Grimaldi, laid the town out in imitation of the Dutch style, with straight wide streets, and uniform two story houses. It contains two parish churches—*S. Antonio* and *del Payés*—an hospital, a Franciscan convent, a bull-ring, and a theatre. The manufactures are flour, chocolate, leather, and glass; but most of the inhabitants are dependent on agricultural pursuits. A yearly fair is held on the 4th, 5th, and 6th of September. Great attention is given to the rearing of horses and mules, and the royal stud used to be remarkable for the beauty of its cream-coloured breed. The ordinary population is between 3000 and 4000, but during the residence of the court, the number of inhabitants used to rise to 20,000. The place suffered severely from the French during the Peninsular War. The treaty of 1772 between France and Spain was concluded at Aranjuez; and there the insurrection broke out in 1808, which ended in the abdication of Charles IV.

ARARAT. This name, originally designating a whole district of Asia (Gen. viii. 4), has long been appropriated by the uniform usage of Europeans to the lofty Armenian mountain which stands on the confines of the Russian, Turkish, and Persian dominions, in lat. 39° 42′ N., long. 44° 35′ E., known to the Armenians as *Masis*, to the Turks as *Ak-Dagh*, and to the Persians as *Kuh-i-Nuh*, or Noah's Mountain. Whether the tradition, which makes it the resting-place of the ark, is of any historical value or not, there is at least poetical fitness in the hypothesis, inasmuch as this mountain is about equally distant from the Black Sea and the Caspian, from the Mediterranean and the Persian Gulf. Another tradition—accepted alike by Christians and Mahometans—fixed on Mount Judi, in the south of Armenia, as the ark's resting-place. There so-called genuine relics of the ark were exhibited, and a monastery and mosque of commemoration were built; but the monastery was destroyed by lightning in 776 A.D., and the tradition has declined in credit. Mount Ararat is the culminating point of the Armenian plateau, which reaches at its base a height of 3000 feet. From this it rises in a graceful isolated cone (having at its side the more perfect but less lofty cone of Little Ararat) far into the region of perennial snow. It was long believed by the Armenian monks that no one was permitted to reach the "secret top" of Ararat with its sacred remains. The summit, however, has been frequently reached in the course of this century. Tournefort had failed in 1700; the Pasha of Bayazeed had been equally unsuccessful; but on Sept. 27, 1829, Dr Parrot of Dorpat, a German in the employment of Russia, set foot on the "dome of eternal ice." Ascents have since been made by Antonomoff (1834 and 1843); Wagner and Abich (1845); Chodzko, Chanykoff, Moritz, and a party of Cossacks in the service of the Russian Government (1850); Major Stuart (1856); and Colonel Monteith (1856). Mr Freshfield, who reached within about 800 feet of the summit in 1868, thus describes the mountain:—"It stands perfectly isolated from all the other ranges, with the still more perfect cone of Little Ararat (a typical volcano) at its side. Seen thus early in the season (May), with at least 9000 feet of snow on its slopes, from a distance and height well calculated to permit the eye to take in its true proportions, we agreed that no single mountain we know presented such a magnificent and impressive appearance as the Armenian Giant." It has been ascertained that the higher peak, or *Ak-Dagh*, is 17,112 (1331 higher than Mount Blanc), and the lower, or *Allah-Dagh*, about 13,085 feet above the level of the sea. That the mountain was of volcanic origin was well known, but all eruptive activity was supposed to have long ceased. Reineggs was discredited, it may be justly, when he spoke of seeing it in eruption in 1785. But in 1840 there was a vast eruption of sulphurous vapours from its sides, and a tremendous earthquake shook the surrounding country. The village of Arguri and the monastery of St James were destroyed, and great damage was done to Nakhchevan, Sharur, and Ardubad. Major Voskoboinikoff's Report (*Athenæum*, 1841, p. 157) was, as Wagner has pointed out, erroneous in some of its details, but in the main trustworthy. There are a number of glaciers in the upper portion, and the climate of the whole district is very severe. The greater part of the mountain is destitute of trees, but the lower Ararat is clothed with birches. The fauna and flora are both comparatively meagre.

(Parrot, *Reise zum Ararat*, Berlin, 1834; Wagner, *Reise nach dem Ararat, &c.*, Stuttgart, 1848; Abich, in *Bulletin de la Soc. de Geogr. de France*, 4 ser. part i., and in *Monatsberichten der Ges. für Erdk. zu Berlin*, 1846, and his *Die Besteigung des Ararat*, St Petersburg, 1849; Dubois, *Voy. autour du Caucase*; Morier's *Second Journey*; D. W. Freshfield, *Travels in the Central Caucasus and Bashan*, 1869.)

ARAS, the ancient *Araxes* (Turk. and Arab. *Ras*, Armen. *Erash*, Georg. *Rashki*), a river which rises south of Erzeroum, in the Bingöl-Dagh (Mountain of the Thousand Wells), and flows east through the province of Erzeroum and Russian Armenia, passing between Mount Ararat and Erivan, till it joins the Kur (*Cyrus*) coming from the north, and falls with it into the Caspian Sea. Its separate course is about 500 miles long, and it receives a number of tributaries, of which one of the chief is the Zenghi, which passes by Erivan and drains lake Goukcha or Sivan. A number of towns are situated on the banks of the Aras, as Hassan-Kaleh, Kagisman, and Abbasabad. It forms the boundary between Russia and Persia from 44° to 48° E. long. The Araxes was known by hearsay to Herodotus, and is the Phasis of Xenophon. It is a rapid and muddy stream, dangerous to cross when swollen by the melting of the snows in Armenia, but fordable in its ordinary state.

ARATUS, one of the rulers of Sicyon, was born in that city, 271 B.C. His father, Clinias, was slain by Abantidas; and Aratus, then seven years of age, only escaped a similar fate through the kindness of Soso, the sister of Abantidas, who had him conveyed secretly to Argos. At the age of twenty he regained without bloodshed his native city of Sicyon, and induced the citizens to join the Achæan League. He obtained assistance in money from Ptolemy, whom he visited, and soon after (245 B.C.) he was elected general of the League. Two years later, when again general, he took Corinth from the Macedonians, and united it to the League. About the same time he defeated the Ætolians at Pellene, and his success drew many other cities into the League, which, under the careful management of Aratus, was rapidly becoming a powerful confederation. Its power, however, roused the jealousy of Cleomenes of Sparta, and in 226 war broke out between the Spartans and Achæans. Cleomenes was victorious at Lycæum, Megalopolis, Hecatombæum, and Dyme, and completely broke the power of the League. As a last resource, Aratus entered into negotiation with Antigonus of Macedonia, and, by promising to deliver up Corinth, secured his assistance. Antigonus was made general of the League, and in 222 totally defeated Cleomenes in the battle of Sellasia. The general peace which now ensued was broken by the turbulent Ætolians, who invaded Achæa. Aratus having marched against them, suffered so severe a defeat at Caphæ that he was accused and tried for mismanagement; his former great services alone saved him from suffering the penalty of failure. Philip of Macedonia, who was then called in to the assistance of the Achæans, succeeded in establishing peace, but his ambition was roused by the hope of obtaining supremacy in Greece. The counsels of Aratus became distasteful to him, and Plutarch does not hesitate to ascribe the death of Aratus, a few years later (213 B.C.), to poison administered by the command of his royal master. The body was conveyed to Sicyon, where a monument was erected as a memorial of his services. Aratus is one of the few great names in later Greek history. He had an intense hatred of tyrants, and devoted his whole life to the attainment of liberty for Greece. His talents as a statesman were great, but their effect was marred by his incompetence and want of success as a general.

ARATUS, a Greek poet, was born at Soli, in Cilicia. The date of his birth is uncertain, but it is known he lived about 270 B.C., and as he was court-physician to Antigonus Gonatas, king of Macedonia, he must have been contemporary with several of the great Alexandrian writers,—

Aristophanes of Byzantium, Aristarchus, and Theocritus. Though not an Alexandrian, Aratus has all the characteristics of that school of poetry. He was learned, and verse furnished him with a vehicle for conveying scientific instruction. His only extant works are two poems, or two fragments of one poem, the first, called Φαινόμενα, in 732 lines, the second, Διοσημεῖα, in 422 lines. The *Phænomena* is a versified imitation or modification of a prose work on astronomy by Eudoxus. It contains little of any value, but one verse has become famous through being quoted by St Paul in his speech from Mars Hill (Acts xvii. 28). The Diosemeia or Prognostics is a treatise on the signs of the weather, accompanied with practical rules. It is imitated to some extent by Virgil in his *Georgics*. The poems of Aratus were very popular, particularly among the Romans, who produced three translations, one by Cicero, another by Cæsar Germanicus, the third by Festus Avienus. The best modern editions of Aratus are those of Buhle, Buttmann, and Bekker.

ARAUCANIA, a territory of South America, between lat. 37° and 39° 50′ S., and long. 70° and 75° 20 W. It is bounded on the N. by the river Biobio, which separates it from Chili, S. by the Valdivia, E. by the Andes, and W by the Pacific Ocean. See AMERICA, vol. i. p. 701, and PATAGONIA.

ARAUCARIA, a genus of Coniferous trees included under the tribe Abietineæ, and the sub-tribe Araucariæ. The sub-tribe has been thus defined:—Leaves flat, often four-angled, arranged more or less in a spiral manner; male flowers in cylindrical terminal spikes, anthers six or more in two rows; female flowers in cones, which are large and globose; scales of the cone linear, arranged in a spiral manner, deciduous (falling off); seeds solitary, pendulous, usually without wings; cotyledons two, entire or divided into two. The species of the genus are magnificent evergreen trees with whorled branches, and stiff, flattened, pointed leaves, found in Brazil and Chili, Polynesia and Australia. The name of the genus is derived from Araucania, the district of South America where the trees grow. *Araucaria imbricata*, the imbricate-leaved pine, or the Chili pine, was introduced into Britain in 1796. It is largely cultivated, and usually stands the winter of Britain; but in some years, when the temperature fell very low, the trees have suffered much. On Christmas 1860, the temperature in the Edinburgh Botanic Garden fell to −8° Fahr., and some fine Araucarias, 24 and 25 feet high, were killed. Care should be taken in planting these trees to select a spot somewhat elevated and well drained. The tree grows to the height of 150 feet in the Cordilleras of Chili. The cones borne by the trees are from 8 to 8½ inches broad, and 7 to 7½ inches long. The wood of the tree is hard and durable. This is the only species which can be cultivated in the open air in Britain. *Araucaria brasiliana* (A. Rich.), the Brazil pine, is another species of the genus. It is a native of Brazil, and was introduced into Britain in 1819. It is not so hardy as *A. imbricata*, and requires protection during winter. It is grown in conservatories for half-hardy plants. *Araucaria excelsa* (R. Br.), the Norfolk Island pine, receives also the names of *Altingia excelsa*, *Eutassa* and *Eutacta excelsa*. It is a native of Norfolk Island and New Caledonia. It was introduced into Britain in 1793. It cannot be grown in the open air in Great Britain, as it requires protection from frost. It is more tender than the Brazilian pine. It is a majestic tree, sometimes attaining a height of more than 220 feet. The scales of its cones are winged, and have a hook at the apex. *Araucaria Cunninghami*, called also *Eutacta Cunninghami*, the Moreton Bay pine, is a tall tree found on the shores of Moreton Bay, Australia. It requires protection in this country during the winter. *Araucaria Bidwilli* (Hook.), the Bunya-Bunya pine, found on the mountains of Eastern Australia, between the rivers Brisbane and Burnett, at 27° S. lat., is a noble tree, attaining a height of 100 to 150 feet, with a straight trunk and white wood. It bears cones as large as a man's head. Its seeds are very large, and are used as food by the natives. *Araucaria Rulei* (Muell.) is another species. It is a tree of New Caledonia, which attains a height of 50 or 60 feet. *Araucaria Cookii* (R. Brown) is another coniferous tree of New Caledonia, attaining a height of 150 feet. It is found also in the Isle of Pines, and in the New Hebrides.

ARAVALLI HILLS, a range of mountains in India, running for 300 miles in a north-easterly direction through the Rajputáná states and the British districts of Mairwárá and Ajmír, situated between 24° and 27° 10′ N. lat., and between 72° and 75° E. long. They consist of a series of ridges and peaks, with a breadth varying from 6 to 60 miles, and an elevation of 1000 to 3000 feet, the highest point being Mount Abu, rising to 5655 feet, near the south-western extremity of the range. (See ABU.) The geology belongs to the primitive formation—granite, compact dark blue slate, gneiss, and sienite. Colonel Tod remarks the dazzling white effect of their peaks—an effect produced, not by snow, as among the Himálayas, but by enormous masses of vitreous rose-coloured quartz. On the north their drainage forms the Luní and Sakhí rivers, which fall into the Gulf of Cutch. To the south, their drainage supplies two distinct river systems, one of which debouches in comparatively small streams on the Gulf of Cambay, while the other unites to form the Chambal river, a great southern tributary of the Jamná, flowing thence, *viâ* the Ganges, into the Bay of Bengal on the other side of India. The Aravalli hills are for the most part bare of cultivation, and even of jungle. Many of them are mere heaps of sand and stone; others consist of huge masses of quartz heaped upon each other. The valleys between the ridges are generally sandy deserts, with an occasional oasis of cultivation. At long intervals, however, a fertile tract marks some great natural line of drainage, and among such valleys Ajmír city, with its lake, stands conspicuous. The hills are inhabited by a very sparse population of Mairs, an aboriginal race. For long these people formed a difficult problem to the British Government. Previous to our accession they had been accustomed to live, almost destitute of clothing, by the produce of their herds, by the chase, and by plunder. But Ajmír having been ceded to us in 1818, the Mair country was soon afterwards brought under British influence, and the predatory instincts of the people have at the same time been controlled and utilised by forming them into a Mairwárá battalion. As the peaceful results of British rule developed, and the old feuds between the Mairs and their Rájput neighbours died out, the Mair battalion was transformed into a police force. The Aravalli mountaineers strongly objected to this change, and pled a long period of loyal usefulness to the state. They have accordingly been again erected into a military battalion, and brought upon the roll of the British army. The Aravalli hills send off rocky ridges in a north-easterly direction through the states of Alwar and Jaipur, which from time to time reappear in the form of isolated hills and broken rocky elevations to near Dehli.

ARBACES, the founder of the Median empire in 876 B.C., was one of the generals of Sardanapalus, king of Assyria, and had command of the contingent from the province of Media. He conspired with Belesys, a Chaldean priest, who commanded the troops from Babylon, and having gained over several other officers of the king, they revolted. After a short contest Sardanapalus was defeated, and committed suicide. The dynasty founded by Arbaces lasted till its overthrow by Cyrus, 559 B.C. This account of the Median empire rests on the authority of Ctesias, as given in Diodorus (ii. 24, 34), and cannot be reconciled with what is stated by Herodotus, who is probably referring to another event. Arbaces, the Mede, is to be distinguished from the satrap of the same name who commanded a division of the army of Artaxerxes in his war with his brother Cyrus.

ARBELA (τὰ Ἄρβηλα), now Arbîl or Erbîl, a small town in the province of Shehrezur, situated to the west of the Tigris, in the plain between the Greater Zab (*Lycus*) and the Lesser Zab (*Caprus*), and on the route between Mosul (*Nineveh*) and Baghdad, about 40 miles from the former. The greater part of the town, which seems at one time to have been very large, is built on an artificial hill about 150 feet high. Arbela has given its name to a battle fought (331 B.C.) between Alexander the Great and Darius Codomannus,—though, in fact, the scene of the conflict was Gangumela, and it was only in the subsequent pursuit that the conquerer arrived at Arbela, where Darius had left his baggage and treasure. It became the seat of the Eyubide Sultan Saladdin, in 1184, was bequeathed in 1233 to the caliphs of Baghdad, was plundered by the Mongols in 1236 and in 1393 by Timour, and was taken in 1732 by the Persians under Nadir Shah. The population, which varies from 2000 to 6000, is chiefly composed of Koords.

ARBITRAGE (from the French *arbitrer*, in the secondary sense of comparing and settling accounts, derived in its turn from the primary sense of arbitrating disputes), is a term that is applied both to a calculation and to a trade: 1st, To the calculation of the relative simultaneous values at any particular moment of any particular merchandise, on *one* market, in terms of the quotations on one or more *other* markets, taking, of course, the exchanges into account; and 2d, To the business founded on such calculations, of buying (or *vice versâ*) wholesale in the cheapest market for the time being, and simultaneously reselling (or *vice versâ*) equal amounts in the dearest market, or if not simultaneously, at least as nearly simultaneously as post and telegraph will permit. Arbitrage proper is a separate, distinct, and well-defined business, with three main branches. Two of these, viz., arbitrage or arbitration in bullion and coins, and arbitration in bills, also called the arbitration of exchanges, fall within the businesses of bullion dealing and banking respectively. The third, arbitrage in stocks and shares, is arbitrage properly so called, and so understood, whenever the word is mentioned without qualification among business men, and it is strictly a Stock Exchange business. A few of the great financial firms outside the Stock Exchange combine the three arbitrations; they are dealers in bullion, in bills, and in stocks and shares all over the world; but, as a rule, the arbitrage properly known as such, is the business of an arbitrageur, who is almost always a member of a Stock Exchange or "Bourse," and his arbitrations with very few exceptions are neither in bullion nor in bills, but in Government and other stocks and shares. In this strict and accurate sense, arbitrage may be defined to be a traffic, consisting in the purchase (or sale) on one Stock Exchange, and simultaneous or nearly simultaneous, re-sale (or re-purchase) on another Stock Exchange, of the same amount in the same stocks or shares, which at any moment are found, on telegraphic or other advices, to be quoted and negotiable on two or more markets at a difference in price (arising from whatever temporary cause), sufficient to cover the cost of transmission, commission, interest, insurance, and leave an adequate profit over and above to be divided by the operators at both ends. The benefit to the various communities at large resulting from the operations of the arbitrageur consists—first, in the general and constant process of equalisation, equilibration, and the consequent stability in the prices of a large number of stocks and shares, and of an enormous amount of capital throughout the world; and second, in the greater inducement thus afforded for the economy of idle capital, by means of temporary investment in interest-bearing securities with a minimised risk of fluctuation. The great Government loans are, in the first instance, the natural subject-matter of arbitrage; and then, in a minor degree, a variety of other securities. British Consols, however, form one great exception to the rule, inasmuch as, from one cause or another (but mainly because they are almost entirely held in *one* country), no arbitrage business is done in these Consols, notwithstanding that they can be now dealt in "To Bearer." On the other hand, there is an enormous arbitrage business in the new French Five per cents., which, with the United States "Five-Twenties," covering between them a round *five hundred millions sterling*, probably stand first in the present list of arbitrage stocks. Indeed, but for the system of arbitrage, it is not easy to see how the great French loans of 1871-72 could have been carried at all without convulsing the financial world. Arbitrage, however, by making the new security universally negotiable, enabled all the great bankers and capitalists of the world—European, American, and East Indian—to join hands simultaneously in concluding an operation gigantic even for modern times. Next to "French Fives" and "U. S. Five-Twenties," on the arbitrageur's list would come, in various order, according to the men and the circumstances, "Turkish," "Egyptian," "Italian," "Spanish" "Russian," some South American stocks, and to a very considerable extent, the shares and obligations of the great Lombardo-Venetian Railways. And these stocks, if we add some East Indian securities, cover perhaps the widest area of international arbitrage. But a vast variety of minor securities constitute financial *flora*, so to speak, with minor and local areas of distribution, known only to particular localities, or to financial specialists. It has been stated above that some great financial houses do each kind of arbitration themselves. Similarly, one or two great firms of arbitrageurs do their own bill broking; but although arbitrage business is carried on by a considerable number of the leading Stock Exchange firms, there are perhaps only two that arbitrate their own bills—this arising from certain regulations that were passed by the London Stock Exchange in 1829 not having a retrospective effect. With these exceptions, the arbitrageurs do not undertake the banking part of the business themselves, but pay their bankers a margin to do it for them. The details of the system of arbitrage, and all the combinations with other business that may arise, constitute a special profession.

The literature of the subject is extremely meagre. Mr Goschen's *Theory of Foreign Exchanges*, London, 1866, is general and theoretical, but throws great light upon particular aspects of the philosophy of arbitrage, without touching specially on the details of the subject itself. The principal other works are—Kelly's *Cambist*, 1811, 1835; Otto Swoboda, *Die Kaufmannische Arbitrage*, Berlin, 1873, and *Börse und Actien*, Cologne, 1869; Coquelin et Guillaumin, *Dictionnaire de l'Economie politique*, Paris, 1851-53; Ottomar Haupt, *London Arbitrageur*, London, 1870; Charles le Touzé, *Traité Théorique et Pratique du Change*, Paris, 1868; Tate, *Modern Cambist*, London, 1868; Simon Spitzer, *Ueber Münz- und Arbitragenrechnung*, Vienna, 1872; J. W. Gilbart, *Principles and Practice of Banking*, London, 1871.

ARBITRATION, a term derived from the nomenclature of the Roman law, and applied to an arrangement for taking, and abiding by, the judgment of a selected person in some disputed matter, instead of carrying it to the established courts of justice. Arrangements for avoiding the delay and expense of litigation, and referring a dispute to friends or neutral persons, are a natural practice, of which traces may be found in any state of society; but it is to the Justinian jurisprudence that we owe it as a system which has found its way into the practice of European nations in general, and has even evaded the dislike of the English common lawyers to the civil law. The eighth section of the fourth book of the Pandects is devoted to this subject. Almost all the advantages, as well as the defects of the system in modern practice, seem to have been anticipated by the Roman jurists. Some of the civilians make a distinction between the *arbitrator*, the name applicable to a person voluntarily chosen by parties to decide disputes, and the *arbiter*, an officer to whom the prætor is supposed to have remitted questions of fact as to a jury. In this sense arbiters appear to have been employed as a substitute for jury trial in some of the old provincial laws of France; and hence, perhaps, it comes that, by a very remarkable provision in the French code of commerce, all questions between partners touching the partnership must be referred to arbitration. In the code of civil procedure the title *des arbitrages* is treated so fully and minutely, as very forcibly to convey the impression of a separate system of voluntary jurisdiction, being created for performing what ought to be accomplished by the ordinary tribunals in a well-regulated judicial system. In Scotland the practice of arbitration has been imported from the Roman law without requiring, as in England, statutory intervention. It is one of the advantages of the Scottish system of registration that the decree-arbitral, or decision of the arbiter, when recorded in pursuance of the consent of the parties in their contract of arbitration or submission, can be enforced as the decree of a court.

Arbitration in Scotch Law.—This term is applied to the contract whereby a dispute is referred to one or more persons by the parties interested, and so withdrawn from the cognisance of the ordinary tribunals. When one person only is chosen he is called sole arbiter or arbitrator; when more than one, an umpire or oversman is appointed either in the contract or by the arbiters themselves, and his award is final if the arbiters differ in opinion. The contract is properly entered into by deed, duly attested and stamped, and is termed a *submission*. Submissions are either general or special; the former including all disputes subsisting at the time, the latter restricted to certain specified matters. The judgment when promulgated is termed the award or decree-arbitral. The deed of submission contains a clause authorising registration for execution, under which, on registration in the books of a competent court, witnesses may be cited and the decree-arbitral put to execution. The procedure may be by written pleadings, and a formal record may be made up if the arbiters deem that desirable. If the determination of the matter falls on the oversman, he may order further debate before deciding. Unless the submission provides otherwise, the powers of the arbiters fall on the expiry of one year; but if it contain a power of prorogation, the arbiters may prorogate from year to year; and in all cases the parties themselves may renew the reference after it has fallen. By Act of Regulations, 1695, c. 25, decrees-arbitral are declared not to be reducible except on the grounds of bribery, corruption, or falsehood; this has, moreover, been so interpreted as not to exclude reduction when the arbiters have plainly travelled out of the powers conferred on them by the submission, or where their procedure has been grossly irregular, *e.g.*, taking evidence in absence of one of the parties. An arbiter has the power of awarding costs, even though the deed contain no such provision. It is the general rule that a reference is ineffectual where the arbiters are not named, or where an arbiter is merely designated as the holder of an office, *e.g.*, the Lord Advocate. To this there is, however, an exception, where in a contract the parties bind themselves to refer, and where a reference is necessary to work out the contract. A rule in friendly societies to refer disputes is binding. Arbiters having once accepted, cannot renounce their office at pleasure; and if they do so, become liable in damages.

Judicial References have been long known to the law of Scotland. When an action is in court the parties may at any stage withdraw it from judicial determination, and refer it to arbitration. This is done by minute of reference to which the court interpones its authority. When the award is issued it becomes the judgment of the court. The court has no power to compel parties to enter into a reference of this kind, and it is doubtful whether counsel can bind their clients in such a matter. A judicial reference falls like the other by the elapse of a year; and the court cannot review the award on the ground of miscarriage. By 13 and 14 Vict. c. 36, § 50, a provision is introduced whereby parties to an action in the Supreme Court may refer judicially any issue for trial to one, three, five, or seven persons, who shall sit as a jury, and decide by a majority. The Consolidation Acts in reference to the acquisition of lands, &c., for public undertakings, such as railways, also contain provisions for settlement of disputes by arbitration.

Arbitration, in the Law of England, is described by Blackstone as an arrangement by which "the parties injuring and injured submit all matters in dispute concerning any personal chattels or personal wrong to the judgment of two or more *arbitrators*, who are to decide the controversy; and if they do not agree, it is usual to add that another person be called in as *umpire*, to whose sole judgment it is then referred; or frequently there is only one arbitrator originally appointed." Proceedings in arbitration were regulated by the Act 9 and 10 Will. III. c. 15, which allowed the submission to be made a rule of any of the courts of record and subsequent statutes. It may be said in general that all questions relating to civil rights may be referred to arbitration, *e.g.*, personal damages, disputes about real property, and pure questions of law. How far questions involving matters of criminal law may be made the subject of arbitration is not quite clear. In many cases the aggrieved person, having a remedy by indictment as well as by action, may compromise the criminal process by referring his civil rights to an arbitrator; but the more serious criminal offences of course could not be dealt with in this way. An arbitrator ought to have no personal interest in the subject of dispute, but this is almost the only restriction recognised by the law. Idiots, lunatics, infants, and married women, who are under a general rule of disqualification in law, may all be arbitrators, for it is said, the parties have selected their own judges and must abide by their choice. In certain cases of arbitration under a statute, the arbitrator must be taken from some special class, *e.g.*, in settling disputes about the proportional expense of county prisoners in a borough gaol, the arbitrator must be a barrister. Under the Common Law Procedure Act of 1854, the reference is to the master of the court. The submission to arbitration may be by agreement between the parties, by order of a court or judge, or by compulsion under the Common Law Act, 1854, or under special statutes. A verbal submission, besides other obvious disadvantages, cannot be made a rule of court. The statute 9 and 10 Will. III. provided that persons might agree that their submission should be made a rule of court, but the insertion of the consent clause in the submission was necessary. The Common Law Procedure Act, 1854, § 17, provides that every agreement or submission to arbitration by consent, whether by deed or instrument in writing, not under seal, may be made a rule of any one of the superior courts of equity or law at Westminster, on the application of any party thereto, unless such agreement or submission contain words purporting that the parties intend that it should not be made a rule of court; or if any particular court is specified, the submission shall be made a rule of that court only. The court has no jurisdiction until the submission has been actually made a rule of court, and that is seldom done until it is necessary to enforce or set aside the award. The courts are very jealous of any attempt to "oust their jurisdiction," by agreements to refer differences not yet risen, or covenants not to sue in respect of such differences. The 11th section of the Common Law Procedure Act, however, enables a defendant to take advantage of an agreement to refer by applying to the court to stay proceedings in the actions, and compel the plaintiff to resort to arbitration. In a pending action the matters in dispute may by consent of the parties be referred to arbitration, before or after the action is called on trial, by a rule of court, or by order of a judge at the trial. If it should be made to appear, at any time after the issuing of the writ, to the satisfaction of a court or the judge that the "matter in dispute consists wholly or in part of matters of mere account," the court or judge may order such matter to be referred to an arbitrator or an officer of the court (Common Law Procedure Act, § 3). At the trial of any issue of fact, matter of account therein arising may by order of the judge be similarly referred (section 6). In the latter case the power cannot be exercised after the jury is sworn. Among the statutes authorising reference to arbitration in cases of dispute the most important are the Land Clauses Consolidation Act, 1845, the Railway Clauses Act, 1845, and the Companies' Clauses Act, 1845—statutes which consolidate the "common clauses" usually inserted in Acts relating to the subjects named in their respective titles.

The powers of the arbitrator are very various. He may have the power of a jury or a judge at Nisi Prius, of a court in banco, of the Lord Chancellor, or of a master. The time for making the award is usually fixed by the submission; in other cases the legal period is three months. The time, however, may be enlarged by a rule of court, or by order of the arbitrators themselves. The award or decision of the arbitrators ought to decide finally all the questions in dispute, and ought to be certain and definite; it ought to be "mutual," *i.e.*, it should ascertain the rights and duties of both parties, and it must be possible and consistent with itself. It is a general rule that an award cannot be impeached for a mistake in law or in fact, although it is to be regretted that the practice of the courts on this point is by no means uniform. Where a demurrer, *i.e.*, an issue in point of law, was referred to arbitration, it was held that a mistake in law was no ground for setting aside the award. On the other hand, it has been held that a clear gross mistake affecting the whole award may be a good ground for having it set aside.

Arbitration, in International Law, is one of the recognised modes of terminating disputes between independent nations. Vattel calls it "a reasonable and natural mode of deciding such disputes as do not directly interest the safety of a nation." Heffter mentions six cases in which the judgment of the arbitrators would not be binding on the contending parties, viz., when the agreement has been insufficient, when the arbitrators have been incapable, when they have acted on bad faith, when the parties have not been understood, when the award is in excess of the reference, and when it is contrary to natural justice. Arbitration is sometimes spoken of as a universal substitute for war, but hitherto there has been no inclination, on the part of independent states, to submit any but secondary questions to the decision of neutral parties. The king of Prussia acted as arbitrator between England and France in 1843, in what were known as the Portendic claims. In the case of the "General Armstrong" privateer, between the United States and Portugal, the president of the French Republic (afterwards the Emperor Napoleon) acted as arbitrator. The most formal experiment in arbitration, however, was the Geneva Convention in 1872. The United States having for many years urged upon England the settlement of what were called the "Alabama" claims, a treaty was concluded by which the case was referred to five arbitrators named by England, the States, the Swiss Republic, the king of Italy, and the emperor of Brazil, respectively. Three new rules were at the same time drawn up for the arbitrators to follow in deciding on the liability of England. The award was in favour of America, and the English representative (Lord Chief-Justice Cockburn) was the only dissentient.

Arbitration is frequently employed to settle differences not of a legal character, *e.g.*, disputes between masters and workmen as to the rate of wages, hours of labour, &c.

ARBOGA, an ancient town in Sweden, in the government of Westerås, 30 miles S.W. of Westerås, on a river of the same name as itself, near its junction with the canal which joins the Malar and Hielmar Lakes. It was formerly a place of great trade, and contained five churches, three monasteries, and four chapels; but, though there is still some traffic in woollen, iron, and wooden wares, its prosperity has greatly decreased. It is well known as the seat of several important assemblies; particularly the parliaments of 1434, 1440, and 1471; and that of 1561, when the estates accepted the "Arboga articles," by which Eric XIV. restrained the power of his brothers. The town gives its name to the coinage of 1625 and 1627, which consisted of *klippingar*, or square copper pieces, and *fyrkar*, or farthings. In the neighbourhood there are mineral springs. Population, 3269.

ARBOIS, a town in France, lat. 46° 54′ N., long. 5° 47′ E., in the department of Jura, and arrondissement of Poligny, situated in a deep valley, on the Cuisance, 940 feet above the level of the sea. It has long been famous for its wines, which as early as 1493 were exempted from taxation in Burgundy and the German empire by Maximilian I. The rest of its trade consists in brandy, oil, fruits and flowers, grain, cattle, saltpetre, leather, cheese, earthenware, and paper. It was the seat of a commandery of the knights of Malta, had two monasteries and three nunneries, and still possesses a college and the ruins of a castle. The church of St Just is famous for its magnificent carvings in wood. Population, from 6000 to 7000.

ARBOR VITÆ (*Tree of Life*), is a name applied to species of Thuja and Biota. The name was given by Clusius, and its origin is uncertain. The plants belong to the Coniferous order, and have been placed in the tribe Abietineæ and the sub-tribe Cupressineæ (Cypresses), in which the anthers are 3 to 5, rarely 2; scales of the cones 4 or more, usually placed opposite to each other in a decussate manner, persistent (not falling off), seeds having usually 2 to 3 wings; cotyledons 2. *Thuja* or *Thuya occidentalis* (L.), is the Western or American Arbor Vitæ. The name Thuja seems to be derived from the Greek word θύος, signifying sacrifice, probably because the resin procured from the plant was used as incense. The plant is the *Cupressus Arbor Vitæ* of old authors. It is a native of North America, and ranges from Canada to the mountains of Virginia and Carolina. It is a moderate sized tree, and was introduced into Britain in 1596. In its native country it attains a height of about 50 feet. The leaves are small and imbricate, and are borne on flattened branches, which are apt to be mistaken for the leaves. When bruised the leaves give out an aromatic odour. The resin obtained from the plant has been used as a remedy in rheumatic affections. The flowers appear early in spring, and the fruit is ripened about the end of September. In Britain the plant is a hardy evergreen, and can only be looked upon as a large shrub or low tree. It does not furnish timber of good size. It is often cut so as to form hedges in gardens. The wood has been used for posts. Another species of Arbor Vitæ is the *Thuja orientalis* (Linn.), *Biota orientalis* (Endlicher). The latter generic name is derived from the Greek adjective *βιωτός*, formed from *βίος*, life, probably in connection with the name "tree of life." This is the Eastern or Chinese Arbor Vitæ. It is a native of Japan and China. It was introduced into France in the reign of Francis I. It has roundish cones, with numerous scales and wingless seeds. The leaves, which have a pungent aromatic odour, are said to yield a yellow dye. There are numerous varieties of this plant in cultivation, one of the most remarkable of which is the *Cupressus pendula* of Thunberg. (J. H. B.)

ARBORICULTURE

ARBORICULTURE comprises all that relates to the culture of trees, and is one of the great divisions of agriculture; it is a branch of rural economy of much more recent date than either the culture of grain and herbage plants, or the breeding and rearing of cattle. The culture of those plants which supply the food of man or nourish the domestic animals must have exclusively occupied his attention for many ages; whilst the timber employed in houses, ships, and machines, or for fuel, was found in the native woods. Hence, though the culture of fruit-trees, and occasionally of ornamental trees and shrubs, was practised by the Egyptians, Greeks, and Romans, the cultivation of timber-trees on a large scale only took place in modern times. In the days of Charlemagne, the greater part of France and Germany was covered with immense forests; and one of the benefits conferred on France by that prince was the rooting up of portions of these forests throughout the country, and substituting orchards or vineyards. Artificial plantations appear to have been formed in Germany sooner than in any other country, apparently as early as the 15th century. In Britain planting was begun, though sparingly, a century later. After the extensive transfers of property on the seizure of the church lands by Henry VIII., much timber was sold by the new owners, and the quantity thus thrown into the market so lowered its price, as Hollingshed informs us, that the builders of cottages, who had formerly employed willow and other cheap and common woods, now built them of the best oak. The demand for timber constantly increased, and the need of an extended surface of arable land arising at the same time, the natural forests became greatly circumscribed, till at last timber began to be imported, and the proprietors of land to think, first of protecting their native woods, afterwards of enclosing waste ground, and allowing it to become covered with self-sown seedlings, and ultimately of sowing acorns and mast in such enclosures, or of filling them with young plants collected in the woods,—a practice which exists in Sussex and other parts of England even now. Planting, however, was not general in England till the beginning of the 17th century, when the introduction of trees was facilitated by the interchange of plants by means of Botanic Gardens, which, in that century, were first established in different countries. Evelyn's *Sylva*, the first edition of which appeared in 1664, rendered an extremely important service to Arboriculture; and there is no doubt that the ornamental plantations, in which England surpasses all other countries, are in some measure the result of his enthusiasm. In consequence of a scarcity of timber for naval purposes, and the increased expense during the war of obtaining supplies from other countries, planting received a great stimulus in Britain in the early part of this century. Since the peace of 1815 the rage for planting with a view to profit has subsided; but there is a growing taste for the introduction of trees and shrubs from foreign countries, and for their cultivation for ornament and use. The profusion of trees and shrubs planted around suburban villas and country mansions, as well as in town squares and public parks, shows how much arboriculture is an object of pleasure to the people. The progress of the Arboricultural Society of Scotland, founded in 1854, and now containing 600 members, is a further indication of the national taste. Again, it may be remarked, that while isolated trees and old hedgerows are disappearing before steam cultivation, the advantages of shelter from well-arranged plantations are more fully appreciated; and more attention is paid to the principles of forest conservancy both at home and abroad. In all thickly peopled countries the forests have long ceased to supply the necessities of the inhabitants by natural reproduction; and it has become needful to form plantations either by Government or by private enterprise, for the growth of timber, and in some cases for climatic amelioration. In British dependencies the Government of India have acted with greatest vigour, having formed a State Forest Department, one object of which is the culture of the most valuable timber trees, as the teak in Malabar, Central Provinces, and Burmah, the Deodar in the Himalayan valleys, and Babool (*Acacia arabica*), &c., which covers large tracts both in South and North India, for the supply of railway fuel. The successful growth of Australian acacias and gum trees on the Nilgiri hills, mahogany in Bengal, and the spread of the cinchona cultivation on various mountain ranges, testify to the energy and skill with which the culture of exotic trees is carried on in British India. Before giving a sketch of the present practice of arboriculture, it is necessary to premise that this article is confined to well-known and hardy British trees, to a few valuable foreign species, and to plantations made with a view to timber produce.

General View of the Trees cultivated in Britain.—Trees differ from one another in regard to magnitude; slowness or rapidity of growth; suitableness for particular soils, and for elevated exposed situations, or low and sheltered places; texture, colour, and durability of the timber; delicacy or hardiness; ease or difficulty of propagation and rearing; production of showy flowers or fruits; and in other respects. In regard to magnitude, those trees which, in Britain, and in the same parallels of north latitude attain the greatest height, are the spruce and silver fir, the larch, and Scotch pine; and these also are the trees which, in most parts of Britain, produce the greatest quantity of timber in their trunks relatively to that contained in their branches, and in the shortest time. Poplars, willows, and some species of elm, are rapid-growing trees; their timber is rarely contained in one straight trunk, as in the case of pines, a considerable portion being distributed among the branches. Hence, where the speedy production of timber is the main object, pines are the preferable trees for planting. Where landscape effect is more desired than the production of timber, some of the poplars and elms, the Huntingdon willow, in some situations the birch, and in others, such as on the sea-shore, the sycamore and tamarisk, are suitable trees. Where the object is to clothe a sterile surface of dry sand, the birch, Scotch, Austrian, and cluster pines are among the best trees we have; and if the situation be exposed to the sea-breeze, the common and the Norway maple may be substituted; in the warmer parts of the island, the evergreen oak (*Quercus Ilex*); and for the marshes of the warmer parts, *Taxodium distichum* or deciduous cypress. For moist soils which cannot be drained, the white, trembling, and Ontario poplars have the property of sending their roots along the surface of the ground. Some species of willow and some poplars will grow near water in situations where their roots can enter into it, but will not grow in undrained soil. All the known species of trees and shrubs may be successfully grown in almost any kind of soil not beyond average moisture, dryness, or tenacity. In some soils, however, they thrive better than in others, and the timber produced generally varies in quality according to the soil. Thus, a rich soil, while it contributes to the rapid growth of the coniferous tribe, renders their timber less durable; and the same law holds, more or less, with every other species of tree.

The influence of climate on trees is much greater than that of soil; for, whilst many trees grow on any soil, every tree may be said to have its particular climate; that is, a climate in which, the soil and other circumstances being suitable, it will produce the largest and most enduring timber. Hence, when we take the geographical range of any species, we find what may be called a central climate, where it attains its largest size; and as it recedes from this climate, by latitude or elevation, into one either colder or hotter, it gradually diminishes in size, till it at last appears in the form of a shrub. Thus the common oak, which in Britain attains its largest size in Sussex and Hampshire, dwindles into a shrub on the mountains of Scotland and in the north of Africa; its degeneracy being occasioned in the one case by extreme cold, and in the other by extreme heat. Even within Britain the absolute character of trees, relatively to climate, is obvious. The English or narrow-leaved elm, supposed to be a native of Asia Minor and of China, attains a large size near London, producing a great bulk of timber in a short period, and ripening its seeds; while in Scotland it is considered only an ornamental tree. The Lombardy poplar, which in the central counties of England attains 125 feet in height in fifty years, is seldom seen of timber size in Scotland. The sweet chestnut and walnut, cultivated both for fruit and timber in many parts of England, can rarely be grown with profit for either purpose north of Newcastle.

Climate may be considered in regard to the average yearly and monthly temperature, and the degree of atmospheric moisture. A high annual temperature is no proof that a climate is suitable for trees; but a high summer temperature is suitable for many kinds, though the winter temperature may be very low. Thus the oaks and other trees of North America, attaining there a prodigious size, survive a winter as cold as that of St Petersburg, where no native oaks are found; but North America enjoys a very high temperature during summer, which rapidly develops the foliage, and matures the young shoots, enabling them to withstand the most rigorous winter. The much larger rainfall of that portion of America, as compared with St Petersburg, has doubtless important bearings on the question. In England the average temperature of the year is as great as that of the oak countries of the United States; but summers in the former country are comparatively cold, moist, and more cloudy; and though its winters are much milder than those of the latter, the spongy, unripened, young shoots are always more or less injured by frost. Again, in a mild climate, the trees of those countries which have a severe winter come into leaf earlier in the spring than the indigenous trees, and frosts often occurring at that season, they are liable to injury.

Evergreen trees form an important division of the vegetable kingdom; and of these there are two classes, distinct relatively to climate and temperature. The first comprises the conifers, which endure a degree of cold as great as that in which any deciduous tree thrives; and the second, the broad-leaved evergreen trees, such as the holly, box, laurustinus, laurel, evergreen oak, cork-tree, and the evergreen magnolia, trees of comparatively mild climates, and always indigenous on islands or on continents at low elevations, and at no great distance from the sea: hence the large number of evergreen trees which grow well in Britain, compared with those which survive the winter in the same latitude on the Continent.

A small proportion only of the trees cultivated in Britain are indigenous. Some are natives of other parts of Europe, and about two-thirds of the whole are from North America. Of these North American trees there are scarcely any worth cultivating in Britain for their timber, the summer not being sufficiently hot and light to bring the timber to maturity. The most useful trees of Britain are those which are indigenous, such as the oak, ash, broad-leaved elm, Scotch pine, &c.; or those found in the same hemisphere and in the same parallels of latitude, such as the larch, spruce, silver fir, &c. Of all trees cultivated in Europe, the most valued for the strength and durability of its timber is the common oak; and next perhaps to it, the larch. The trunk of the oak, when freed from the soft or outer wood, and thoroughly seasoned by exposure to the air, will last an unknown period of time in buildings and machines. The common European oak is more durable as timber than any of the American oaks, even when grown in America, unless we except the live oak (*Quercus virens*); and no timber equals it for ship-building, except the teak of India. The most generally useful timber grown in Britain is the Scotch fir; but as this is imported from the north of Europe, and a substitute for it from North America, it is not planted in Britain so extensively as it otherwise would be. The timber of the larch is more durable than that of the Scotch fir; but being apt to warp, and not so easily worked, it is less convenient for house-carpentry and joinery. The timber of the common ash is valuable in the construction of agricultural instruments and machines, and it is one of the few woods which are almost as valuable when young as when mature. The wood of the broad-leaved elm is strong and durable, but that of the English and Dutch elms is less so. The wood of the poplar and of the willow, when exposed to constant atmospheric changes, speedily decays; but when thoroughly seasoned, and kept perfectly dry, it is very durable.

Trees suited for Particular Purposes.

1. Conifers or resinous trees; 2. Hard-wood trees; and 3. Soft-wood trees.

1. *Conifers.*

Coniferous trees are characterised by straight erect trunks, with branches in regular tiers, which do not acquire the size of timber. They never send up shoots from the stool when cut over at the ground. The leaves are generally linear or needle-shaped, without veins, and evergreen. The seeds are produced in cones, and the whole plant is more or less resinous. They belong to the Gymnosperms, a family of the Dicotyledons.

The Larch (*Larix europæa*, D.C.) produces the most valuable timber, which is of great durability. Young larches, 6 or 8 feet high, are useful for sheep stakes, rustic palings, or dead fences. Young trees from 10 to 15 feet in height are found to form excellent hop-poles.[1] The

[1] For the durability of the mature timber, both in civil and naval architecture, we may refer to the *Transactions of the Highland Society of Scotland*, vol. xi. p. 165, and Loudon's *Arboretum Britannicum*, vol. iv. p. 2357.

bark of the larch is of considerable value in tanning; and as the leaves are deciduous, grass grows better under its shade than under any other species of pine. The larch is readily increased by seeds, which ripen abundantly in Britain; it prospers best in cool argillaceous soil, moist rather than dry, and at a considerable elevation above the sea. In certain soils, it is subject to decay of the heart-wood; and of recent years disease has seriously affected many of the finest plantations in this country, especially those beyond the age of fifty years. The larch is indigenous in the alpine region of Central Europe, and is a striking example of the successful introduction of an exotic, having been completely naturalised in Scotland for more than a century. Other species of *Larix*, natives of Siberia and North America, are inferior as forest trees.

The Scotch Pine (*Pinus sylvestris*, L.) is, next to the larch, the most valuable coniferous tree grown in Britain. It furnishes the yellow deal of the Baltic and Norway, which is unequalled by any other pine in Europe or North America. The best grown in Britain is produced in the native Highland forests; but there is reason to believe that artificial plantations, in similar soils and situations, would produce timber of nearly equal value. This tree is readily increased from seeds, which, unfortunately, are produced in the greatest abundance on stunted or inferior trees. It is very desirable to select seeds from the best varieties, as is now systematically done by nurserymen. The Highland variety with horizontal branches is that of highest repute. The Scotch fir is a native of Europe and Asia, but not of America.

The Cluster Pine (*Pinus Pinaster*, Sol.) is not adapted for general culture in Britain, and therefore scarcely merits to be ranked among British timber-trees. In some parts of the east coast of England, however, plantations of this tree have been raised; and in deep sandy soil it produces a considerable bulk of timber in a short time, thriving better when exposed to the sea-breeze than any other pine. The wood is not so durable as that of the Scotch pine; but it may be employed in the joinery of ordinary apartments. In general, however, it is not sufficiently strong for the roofing, joists, and other carpentry of dwelling-houses. In France, and particularly in the neighbourhood of Bordeaux, it is extensively grown on the sandy wastes, for the production of resin, tar, and pitch, which are obtained by incisions made in the trunk, and by subjecting the wood to the action of fire. The seeds are ripened in England. The young plants require more care in transplanting than those of most other pines, being furnished with a stronger tap-root. The cluster pine is a native of the south of Europe and Algeria.

The Spruce Fir (*Abies excelsa*, D.C.) is, as a British timber-tree, next in value to the Scotch pine. The young plants and the spray are durable; and the trunk grows straighter, more erect and slender, than the larch. The trunk is seldom sawn into boards; the great value of the tree being for poles of every kind, from those fit for the hop up to masts for smaller ships. It is often used with the bark on, for poles or fence-wood. In most parts of Europe, the poles used in the scaffolding employed in erecting buildings are formed of this tree, the wood being light and elastic. The spruce fir ripens seeds abundantly in Britain, from which plants are as easily raised as the Scotch pine and the larch. It prefers a rather moist soil, and only attains a great height in sheltered situations; but it grows anywhere to a size fit for hop-poles or fencing in a short time. Like the Scotch pine, it is subject to few diseases. The spruce is a native of Germany, Sweden, Russia, and Norway, but not of Britain or of North America.

The Silver Fir (*Abies pectinata*, D.C.) the largest of the European conifers, in various soils and situations produces a great bulk of timber in a comparatively short period; the timber is considered less strong and durable than that of the spruce fir or the Scotch pine, but it does not warp, and is adapted for all kinds of carpentry. The timber is white, and when not exposed makes excellent flooring. The tree is of slow growth for the first ten or twelve years; nevertheless, even in the north of Scotland it attains the height of 100 feet in sixty or seventy years. It ripens seeds in Britain, but more sparingly than the spruce fir, and plants are easily raised. It is in general healthy, but its cultivation is more difficult than that of the spruce, as the shoots of young trees are liable to be killed by frost. This species is also very subject to the attacks of an insect, *Eriosoma*, which often causes the death of the tree. The silver fir is a native of Central Germany, and of the mountains of Italy and Spain. Nearly allied is the *Abies balsamea*, balm of Gilead fir, a native of North America, which produces the Canada balsam, but it cannot be recommended for cultivation, as it is short lived.

Many conifers might be mentioned which, though not producing timber in Britain, are worthy of cultivation. Of the American pines we have the *Pinus Strobus*, L., Weymouth pine, which furnishes the white wood of American commerce. Several Californian pines have been introduced; of these *Abies Douglasii* is the most promising. *Cupressus Lawsoniana* is a beautiful tree, and also *Sequoia gigantea*, the mammoth tree, a general favourite in pleasure grounds, but a considerable period must elapse before we can judge of their being adapted for general culture as timber trees in this country. Of Asiatic conifers, *Cedrus Deodara* and *Libani* are much grown for ornament. *Pinus excelsa*, which resembles the Weymouth pine, and *Abies Smithiana* and *Webbiana* grow fairly in many parts of Britain; the Smithian pine being apparently the best adapted to the climate.

The Yew Tree (*Taxus baccata*, L.) attains its full perfection in this its native country; but on account of its slow growth it cannot be recommended to the planter, whose main object is profit.

Broad-leaved Trees (*bois feuillus*) in contradistinction to needle-leaved, are classed, according to their timber, in two subdivisions, hard and soft wood trees. They are characterised by large trunks and widely spreading woody branches, and broad leaves with branching veins; they send up shoots from the stool when cut over by the ground; and they are deciduous. They belong to the Dicotyledons.

2. *Hard-wood Trees.*

The hard-wood Timber-trees of Great Britain are characterised by the comparative hardness and durability of their wood, and comprise the oak, ash, elm, beech, sweet chestnut, walnut, and *Robinia* or false acacia. The British oak includes two sub-species, the stalked fruited or most common oak, *Quercus pedunculata*, and the stalkless fruited or less common oak, *Quercus sessiliflora*. The latter grows more erect and more rapidly than the other, particularly if the soil be good. In England and the lowlands of Scotland, *Q. pedunculata* is the commoner of the two oaks; but in North Wales and the hill parts of northern England, *Q. sessiliflora* is more frequent. Intermediate forms between these two oaks are found in England and elsewhere, and the leading botanists of the day unite them under the old name of *Q. Robur*. The wood of the oak is the strongest and most durable of all British timber-trees; but on account of the slowness of its growth it is not always the most eligible for planting. Oak plantations are more valuable than others when in a young state, on account of their bark. From the demand for oak as ship-timber, the price of trees fit for that purpose is always considerable; but the largest trunks employed in naval architecture do not afford an adequate return for the number of years they have stood on the ground. Accordingly, we find that the Governments both of France and England grow this description of timber largely in national forests. The wood of the oak is applicable to a greater number of uses than that of most other trees. Houses, ships, furniture, and machines may be formed almost entirely of oak, and consequently there is a ready sale for this timber almost everywhere. Hence there is more inducement to plant it in Britain than any other hard-wood tree. It is easily raised from acorns, which ought to be collected from the most vigorous trees. The British oak is a native of most parts of Europe, but not of Asia, Africa, or America.

The Ash (*Fraxinus excelsior*, L.) is in Britain next in value to the oak as a timber-tree. It requires a good deep loam with gravelly subsoil, and a situation naturally sheltered, such as the steep banks of glens, rivers, or lakes; in cold and wet clay it does not succeed. As the value of the timber depends chiefly on its toughness and elasticity, it is best grown in masses where the soil is good; the trunk is thus drawn up free from large side-branches. The tree is a native of Central Europe, and is easily propagated from seeds. It throws up strong root shoots. The ash requires much light, but grows rapidly, and its terminal shoots pierce easily through thickets of beech, with which it is often associated. Unmixed ash plantations are seldom satisfactory, because the foliage does not sufficiently cover the ground; but when mixed with beech it grows well, and attains great height and girth. Coppice shoots yield excellent hop-poles, crates, hoops, whip-handles, &c. The timber is much used for agricultural implements, and by coach-builders and wheelwrights. The supply of this valuable timber is annually becoming more limited on account of the decreasing use of hedgerow trees.

Of the Elm there are two species, the common or narrow-leaved elm (*Ulmus campestris*, L.), and the Wych or broad-leaved elm (*Ulmus montana*, L.) There are many varieties, such as the Dutch elm and the smooth-leaved or Huntingdon elm, the latter much valued for its timber. The narrow-leaved elm is not very common in Scotland, but in the central districts of England it becomes a handsome tree; and the timber is used for important purposes in ship-building, as well as in the construction of machines and agricultural buildings. The Wych elm is a hardy tree, of rapid growth; but, unless planted in masses, it seldom produces a straight handsome trunk. It strikes from layers with great facility, and when a branch touches the ground it is sure to take root. Few trees are more difficult to uproot than *Ulmus montana*, and it is rare to see it thrown over by the wind. It has a wide-spreading head, often sloping to one side, and lashing its neighbours with such force that it is sometimes interdicted in mixed plantations. Its timber is more durable than that of the English elm, or of any of the hybrids. It is much used in agricultural carpentry, in rural machinery, and in household furniture. The Wych elm produces abundance of seeds, which, if sown as soon as they are gathered, often come up the same year; but the English elm and the hybrids produce seeds sparingly, and are usually propagated by layers or by grafting on the Wych elm. One remarkable difference between the English and Wych elms may be noticed, viz., that the latter never throws up suckers from its roots; and it is therefore peculiarly valuable as a stock for the English elm, and for those varieties which do throw up suckers. There are other species and varieties of European elms, and several kinds of American elms, but none are deserving of culture in Britain as timber-trees. The elm is subject to the ravages of several insects, especially *Scolytus destructor*.

The Beech (*Fagus sylvatica*, L.) is one of the largest British trees, particularly on chalky or sandy soils. It is a handsome tree in every stage of its growth, but is more injurious to plants under its drip than other trees, so that shade-bearing trees, as holly, yew, and thuja, suffer. Its leaves, however, enrich the soil. In England and America the beech has a remarkable power of holding the ground where the soil is congenial, and the deep shade prevents the growth of other trees. It is often and most usefully mixed with oak and Scotch fir. The timber is not remarkable either for strength or durability. It was formerly much used in mill-work and turnery; but its principal use at present is in the manufacture of chairs, bedsteads, and a variety of minor articles. It is a native of the south of England, and of various parts of the continent of Europe. There are some varieties, particularly the purple and weeping beech; and there are one or two species natives of North America, but none of them deserve notice as timber-trees. It is propagated by its mast, which is produced plentifully in fine seasons.

The Hornbeam (*Carpinus Betulus*, L.) is an indigenous, moderate-sized, slow-growing tree, bearing a general resemblance to the beech, though of less value. It coppices well, and along with beech is valued for making hedges, as these trees retain their leaves a great part of the winter. The hornbeam is propagated by its nuts, which are produced in abundance. The wood is used for tool-handles, cog-wheels, and screws. Selby (*British Forest Trees*) recommends the use of the hornbeam as a nurse-tree.

The Sweet Chestnut (*Castanea vulgaris*, Lam.) is a large, long-lived, deciduous tree, of rapid growth while young, and attaining a vast size in South Europe (*e.g.*, the renowned chestnut of Mount Etna). It was early introduced to England, and is one of its most ornamental trees. The timber bears a striking resemblance to that of the oak, which has been mistaken for chestnut; but it may be distinguished by the numerous fine medullary rays. Unlike oak, the wood is more valuable while young than old. When not more than fifty years old it forms durable posts for fences and gates; but at that age it often begins to deteriorate, having ring-shakes and central hollows. In a young state, when the stems are not above 2 inches in diameter at the ground, the chestnut is found to make durable hoops for casks and props for vines; and of a larger size it makes good hop-poles. It is a native of Asia, North Africa, and North America. In Spain and Italy it is grown for its fruit, in Britain, for ornament. In the south of England in warm seasons it ripens its fruit, from which plants are easily raised. None of the other Continental or American species are cultivated in Britain for their timber.

The Common Sycamore or false plane (*Acer Pseudo-Platanus*, L.), the plane-tree of Scotland, is a large tree naturalised in Britain, though seldom attaining the height of those already mentioned. It withstands the sea and mountain breezes better than most other timber trees, and is often planted near farm-houses and cottages in exposed localities for the sake of its dense foliage. Its wood is valued in turnery, for cups, bowls, and pattern blocks. It produces abundance of seeds, and is easily raised, but it requires good and tolerably dry soil; it will not thrive on stiff clays nor on dry sands or chalks. The Norway maple (*A. platanoides*, L.) is a hardy tree, used as a breakwind in exposed situations on the east coast; but neither it nor the other species from Europe or America seems to deserve cultivation for the sake of its timber. The sugar maple (*A. saccharinum*, L.) forms extensive forests in North America. It has been introduced into Britain for a century, but is rather tender, and requires a dry sheltered situation. It is propagated by imported seeds, and it is doubtful if it can be profitably cultivated in this country.

The Common Birch (*Betula alba*, L.) is a tree of the second rank, worthy of culture in inferior soils and situations, especially as coppice-wood. The spray, in some parts of the country, is sold to the besom-maker, and gives a fair return. The tree seeds freely, and is easy of management. It is often planted in poor soil as a nurse for oak and sweet chestnut. It yields excellent fuel. The wood is used for carving, furniture, and agricultural implements, and in the Highlands of Scotland and Sweden for building material. The bark, covered with a layer of earth, is used in roofing, and baskets and boxes are made of it. The weeping birch forms one of the most beautiful features in Highland scenery. None of the American or Himalayan birches have yet been planted with a view to profit as timber-trees, though cultivated for many years.

The COMMON WALNUT (*Juglans regia*, L.), is mentioned in the earliest British botanical writings, and is supposed to have been introduced by the Romans. It grows well, and ripens its fruit in the southern and midland counties of England; but large trees may be seen as far north as Ross-shire in sheltered places. The fruit is in some years plentiful, but ripens only in the hottest summers. The timber is excellent, and held the first place for the manufacture of furniture till the introduction of mahogany, and on this account the tree merits more attention. It is raised from the nuts, like horse chestnuts; the seedlings should be protected from frost during the first winter. The rate of growth is not rapid, and a deep soil is essential to success. If cultivated for the fruit, the seedlings should be transplanted once or twice.

The ROBINIA or false acacia (*Robinia Pseud-Acacia*, L.) is a tree of unquestionable beauty, and much has been written of the value of its timber. It was introduced from North America in the 17th century, and has been extensively cultivated as an ornamental tree. In 1825 Cobbett strongly recommended the planting of it for its timber. It has been used largely in England for hop-poles, and in France for vine-props. In America it is much used for trenails or wooden pins for bolting ship timbers. It is now planted sparingly, the English summer not being sufficiently long and warm to ripen the shoots. The tree is readily produced from imported seeds, and occasionally from suckers, which are abundant. It should be planted in sheltered situations in dry friable loam. It grows rapidly the first few years, but the trunk in Britain rarely exceeds 1 foot in diameter.

Amongst hard-wooded trees of the third rank, the timber of which is useful, are *Cerasus sylvestris*, the wild cherry or gean; *Cratægus Oxyacantha*, white thorn; *Pyrus aucuparia*, mountain ash or rowan; *P. Aria*, white beam tree; *P. Malus*, crab-tree; *P. communis*, wild pear; *Ilex Aquifolium*, holly; and *Cytisus Laburnum*, laburnum. A plantation formed solely of any of these trees is not to be recommended, but when they are self-sown or introduced by way of variety or ornament, it is well to know that their timber is of some value; the laburnum, yew, and holly are the most valuable of the trees of the third rank.

3. *Soft-wood Trees.*

The soft-wood trees are remarkable for the rapidity of their growth, the lightness and whiteness of the wood, and often for their early decay. Among those worthy of cultivation in Britain for timber, are the poplar, willow, alder, lime, and horse chestnut; the two first being those that are generally recommended with a view to profit.

Of the POPLAR (*Populus*, L.) there are numerous species, and several deserve culture for their timber in situations where the soil is good and deep, and where the roots can reach running water; but they do not thrive in stagnant marshes. The following are the best adapted to our climate:—*P. alba*, abele or white poplar, is widely distributed over Europe, and is extensively cultivated in Britain. *P. canescens*, the grey poplar, is classed by Hooker as a sub-species. These trees attain a large size, giving long clean, straight timber, which induces planters to grow it, especially near factories, where the wood is used for flooring, machinery, &c., as it does not easily ignite. The timber is soft, white, and light. The root throws up strong suckers, which always replace trees cut down. *P. tremula*, the aspen, produces a white wood, which is much sought after for the manufacture of paper, and on that account it is rising in value. *P. nigra*, the black or Lombardy poplar, is much planted on the Continent in hedgerows, and also in Kashmir—where the pyramidal variety is common. The wood, which is white, soft, and light, is used for sabots, but is not good for fuel. The bark is used by the tanner. The black Italian poplar (*P. monilifera*) is always propagated by cuttings of the young wood. It pollards well, and is a rapid grower. Poplars should not have large branches pruned off, and they do not coppice well, because moisture enters cracks in their wood.

The WILLOW (*Salix*, L.) is an extensive genus, found in Europe, Asia, and North America, including all the shrubby osier species used for basket-work, as well as a few trees. The arborescent willows are most useful trees, and well merit the attention of planters. They are invaluable for fixing the banks of rivers and canals, and are successfully used for that purpose. As coppice woods with short rotation, they are grown in osier beds, and cut annually for basket-work, or when three or four years old, for hoops, &c., and in this way they yield a good return. The laying down and treatment of osier beds may be seen in great perfection on the banks of the Thames. The wood is used for carving and other purposes. In North America, fishing nets and lines are made of the inner bark. All the species are easily propagated by cuttings, and require to be grown in damp soil. There are three species attaining the size of trees—*S. alba*, the white or Huntingdon willow, reaches a larger size in twenty or thirty years than any other British tree except *Populus alba*, and often yields 1 foot of solid timber for every year of growth. *S. caprea*, the goat willow or sallow, occurs generally as a large shrub, but attains 40 or 50 feet in height. It forms a good protection in maritime situations, but often by its exuberant growth injures more valuable trees. The third tree is *S. fragilis*, the crack willow, and its sub-species *S. Russelliana*, the Bedford willow. Another tree willow, *S. babylonica*, or weeping willow, a native of Russia and China, is very ornamental on islands and river banks. The larvæ of several nocturnal Lepidoptera feed upon the leaves of the willows, and the trunk of the sallow is often injured by the perforations of the *Trochilium crabroniforme* (Lunar Hornet Sphinx).

The ALDER (*Alnus glutinosa*, D.C.) is an indigenous tree met with commonly on the banks of streams, but of smaller size than the poplars and tree willows; it often, however, attains to 40 or 50 feet. It is readily propagated by seeds, but throws up root suckers abundantly. The alder is important as coppice-wood on marshy ground. The wood is soft, white when first cut, and turning to pale red; the knots are beautifully mottled. It is adapted for piles in embankments and bridges; and charcoal of alderwood is valued in the manufacture of gunpowder.

The LIME TREE (*Tilia europæa*, L.), is a beautiful leafy tree with wing-like bracts, much prized for ornament, and suitable for avenues. It is much planted along streets and promenades, affording a pleasant shade during summer; the blossoms are fragrant, and yield most delicate honey. The lime is generally propagated by layers. Its wood, which is very light and soft, is used by saddlers, shoemakers, glovers, and toy-makers; and for carving and modelling purposes, it is superior to all other British trees. Several American lime trees have been introduced, and appear well deserving of a place in our arboricultural collections.

The Common Horse Chestnut (*Æsculus Hippocastanum*, L.), cultivated in Europe since the 16th century, is an ornamental tree of quick growth in good soil. Its handsome blossom surpasses that of all other British trees, and its massive foliage is effective, but the timber is of an inferior quality, only used for boarding and packing-cases, linings of carts, and wheel-barrows. It is rarely planted in mixed plantations where profit is an object; it interferes with its neighbours, and occupies too much room. It is generally introduced near mansion-houses for ornament and shade, and the celebrated avenues at Richmond and Bushy Park are at the time of flowering objects of great beauty. From the crop of nuts which ripen in October seedlings are easily raised, and should be placed in rich loam, and transplanted before being finally planted out.

Roadside Trees and Hedges.

Little attention is paid to the planting of trees along roadsides, and in such situations healthy or well-shaped ones are seldom seen. A pit should be made of sufficient size (2 to 3 feet square), and filled with good soil mixed with rotten dung. The plants require to be fenced, and for the first summer occasionally watered, and the earth dug and kept clear of weeds. In forming avenues on boulevards, the trees should be planted 30 feet apart, and if space allows of it, there should be a double row to form a shady arch for pedestrians. The oversight of these is sometimes given to the surfaceman, or to a man appointed for the purpose, and it should be his duty to maintain the avenues complete. Trees, especially in or near large towns, are subject to injuries which disfigure their appearance or retard their growth, and not unfrequently destroy the plants. To prevent this it is customary to surround the stem with a cradle, or matting, or thorny branches.

Hedge-plants are of great importance both for shelter and protection of plantations. By far the best for outside hedges are the common hawthorn and the wild crab. The sloe or black thorn makes an excellent hedge; but it throws up many suckers, and requires constant attention to keep it within bounds. It forms, however, an excellent barrier for picturesque plantations, where it is allowed to spread itself in every direction. Holly and yew hedges are suitable for inner enclosures. The holly forms an excellent hedge, both for gardens and fields, as its leaves are rarely injured by insects; and, being an evergreen, it harbours neither weeds nor vermin at its roots. Birds are also much less apt to build in it than in deciduous hedges. It has two disadvantages, viz., the slowness of its growth, and imperviousness to wind in the winter season. Were holly hedges occasionally introduced among those of the common thorn, they would add greatly to the beauty of the country in winter. The common furze sown on the top of a bank forms an effective hedge in a short period, but it is not durable. In moist soils, willows or poplars, and in situations exposed to the sea-breeze the elder, may be planted; but such hedges can be hardly considered as fences from want of compactness and density of foliage. The land for hedges should be carefully prepared and freed from weeds before planting, and the expense of doing this will be well repaid by the growth of the hedge afterwards. The ground should be cleared of weeds two or three times a year until the plants have reached some height. Hedge plants should not be pruned till after three years, or they will become stunted; after that pruning should take place once a year. A hedge one-third beech and two-thirds hawthorn is excellent for high and cold situations.

Coppice.

Coppice or Copse consists of self-sown or planted trees periodically cut before they attain the size of timber. This system of wood cropping was more extensively adopted thirty years ago than it is now, as the value of oak bark is much reduced owing to the introduction of foreign bark and other substances for tanning. One requisite for copse woods is that they should spring up freely from the cut root. Most of the broad-leaved trees and shrubs may be cultivated as coppice wood; in soft, wet soils, birch, alder, and various willows are amongst the most useful trees, and in drier soils the oak, chestnut, and ash are valuable for this mode of cultivation.

Ornamental Trees and Shrubs.

As already observed, we exclude from consideration in this article flowering and fruit-bearing trees and shrubs. We also exclude all those that require special protection, and confine ourselves to trees and shrubs considered ornamental from their general form, and suited for introduction into plantations in most parts of Britain. These are arranged under the heads of evergreen and deciduous.

Evergreen Ornamental Trees and Shrubs.—The climate of Britain enables us to cultivate many evergreens; new species are imported, and varieties are produced by accident or experiment, so that the number is always increasing. All the pine tribe may be described as highly ornamental, and many of them endure the open air in the coldest parts of Britain. The Deodar (*Cedrus Deodara*) naturally grows in compact forests, clearing itself of side branches like the larch; in this country single specimens have been extensively planted of late years for ornament. Large quantities of seeds are annually imported from the Himalaya, and it is also raised from cuttings. The Lebanon and Atlas cedars (*Cedrus Libani* and *atlantica*) are closely allied to the Deodar; and it is proved by Hooker that they cannot be separated by constant specific characters. The Atlas cedar is distinguished by a stiff erect leader, and the foliage is generally dark, that of the Deodar being light or bluish green. *Cryptomeria japonica*, the Japan cedar, is a beautiful evergreen tree, attaining 100 feet in height, with a pyramidal head; it yields cones abundantly. *Sequoia gigantea*, the Wellingtonia or mammoth tree, remarkable as the loftiest tree known, attains 300 to 330 feet in height, and 80 to 100 feet in girth, and is a handsome and symmetrical tree. *S. sempervirens*, the redwood of California, is another giant tree, though of smaller size. Both species are hardy in England, and are easily raised from cuttings.[1] The Weymouth pine (*Pinus Strobus*) is a hardy ornamental tree, introduced in 1705, suited for cold situations; and still more so is the *Pinus Cembra*, which is of slow and erect growth and long retains the beauty of youth. *Pinus excelsa* is a hardy and ornamental species, from the Himalaya; but when exposed to wind it does not thrive. It is inclined to seed rather too early and freely in this country. Some of the Californian and British Columbian pines are hardy and ornamental, particularly *P. ponderosa*, the heavy-wooded pine; but it is easily blown over by the wind. Other species are *P. Sabiniana*, *insops*, and *Murrayana*. The Douglas fir (*Abies Douglasii*, Lindl.) is a handsome tree, as hardy as the common spruce, differing in the dark green colour, and apparently intermediate between the common spruce and the silver fir. It was introduced in 1827, and is of very rapid growth in England and Scotland. At Dropmore there is a tree which, at the age of 44 years, was 100 ft. high, with 9 ft. 7 in. girth at 3 feet above the ground. Many specimens in Perthshire raised from layers and cuttings since 1846, are 50 to 70 feet high. The

[1] An interesting paper "On the *Wellingtonia gigantea*," containing a table of the growth of this tree on various soils in different parts of Britain, by Mr Hutchison, is published in the *Trans. High. Soc. of Scot.* 1873.

black and white spruces (*Abies nigra* and *alba*) of North America are well-known ornaments in our pleasure grounds; and there are some Californian species, such as *Abies Menziesii*, *nobilis*, and others, which are hardy, and promise to be valuable additions to our ornamental trees. The Hemlock spruce of Canada (*Abies canadensis*) is hardy throughout North Europe. The Cephalonian fir (*Abies cephalonica*, Loudon), closely allied to and probably only a variety of the silver fir, is a handsome tree, readily propagated by cuttings and from cones imported from the Mediterranean. *A. Nordmanniana*, Link, a stately tree with dark, compact foliage, and ovoid cones, of late years much cultivated in England, forming forests in the Crimea and the Caucasus, is regarded as a variety of the silver fir by Parlatore and Grisebach. *A. Pinsapo*, Boissier, is a beautiful tree with rigid whorled branches, introduced from Malaga and Algeria; it is much cultivated in England, and thrives well. *Abies Smithiana*, the Himalayan spruce, closely resembles the common spruce, and is hardy in England and Scotland, where it grows with great vigour; it is readily propagated by cuttings, and by grafting, and British trees already produce cones. *Abies Webbiana*, Lindl., the Himalayan silver fir, suffers in spring in North Europe, because it starts into growth too early: it is grown in Ireland and the south-west of England. The Chili pine (*Araucaria imbricata*), a noble tree in its native country, and a conspicuous object in a park from the peculiarity of its whorls of rigid branches, is hardy in many situations in Scotland as far north as Dunrobin. *Cupressus Lawsoniana*, introduced in 1854 from California, is hardy, and rapidly becomes a handsome tree, ripening its cones. The common cypress (*Cupressus sempervirens*, L.) grows vigorously in the central districts of England, but scarcely thrives in the northern counties. *Cupressus glauca* or *lusitanica*, L., is a beautiful evergreen, with glaucous foliage, but tender; nevertheless, in Ireland it attains a great size. The Ginkgo or maidenhair tree (*Salisburia adiantifolia*, Sm.) is remarkable for the singularity of its foliage; it is a native of China, but is hardy in many parts of England. *Biota orientalis*, Endl. (syn. *Thuja orientalis*, Linn., the *Arbor vitæ*), is a small evergreen tree, indigenous in Japan and China, much cultivated in Europe, with foliage similar to that of the Cypress. The red cedar (*Juniperus virginiana*, L.), the Phœnician, and other species of juniper, are hardy and ornamental. The holly, boxwood, evergreen oak, and Portugal laurel are universally known and admired, and their glossy foliage makes them specially beautiful in winter.

Deciduous Ornamental Trees.—We can name only a few of the most prominent deciduous trees planted solely for ornament. *Magnolia grandiflora* is grown chiefly on walls, as it suffers from wind. Its flowers and foliage are very beautiful. The tulip tree (*Liriodendron tulipifera*, L.) forms a tree of the first rank in the climate of London, and attains a large size in the milder parts of Scotland; for the beauty of its foliage and flowers, it deserves a place in every collection. *Pavia indica*, the Himalayan horse chestnut, is smaller than the common horse chestnut, but extremely beautiful from its large panicles of variegated blossoms. There is a fine specimen in the Edinburgh Botanic Garden. *Kœlreuteria paniculata*, a native of China, is a hardy tree, very ornamental from its foliage as well as its flowers. There are fine specimens both in England and Ireland, yet the tree is not generally met with in pleasure-grounds. The ailanto (*Ailanthus glandulosa*), a Chinese plant, is hardy in England. It forms a stately tree with a straight trunk and magnificent foliage, the leaves being sometimes 3 feet in length. In some parts of France it is planted as a timber-tree, and thrives well on chalky soils. The bladder-nut tree (*Staphylea*, L.) may be trained to be a handsome low tree, ornamental from its foliage, white flowers, and curious bladder-like capsules. There are two species—*S. trifolia* and *S. pinnata*. The common spindle tree (*Euonymus europæus*) and the broad-leaved spindle tree (*E. latifolius*), when trained up to single trees on a deep loamy soil, with ample space, form in autumn, when their capsules are ripe, remarkable and striking objects. The winter-berry (*Prinos glaber*) is a deciduous shrub, a native of North America, which, like the holly, produces fine scarlet berries, and retains them through the winter. There are several species, all hardy, and worthy of a place in our collections. *Sophora japonica* forms a splendid tree in the climate of London, and a pendulous-branched variety is very ornamental. In dry and warm seasons, when the leaves of most other trees become of a paler green than usual, those of this tree assume a darker hue. *Virgilia lutea* is a North American tree, with fine large foliage, hardy in most parts of Britain; and, in America, valued for the yellow colour of its wood. The laburnum has already been mentioned as a useful and ornamental tree. The genus *Cratægus* consists of many species and a vast number of varieties, among which are many beautiful small trees, remarkable for an irregular picturesque outline even at an early age. They flower and fruit profusely; the flowers are generally white and fragrant, but some varieties are tinged with red and purple; they appear from March to July, and the Glastonbury thorn blooms at Christmas. *Cotoneaster frigida*, *bacillaris*, *acuminata*, *microphylla*, and *nummularia* are small trees of great beauty, both on account of their foliage and their fruit. They are from the Himalaya, and hardy in England. They are cultivated in a variety of forms, some of which have been described as distinct species. The wood is hard and elastic. There are many ornamental species and varieties of the genus *Pyrus*, which now includes species formerly grouped under *Sorbus*, *Mespilus*, &c. From the Himalaya we have (*P. variolosa*), a remarkable tree, with leaves sometimes like those of the common pear, and at other times lobed or pinnatifid. *P. Aria*, the white-beam tree, and all its varieties, deserve culture, as compact small trees, remarkable for their large woolly foliage, which dies off a fine yellow, their white blossoms, and showy red fruit. The service tree (*Pyrus Sorbus*) and its varieties are very ornamental. *Pyrus japonica*, L., is well known as one of the most ornamental spring-flowering plants in cultivation. *Hamamelis virginica*, the Wych hazel, is valuable from its beginning to flower in November, and retaining its blossoms till February or March: though rarely seen in collections, it is hardy, and forms a handsome small tree. The snow-drop tree (*Halesia tetraptera*) is one of the hardiest of North American trees, and, when in flower, one of the most beautiful: it ripens abundance of seeds in this country, by which it is readily propagated; in some parts of England it is, like the American bird-cherry, naturalised in the copses. It is rarely met with in Scotland, though few ornamental trees are so well adapted for the climate. The date-plum (*Diospyros Lotus*) though it ripens fruit as a standard near London, is tender in the northern counties. The Virginian snow-flower or fringe tree (*Chionanthus virginica*) is nearly as hardy as the snow-drop tree; and when planted in a moist soil and trained to a single stem, its head is ornamental from its large deep-green foliage, independently of the fine, white, fringe-like flowers, which are suspended from the axils of the leaves. The common purple and white lilacs (*Syringa vulgaris* and *S. vulgaris alba*) are hardy, and make neat small trees when trained to a single stem. The weeping-ash (*Fraxinus excelsior*, var. *pendula*) is well known. It suffers much from cattle or sheep browsing on the pendulous branches, disfiguring the plant, which should always be enclosed.

The flowering or manna ash (*Fraxinus Ornus*), a native of the mountains of South Italy, is a handsome tree, deserving a place in ornamental plantations. It has a fine effect standing singly on a lawn. The medicinal manna it yields is obtained by making incisions in the stem. *Catalpa syringæfolia* is a splendid tree when in flower: it attains the height of 30 or 40 feet, and sometimes ripens its seeds in the climate of London; but in the northern counties it seldom does much good. It bears a very severe cold in winter, provided there has been heat and sunshine enough in summer to ripen its wood. Of the genus *Quercus*, 281 species, European, American, and Asiatic, are described in De Candolle's *Prodromus*, and a great variety are procurable in British nurseries. The best known European species are *Q. Suber*, the cork oak; *Q. Cerris*, the Turkey or mossy cupped oak; *Q. Æjilops*, the Vallonea oak; and *Q. lusitanica infectoria*, the gall or dyer's oak. The Lucombe and Fulham oaks are believed to be hybrids between *Q. Cerris* and *Suber*. *Q. Ilex*, the evergreen or holm oak, a native of South Europe, Persia, and the North-West Himalaya, but introduced into Britain in 1581, and commonly planted, attains a large size, and frequently ripens its acorns. The oaks of North America are very numerous and interesting, but they do not ripen their shoots sufficiently to be frost-proof. None of the deciduous Himalayan species have yet been successfully introduced.

Propagation and Culture in the Nursery.

Nursery Culture.—A nursery is a plot of ground devoted to the propagation and rearing of trees; it should as far as possible be exempt from the influence of frost, which prevails in low situations, and it ought to contain a variety of soils. As a general principle, all seeds will germinate in any soil provided it contains vegetable matter, and is friable, free of stones, and well drained, with a convenient supply of water. If a nursery therefore contains the three leading soils, sand, loam, and peat, it will suffice for all required purposes. With regard to climate, all deficiencies which occur in Britain may be met by glazed frames for raising the more tender kinds. It is the interest of the nurseryman to have his nursery in a fine climate, and in deep fertile soil, that he may raise large vigorous plants in the shortest period; but it is the interest of the purchaser to have the plants reared in a climate and soil inferior to that into which they are to be transplanted, because, when this is done, instead of the plants receiving a check, as is usually the case, they will be improved by transplanting. The strength of a plant and its suitableness for successful transplanting consists in all its parts being developed, in the thorough ripening of its wood, and in the dormant state of its fibrous roots. If by any mode of culture these requisites can be obtained, together with the long and thick shoots which are produced by growing the plants in deep rich soil, so much the better; but in the climate of Britain trees reared in nurseries with inferior and unmanured soil are likely to prove most hardy. Those who plant in mountainous districts will always find it better to have their nurseries on the sides of mountains than in the valleys.

Propagation.—Trees are chiefly propagated by seeds, but also by cuttings, layers, budding, and grafting. The timber-trees of all countries are raised from seeds, with a few exceptions, such as the poplar and willow, which are raised from cuttings, and some species of elm, lime, and a few others, which are raised from layers or by grafting. Most ornamental trees are raised by some of these artificial methods, because in this country they seldom ripen seeds. Thus, all the American oaks may be grafted on the common British oak. Most of the foreign maples and birches are raised by layers, most of the ornamental thorns by budding and grafting, and willows and poplars by cuttings. All plants which do not ripen seeds readily are propagated artificially, and that mode is preferred by the nurseryman, which experience has proved will produce the largest and most vigorous plants in the shortest time. Thus, though more suitable plants would be produced by raising the plane and poplar from cuttings, because in that case nature would adjust the tops to the power of the roots, yet as much larger plants are produced by layers, that mode is preferred in commercial nurseries. The lime tree and English elm ripen their seeds in Britain, but large plants are much more rapidly procured in the first case by layers, and in the second by grafting: the mode by which the largest plants are most rapidly produced need not always give way to the slower method; but in most cases, it would be advantageous to the purchaser that the slower mode should be adopted. According to some writers, seedling plants are of greater durability than those raised in any other way; but though this may be true in some cases it is not universally applicable, as we know that a bud produces as perfect a plant as a seed; the only difference being that the bud seems more fully imbued with the peculiarities of the individual which produced it than the seed. The poplar, willow, vine, &c., have been propagated by cuttings from time immemorial, and appear to possess respectively the same properties now that they did in the days of the Romans. Seeds should be collected when mature from the best specimens; and should either be sown immediately, or preserved in a place where they will undergo few atmospheric changes till the proper sowing season, which in most cases will be the following spring. Nature, it may be observed, sows all her seeds soon after they are matured; that is, they drop from the tree upon the ground in autumn or the beginning of winter, or, in the case of some trees, such as the conifers, not till spring; but when seeds are thus left to sow themselves many are destroyed by animals, many fall in unfavourable positions for germination, and only a small proportion produce plants. It is for the arboriculturist to study nature's mode of sowing, and to imitate only her favourable features. The greater number of seeds may be stored till the following spring, that is, till February or March, and then be committed to the soil. Poplar and willow seeds, however, ripen early, and when sown immediately on dropping from the tree, often come up in the course of a few weeks; whereas, if they are kept till spring, the greater number do not come up at all; and seeds which lie two years in the ground before coming up, such as those of the hawthorn, the holly, &c., may be kept till the second spring before they are sown.

In order to show the treatment required for different kinds of seeds, and the plants raised from them, it will be convenient to throw them into the following groups:—Trees producing (1) cones; (2) nuts, acorns, masts, or keys; (3) cottony or feathery seeds; (4) fleshy fruits; or (5) leguminous seeds.

Coniferous Trees.—Coniferous trees ripen their seeds from October till January, and if the cones remain on the tree throughout the winter the seeds do not generally drop out till April or May; such as drop into favourable soil come up in five or six weeks. The cones should be collected immediately after they are ripe, and laid in a dry place. The seeds are extracted by exposing the cones to the heat of the sun under glass, or by subjecting them to artificial heat before an open fire, or on a kiln. The seeds are sown in April, in soil dug over and finely raked; and then covered with a thin coating of soil. The beds, after the sowing is completed, should be shaded from the sun by branches of tree. In cold moist climates, such as that of Aberdeen, this shading may be dispensed with;

but in the climate of London it is in most seasons necessary, and may be effected by mats, straw, or evergreens. For convenience, the seeds are generally sown in beds, a slight excavation being made by drawing some of the earth to the sides; and in order that the seeds may be evenly deposited on a somewhat firm surface, the bottom of this excavation is lightly rolled. After the seeds are scattered over the beds they are again rolled, and the covering of earth thrown over them. It is found that the rolling of the beds before and after sowing, by bringing the seeds into close contact with the soil, accelerates germination. The more tender pines are sown in pots or flat earthen pans, for the convenience of making them germinate under glass, and to facilitate future transplantation; but the process of sowing is exactly the same. The seedlings require nothing but the usual culture of the nursery for two summers; after which they should be transplanted where they are finally to remain; or they should be planted in the nursery in lines, or scattered over beds; in either case they should be 3 to 6 inches apart, according to their height and the length of the leaves. For the Scotch pine and spruce fir, which grow slowly when young, 3 inches are sufficient; for the larch, which grows rapidly, and for the pinaster, which has long leaves, 6 inches are required. Here the plants may remain two years, and afterwards be again transplanted; unless they are in the meantime removed to where they are to remain, which, to ensure good timber trees, should be done before young conifers exceed four years' growth.

Trees bearing Nuts, Acorns, Masts, Keys, &c.—These ripen from October to December. Acorns usually in November; but the beech, horse chestnut, walnut, and hazel, ripen their fruit in October, and most of the sycamores and maples in September. All these ought to be gathered as soon as ripe, because the best are liable to be picked up by wild animals as soon as they drop. They may be sown immediately or kept till February, as in neither case will they come up till April or May. The seeds should be sown in a sandy loam, in drills, at such a distance from each other that the leaves of the seedlings may not touch at the end of the first season; they should be gently pressed down into the soil, and covered to twice the depth of the seed. Drills are recommended for this description of tree-seeds that a spade may be inserted obliquely between the rows, so as to cut the tap-root of the plants, and force it to throw out lateral roots. This is commonly done in the spring of the second year, and, by increasing the lateral roots and their fibres, renders the tree better adapted for transplanting. At the end of the second year plants so treated may be taken up, and either planted where they are to remain, or transplanted into nursery lines, at distances suited to the habit of the species. Here they may remain two years longer, and be again replanted. The larger and stronger broad-leaved tap-rooted trees are, up to a certain point, before they are removed from the nursery, the more vigorously will they grow where they are finally to remain. The size to be attained in the nursery must depend on the condition of the soil into which they are to be transplanted. If moisture be so abundant as to supply the fibrils with water during the first summer, even if the removed plant has a stem an inch in diameter, so much the better; it being understood that it has been transplanted in the nursery every two years, and is therefore well supplied with fibrous roots, and has its wood perfectly ripe. If, on the other hand, the soil into which the plant is to be transplanted is dry and poor, the plants should be removed there at the end of the second year, because such plants, being of small size, have few leaves to exhale moisture, and before they grow large they will have adjusted their roots and annual growths to the locality.

Trees with Cottony, Feathery, and other soft Seeds.—The seeds of the genera *Populus, Salix, Alnus, Betula, Ulmus*, &c., ripen from May to November; poplars in May; willows and elms in June; alders in November; and birches in October. The seeds of the alder and birch may be kept in a cool, dry, airy situation till spring, or sown immediately after they are gathered. They come up in the May or June following; but the seeds of the elm, poplar, and willow should be sown immediately. Many will come up the same autumn, and the remainder the following April and May. The seeds may be dried and preserved in bags for a year; but in this case the greater part will not vegetate. Poplar and willow seeds require to be sown on a surface rendered level and slightly firm by rolling. After the seeds are equally distributed over it, they should be covered with light sandy soil, or vegetable mould, no thicker than barely to conceal the seed. After this the bed should be watered and shaded and kept uniformly moist by occasional watering when the plants make their appearance. Of all seedling trees raised in British nurseries, none grow with so much vigour the first year as the common elm; and, therefore, the seeds of this tree require to be placed at a greater distance from each other than those of any other kind. The seeds of the elm keep better till the following spring than those of the poplar and willow.

Trees with Fleshy Fruits.—The fruit of the genera *Pyrus, Cotoneaster, Viburnum, Cratægus, Ilex, Prunus, Cerasus, Rhamnus*, &c., ripens from August to December. It should be gathered when ripe, mixed with sand, and laid in a heap till the pulp rots away. With some species the seed may be sifted from the sand and sown in the following February, the seedlings being treated as the seedlings of the conifers. In others the heap may be left for two years, and many of the seeds will not germinate till the third spring.

Trees with Leguminous Seeds.—These include the genera *Cytisus, Acacia, Robinia, Gleditschia, Caragana*, &c. The pods generally ripen in September or October, but some not till November or December. The seeds may be kept in the pods till February, and then sown in beds, as described. At the end of two years the young trees may be transplanted.

The Formation and Management of Plantations.

Whether plantations of forest trees should be sown or planted, is a question which has been much discussed. It is readily allowed, that sowing is the natural mode; but man tries by art to supplement nature, and to obtain a higher rate of production by skill and labour. Some indeed have asserted that the timber of transplanted trees is never so valuable as that of sown ones, the reason alleged being, that the transplanted trees have lost their tap-roots. On examining the roots of full-grown trees, however, no tap-root is ever found; on the contrary, those roots which proceed either directly or obliquely downwards from the base of the trunk, are uniformly much smaller than those which proceed horizontally, a few inches below the surface of the ground. The tap-root, therefore, is chiefly of use to the tree whilst young, and is larger in proportion to the part of plant above ground, in the first year, than in any succeeding year; and as the top of the tree and the lateral roots increase in size, the tap-root ceases to increase, till in ten or twelve years' growth, it is found to be the smallest of the main roots of the tree. We assume, therefore, that a transplanted tree, other circumstances being the same, is in all respects as good as a seedling. Hence we conclude, that all artificial plantations ought, in the first place, to be made by planting, and at regular distances. We would carefully prepare the soil for the trees, removing the weeds afterwards for two or three years till the branches begin to cover the ground; in which state we should leave it during the growth of the plantation, only taking care to remove large weeds. This kind of tree culture, however, can only take place with advantage, on a tolerably level surface, where the soil is of the same nature throughout. Not to speak here of grounds destined for ornamental plantations, the great majority of plantations formed with a view to profit are necessarily on hilly and unculturable surfaces, and where there is probably a variety of soil, even in a limited space. The preparation to be given in such cases is under-draining; for to dig or trench the surface would render it liable to be washed away by heavy rains and thawing snow. Plantations under such circumstances must be formed by digging pits for each tree, and by selecting such kinds as are best adapted to the locality. This frequently occasions the use of a variety of trees in the same plantation, causing a more picturesque effect in the landscape and a more advantageous result in the production of timber. We have already stated that coniferous trees should be transplanted before they are four years old; but that broad-leaved trees may be moved at four, six, eight, or ten years' growth; provided they have been transplanted every two years in the nursery, and that the soil is sufficiently deep and moist to bring the fibrous roots into full action the first summer. When strong plants of this kind are used they overcome the natural herbage immediately; and, if carefully planted in good soil, not one in a score will fail. Smaller plants, on the other hand, are apt to be choked by herbage, and to have their leaves and young shoots injured by insects. In a dry soil and subsoil, plants with a mass of roots cannot subsist the first year; and therefore smaller plants, once transplanted, are preferable. There are circumstances under which sowing is perhaps the only mode of forming plantations that can be adopted: as for example, in the dunes of Gascony, which by nearly a century of regularly continued sowings have been almost entirely transformed from drifting sandy wastes into forests of the cluster pine. In making plantations of this pine we should prefer sowing several seeds in every place where a plant was intended to remain, unless we could procure a sufficient number of plants of two years old in pots. If more than one came up, the rest should be removed the second or third year; and while the plants are young care must be taken that they are not choked by herbage. When steep rocky cliffs or stony hill-sides are to be covered with wood, sowing is the only mode that can be resorted to; the kinds of seeds to be sown may be selected according to the nature of the debris or the soil in the clefts of the rocks. Where the soil is good, broad-leaved trees may be introduced; but where it is poor, the Scotch fir, larch, birch, mountain ash, and white beam tree are most suitable. Where there is no visible soil, two or three seeds, enveloped in a composition of moss, cow-dung, and loam, may be deposited in crevices, or among loose stones; acted upon by the rain, the seeds will vegetate, and find nourishment in the fragments of the ball in which they were enveloped.

Two important points connected with the formation of plantations are the distances at which trees should be planted, and the use of nurse-trees. As the strength of a plant depends on the number of its leaves, and their full exposure to light, it follows that the strongest young trees will be those which are clothed with branches and leaves from the ground upwards, and which have their leaves fully exposed on every side to light. The distance from each other at which trees should be placed in a plantation depends on the size and nature of the plants, and the soil, and situation. To have tall and straight stems, the trees are planted thickly (conifers more so than other kinds), about 4 to 6 feet apart; but when the lower branches of the plants interfere with one another, thinning should be commenced and continued from time to time. When the lower tier of branches shows symptoms of decay they should be removed by cutting close to the stem. This process of pruning has been condemned by many, particularly in soft-wood trees; but if practised early and judiciously it may be attended with benefit, especially when the part removed does not exceed an inch in diameter, or as long as the operation can be performed with an ordinary pocket-knife; the wound will heal quickly, and leaves no mark. If branches are allowed to remain till they are 3 or 4 inches in diameter, and are then cut off at some distance from the bole (snag-pruning) the timber deteriorates, the wound heals over in time, but the timber is either knotty or unsound. Close-pruning is performed by sawing off a branch close to the trunk or a leading branch. When the wound is large, a dressing should be applied to exclude air and moisture. For this purpose linseed oil, or three parts cow-dung and one part powdered lime, will be found useful. In the Royal Forests of England the branch of an oak is never removed unless special circumstances require it. Long experience has justified this system. Lateral branches which are growing with over luxuriance, and attracting too much of the sap of the plant, should be foreshortened, just as the lateral branches of a hedge are clipped when they extend too far. The only objection to this method of pruning is the amount of labour it entails. Mr M'Nab of the Royal Botanic Garden, Edinburgh, has recently urged the advantage of stem-pruning of conifers, on the grounds that it encourages a free growth, and tends to make the trees hardy by exposing the bark of the stems to the freer action of the air. Stem-pruned trees also are less likely to be broken by a weight of snow lying on the branches.

For pruning, the following tools are required,—a pocket knife, hand-saw, chisel, and pruning shears; the two last are fixed on long poles. Thinning, carried out with care from time to time, is of the greatest consequence. The removal of weak and crooked supernumeraries prevents unnecessary exhaustion of the soil, while it admits the essential agents, air and light, which favour the expansion of lateral branches. If, however, the trees be thinned out too widely, the side branches become robust and the stem is not drawn up. The rule in thinning should be, to keep the trees clear of each other, so that the branches do not interlace, and the air circulates all round. The time when thinning should commence depends on local circumstances, and the species under cultivation. In a well-managed plantation the proceeds of thinnings in twenty years should go far to cover the expense of culture and interest of capital.

The next point to be considered is that of introducing nurse-plants into plantations. That these have a tendency to accelerate the upward growth of trees for a number of years there can be no doubt, but it is at the expense of the side branches and leaves. Evergreen nurses, such as the Scotch, silver, and spruce firs, improve the condition of a plantation by preventing the radiation of heat from the ground, by checking the growth of herbage, and by protecting the principal trees from high winds until they are thoroughly established in the plantation. The kind of tree which is to form the main crop having been fixed on, and the number that when full grown will stand on an acre or any given surface, they should be planted in their proper places, and the intervals filled up with the nurse-plants. As the nurses grow, and their branches touch the principals, let them be thinned, so as not to prevent the free growth of the principals: this should be done gradually. For example, it is customary to plant oak with coniferous nurses, and in the course of seven to ten years the nurses require a partial thinning to make way for the principal trees; at this date the pines will be fit for poles or rails. It often, however, happens that the nurses are allowed to remain too long, and the principal crop consequently suffers from the evils of overcrowding.

We have now alluded to some of the chief points connected with arboriculture, but the subject is of such extent that it could not be fully treated in the limits of this article. Our object has been rather to direct attention to general principles; and for fuller information we would refer those who desire a more practical and detailed acquaintance with the subject to the following works:—

The classic *Sylva* of Evelyn and the exhaustive *Arboretum et Fruticetum Britannicum* of Loudon should be in the hands of all students of Arboriculture. Selby's *History of Forest Trees*, 1842; *The Forester*, by James Brown, 4th ed., 1871; Grigor's *Arboriculture*, 1868; Du Breuil's *Cours Elémentaire d'Arboriculture*, Paris; Paradè's *Cours Elémentaire de Culture des Bois*, Paris; Mathieu's *Flore Forestière*, Nancy, 1860; and Hartig's *Lehrbuch für Förster*, Stuttgart, 1861, are all useful books. Prize essays on special subjects are contained in the *Transactions of the Highland and Agricultural Society*, and instructive papers on various practical details are to be found in the *Transactions of the Scottish Arboricultural Society*. The *Forest Flora of Northern India*, by Stewart and Brandis, 8vo, with 4to volume of illustrations, London, 1874, contains a great amount of information on the culture of trees in India and the Himalayan region. For American trees see the *North American Sylva*, by Michaux, Paris, 1819; *Trees and Shrubs of Massachusetts*, by Emerson, Boston, 1846; and *Trees of America*, by D. J. Broune, New York, 1846. (H. C.)

TABLE

Showing the number of Trees required to plant an Imperial or Scotch Acre, at distances of one to thirty feet.

Imperial Acre.				Scotch Acre.			
Distance.	Number.	Distance.	Number.	Distance.	Number.	Distance.	Number.
1	43,560	12	302	1	54,760	12	380
1½	19,360	12½	270	1½	24,338	12½	350
2	10,890	13	257	2	13,690	13	324
2½	6,970	13½	239	2½	8,761	13½	300
3	4,840	14	222	3	6,084	14	279
3½	3,556	14½	207	3½	4,470	14½	260
4	2,722	15	193	4	3,422	15	243
4½	2,151	15½	181	4½	2,704	15½	228
5	1,742	16	170	5	2,190	16	214
5½	1,440	16½	160	5½	1,810	16½	201
6	1,210	17	150	6	1,521	17	189
6½	1,031	17½	142	6½	1,296	17½	178
7	889	18	134	7	1,117	18	169
7½	774	18½	127	7½	973	18½	160
8	680	19	120	8	855	19	151
8½	603	19½	114	8½	758	19½	143
9	537	20	108	9	675	20	137
9½	482	22	90	9½	606	22	113
10	435	24	75	10	547	24	95
10½	395	26	64	10½	496	26	81
11	360	28	55	11	452	28	70
11½	329	30	48	11½	414	30	60

ARBROATH, or ABERBROTHOCK, a seaport and manufacturing town of Scotland, in the county of Forfar, 17 miles N.E. of Dundee and 60 N.N.E. of Edinburgh, in lat. 56° 33′ N. and long. 2° 35′ W. Of its origin we have no information, but it is probable that the shelter of the river Brothock, from which it derives its name, early attracted a settlement of seafaring folk. It was certainly in existence before the Tyronensian monks came from Kelso to take possession of the beautiful abbey dedicated to Thomas-a-Becket, which King William the Lion had just founded in 1178. Whether the town was created a royal burgh in 1186, as has been stated, is uncertain; but it still preserves its charter of 1599. By King John of England it was exempted from "toll and custom" in every part of the southern kingdom except London. In 1320 a parliament was held in the abbey by Robert I., and a letter—one of the most remarkable documents of our early history—was addressed to the Pope in regard to the relations between Scotland and England. In 1394 the burgesses of Arbroath entered into an agreement with John Gedy, the abbot, by which he and his successors were bound to maintain a sufficient harbour at their own expense. The abbacy was held in succession by Bishop Beaton of Glasgow, and his nephew, Cardinal Beaton, afterwards Archbishop of St Andrews. It was abolished by Act of Parliament, and erected into a temporal lordship of the Hamilton family in 1541. There is a tradition that the abbey was burned by a neighbouring "laird" in consequence of a private quarrel with the commendatary; but it is more generally believed that it merely fell into ruin from neglect. There is no evidence that it suffered from the attacks of the Reformers. The vestry, the south transept, part of the chancel, the south wall of the nave, part of the entrance towers, the fine Norman gateway, and part of the secular buildings are still standing, and the abbot's house, now called the abbey house, is still inhabited. At the beginning of the 18th century Arbroath was a place of but little importance, but has since gradually risen. It is now the principal seat of the sail-cloth manufacture, has about thirty spinning-mills and seventeen factories, several considerable foundries, tanneries, and other works. During the course of last century the abbot's harbour was superseded by one more commodious a little to the west, which was enlarged and improved, about 1844, at a cost of £50,000. More recently, by means of a Government loan and other funds, amounting together to £35,000, the entrance and bar have been much deepened, and a wet dock is (1875) in course of formation. A neat signal tower, 50 feet in height, with an excellent telescope, communicates with the Bell-Rock lighthouse; and on the north pier is a fixed red light, at an elevation of 24 feet, visible 8 miles off. The imports are flax, hemp, coal, &c.; and the exports, paving-stones, grain, potatoes, fish, &c. At the first of December 1873 the number of vessels registered at the port was 64, with an aggregate burden of 9242 tons. The customs receipts that year amounted to £15,861, 13s. 1d.; the tax on British spirits to £6767, 11s.; total, £22,629, 4s. 1d., showing an increase on the previous year of £604, 14s. 1d. Among the public buildings are the town-hall, a trades' hall, the new hall, the parish church, with a spire 150 feet high, three *quoad sacra* churches, five Free, three United Presbyterian, one Episcopalian, one Roman Catholic, and two Independent. There are six branch banks, a savings bank, a public library, an excellent museum, a high school, five other public and a number of adventure and denominational schools, with an aggregate attendance of 3000 children, an infirmary, and a considerable number of charitable endowments. The municipal government is vested in a provost, three bailies, a treasurer, a dean of guild, and twelve councillors; and there are seven incorporated trades. In the year 1873–74 the expenditure for general public purposes—including paving, lighting, cleansing, but excluding improvements, water, and sanitary expenditure—was £6773, 15s. 3d. The town has been drained and well paved; an additional though somewhat small supply of water has been recently obtained, and the sanitary condition is on the whole satisfactory.

Arbroath unites with Forfar, Montrose, Brechin, and Bervie, in sending a member to parliament. By the census of 1871 it contained 2359 inhabited houses, and, including

179 within the royalty but beyond the parliamentary boundary, 20,170 inhabitants. Of these 3723 are engaged in manufacturing linen fabrics. Arbroath is a station on the Caledonian Railway The market day is Saturday; and fairs are held on the last Saturday of January, the first Saturday after Whitsunday, the 18th of July, if that day is a Saturday, or on the first Saturday thereafter, and the first Saturday after Martinmas. About a mile from the town, at St Vigeans Church, is one of the most interesting of the Scottish sculptured stones, containing what has been held to be the only legible inscription left us in the Pictish language (*Sculptured Stones of Scotland*). See *Statistical Account of Scotland*; vol. xi., and local histories.

ARBUTHNOT, John, a celebrated physician, wit, and man of letters of the age of Queen Anne, was born at Arbuthnot, near Montrose. The date of his birth is somewhat uncertain; many authorities give 1675, which is scarcely reconcilable with his first appearance in London; it should probably be 1665 or 1667. His father was a clergyman of the Scotch Episcopal Church, who was compelled by the Revolution to resign his charge, and whose family were consequently dependent on their own exertions. Young Arbuthnot studied at the University of Aberdeen, where he took the degree of M.D. He proceeded soon after to London, and for a time supported himself there by teaching mathematics. His first published work was a translation, with considerable additions, of a treatise by Huyghens, called *Of the Laws of Chance, or a Method of Calculation of the Hazards of Game*, 1692. About this time there was much speculation concerning the geological formation of the earth, and Dr Woodward published an Essay towards a natural history of the earth, in which some curious views were propounded with regard to the deluge. This essay Arbuthnot attacked with great success in his *Examination of Dr Woodward's Account of the Deluge*, &c., London 1695. By this work he was brought into prominent notice, and not only gained means to extend his practice, but at the same time brought himself into connection with the circle of wits and literary men who formed the chief glory of the age. He followed up the work on Dr Woodward by another on the usefulness of mathematical learning, and contributed to the Royal Society an interesting memoir, called *An Argument for Divine Providence drawn from the Equal Number of Births of both Sexes*, which procured him, in 1704, admission as a Fellow to the Royal Society. A year later appeared the first edition of a larger work, *Tables of the Grecian, Roman, and Jewish Measures*, &c. This is still a work of some value, though in many parts superseded. It was held in considerable estimation on the Continent, and was translated into Latin. About this time a happy accident introduced Arbuthnot to Prince George of Denmark, who was seized with sudden illness when on a visit to Epsom. Arbuthnot, who chanced to be there at the time, was called in, and ever afterwards continued to be physician to the prince. In 1705, at the especial request of the Queen, he was made her physician extraordinary, and four years later he became Royal Physician in ordinary. In the same year he was elected a Fellow of the Royal College of Physicians. He was now in the very centre of the literary society of the time, and in it his great talents, massive learning, and brilliant wit enabled him to take a prominent place. He was on terms of close intimacy with Pope, Swift, Gay, and Parnell, and quickly became one of the foremost literary men of the Tory party. In 1712 appeared the celebrated political allegory, called the *History of John Bull*. The object of this admirable piece of satire was to throw ridicule on the duke of Marlborough, and to excite among the people a feeling of disgust at the protracted war then being carried on against Louis of France. The nations at war are represented as tradesmen involved in a lawsuit: the origin of the dispute is traced to their selfish and narrow views; their national characteristics are skilfully hit off, and the various events of the war, with the accompanying political intrigues, are symbolised by the stages in the progress of the suit, the tricks of the lawyers, and the devices of the principal attorney (Marlborough) to prolong the struggle. There have been many imitations of this famous allegory, but few of them have been so happily conceived, or so well sustained. Its immediate effect was very considerable, and it is even now of interest for the lively picture it presents of the politics of the period. At the time of its appearance it was generally attributed to Swift, but passages in Swift's own letters make it quite clear that Arbuthnot was the sole author.

The death of the Queen in 1714 was a severe blow to Arbuthnot. He lost his post as court physician, and was much impaired in his means. He appears about this time to have paid a short visit to Paris, and on his return took up his residence in Dover Street. His correspondence shows that after the Queen's death he was at first disposed to be despondent and gloomy, but he soon recovered his natural buoyancy of spirits, and entered with eagerness into the proposed work of the Scriblerus Club. The principal members of this club were Pope, Gay, Swift, Arbuthnot, Parnell, Harley, Atterbury, and Congreve. The work projected by them, a comprehensive satire on the abuses of human learning, was never completed. One brilliant fragment, the first book of the Memoirs of Martinus Scriblerus, published in Pope's Works, is undoubtedly the work of Arbuthnot, though it is not improbable that some portions are due to Pope and Swift. It is an admirable combination of wit and learning, and is certainly one of the finest pieces of sarcastic humour in the English language. Arbuthnot still continued practice as a physician, and attained great eminence in his profession. In 1723 he was made one of the censors of the Royal College of Physicians, and in 1727 had the honour of delivering the Harveian oration. In 1731 he published an *Essay concerning the Nature of Aliments*, which has been frequently republished, and has been translated into German. In 1733 he wrote an *Essay on the Effects of Air on Human Bodies*. He died in February 1735. The scattered writings of Arbuthnot, on which his reputation as a wit rests, are so interwoven with the works of Swift and Pope, that it is difficult to discover what is absolutely his. A collected edition, *Miscellaneous Works of the late Dr Arbuthnot*, Glasgow, 1750–51, contains many pieces that were expressly disclaimed by the author's son.

ARC, Joan of. See Joan of Arc.

ARCADE (Fr. *arcade*, *arcature*, Ital. *arcata*, Ger. *Bogengang*), in street architecture a covered way or passage, either open at the side with a range of pillars, or completely covered over. The finest arcades of this description are to be found in Paris. Some have open sides, such as those in the Rue de Rivoli, Palais Royal, and Old Place Royal; others, such as the Passages des Panaromas, Jouffroy, and de Princes, are covered passages, and form convenient thoroughfares. A few, like the Passages Choiseul and de l'Opera, are favourite lounges. They are all more or less lined with elegant shops. There are two specimens of covered passage-arcades in London, the Burlington and Lowther, but they are very inferior in style to those in Paris. The arcade which runs round three sides of the Square of St Mark at Venice is the finest of its kind. In Gothic architecture the term signifies a range of arches, supported on columns or piers, and either open or attached to a wall. The word is used in contradistinction to colonnade, which is a range of columns carrying level entablatures. The oldest known in England is probably that of the old refectory in Westminster Abbey, the work of the Confessor (fig. 1). Examples of *attached arcades* may be seen at St John's, Devizes (fig. 2), at Canterbury and Amiens, and at Notre Dame, Paris; of *detached arcades*, at Wells, Lucca, and Pisa; of arcades over piers and arches, at Lincoln; of arcades, the openings of which form seats or canopied stalls (which is very common in chapter-houses), at Lichfield. Arcades are found both inside and outside mediæval buildings. If under the windows inside a

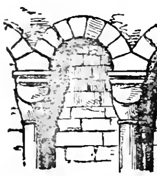

Fig. 1.—Arcade, Westminster Abbey.

Fig. 2.—Arcade, St John's, Devizes.

building, their columns generally rest on a stone seat or bench table. Sometimes the arcades are pierced here and there to form windows. Sometimes the triforium is a series of arcades, as in parts of Canterbury, Exeter, Beverley, St John's, Chester, and many other examples. In detached arcades, a very pleasing effect is often produced by placing the columns, which are attached to the wall, opposite the centre of the opening instead of immediately behind the front column, so as to alternate and enhance the effect of the perspective, as at Wells. The intersections of arcades of interlaced circular arches, as at St John's, Devizes, and at Canterbury, were at one time supposed to have been the origin of the Gothic or pointed arch. Many of the cathedrals abroad have arcaded fronts, as at Pisa. That at Lucca has a range of double arcades, one behind the other, the columns alternating, as may also be seen at Wells and Lincoln. (For examples of arcades, see Parker's *Glossary of Architecture*, and Viollet le Duc's *Dictionnaire*, vol. i.)

ARCADIA, an inland and mountainous country of ancient Greece, bounded on the N. by Achaia, on the W. by Elis, on the S. by Messenia and Laconia, and on the E. by Argolis, and almost shut in from the neighbouring states by a natural rampart. Its most important heights were Cyllene, the birth-place of Hermes, in the north-east, Erymanthus in the north-west, Artemisium and Parthenium in the east, and Mænalus and Lycæus in the south. It was watered by the Alpheus, the largest river of the Peloponnesus, the Helisson, the Ladon, the Erymanthus, and a number of smaller streams which cut their way, in many cases by underground passages, through the limestone rocks. In the east there were several lakes, as those of Orchomenos and Stymphalus; and in the north-east, near Nonacris, was the great waterfall of the Styx, which produced such a deep impression on the ancient Greek mind. Arcadia seems to have been inhabited from the earliest times of Grecian history by the same race of people, which down to the days of Roman dominion continued to be distinguished from the neighbouring states by greater simplicity and inertness of life. Deprived by their position of the quickening influence of commerce, broken up into small and almost independent communities by the physical character of their country, and thus having hardly any proper national existence, the Arcadians acquired a certain awkwardness in dealing with their more vivacious neighbours, who laughed at Arcadian stupidity, while they were pleased with Arcadian hospitality, and almost envied Arcadian repose. Like other mountain-dwellers they were determined defenders of their liberty, and their history is chiefly taken up with united or sporadic conflict against Spartan invasion. About the time of the foundation of Megalopolis (370 B.C.) a certain unity and consequent power were attained, but it was not long ere matters fell back to their former condition. Ultimately the whole country joined the Achæan League, and was afterwards incorporated with the Roman province of Achaia. The most important towns in Arcadia were Tegea, Stymphalus, Cleitor, Pallantium, Pheneus, Caryæ, Nonacris, Methydrium, Heræa, Mantinea, Lycosura, according to Pausanias, the most ancient town in Greece, and Megalopolis, one of the most recent. The Greek and Roman poets celebrated the simplicity of Arcadian life and character, not without a certain touch of satire; but by moderns, such as Sannazar and Sydney, the country and its inhabitants have been idealised and elevated into a type of pure pastoral happiness.

ARCESILAUS, a Greek philosopher, and founder of the New or Middle Academy, was born at Pitane in Æolia, about 316 B.C. He received careful training in his youth from the mathematician Autolycus, and then proceeded to Athens, where for some time he studied under Theophrastus. He was gained over to the Academy by Crantor, with whom he continued to live on terms of the closest intimacy. After the death of Crantor, Arcesilaus continued to study under Polemo and then under Crates, whom he succeeded as leader of the school. There is a little doubt as to the philosopher's mode of life. According to some he lived in extravagant, even profligate style, and Diogenes Laertius tells us that he died in his 75th year of excessive drinking. But the testimony of others, *e.g.*, Cleanthes, seems to show that he practised extreme moderation; and some of his practical precepts tend to confirm this view. He was much beloved and respected by the Athenians, and is celebrated for his acuteness, eloquence, and learning. His philosophical opinions can only be gathered from scattered notices in Cicero, Sextus, and others. He advocated the Socratic or colloquial method of discussion, although he depreciated dialectic proper, and seems to have carried out thoroughly the sceptical element in the Platonic school. His theory of knowledge was developed in direct antagonism to that of the Stoics. He especially opposed their favourite doctrine, that the criterion of truth was to be found in the irresistible or irresistibly convincing impression, which served as a mean between science and opinion, and was common to the wise man and the foolish. Arcesilaus denied that such a mean was possible, and showed further, that as conviction implied approval or judgment, it could not apply to impressions but only to thoughts. Moreover, the mere force of conviction could not be a test of truth, since a false conception might be quite as irresistible as a true one. Arcesilaus brought forward no new arguments against knowledge in general; he appears to have thought that by overthrowing the theory of knowledge which rests on the truth of the senses, he had destroyed all possibility of rational conviction. The final result of his speculation was accordingly, that he could not know anything, not even his own ignorance. It was the part of a wise man to despair of certainty. To the ordinary argument against scepticism, that it destroys the power of acting, Arcesilaus replied by pointing out that impressions or ideas affect the will and produce actions, whether they are true or not. Men can act upon their ideas with or without a conviction of their truth. In practical matters probability is a sufficient guide. We have no certain information as to how this doctrine was applied to the questions of morals. (See Brodeisen, *De Arcesila philosopho*, 1821; Geffers, *De Arcesila*, 1842; Zeller, *Philosophie d. Griechen*, iii. 1, 448, *sq*.

ARCH

ARCH, in building, a portion of mason-work disposed in the form of an arc or bow, and designed to carry the building over an open space. The simplest and oldest expedient for supporting a structure over a door-way is to use a single stone or lintel of sufficient length. On account of the difficulty of procuring stones of great size, this expedient can only be used for moderate apertures; nor can it be applied when there is to be a heavy superstructure, because the weight resting on the lintel would cause a compression of the upper, and a distension of the under side. Now, no kind of stone can bear any considerable distending strain, and thus stone-lintels are liable to fracture. The ancient Greek temples afford instances of the use of horizontal lintels of considerable size, but these architraves carry only the cornice of the building. The employment of a colonnade with flat architraves to support an upper story is contrary to sound principles, and, even in the case of ordinary houses, we see that the builder has been fain to relieve the pressure on the lintel by means of a concealed arch. In stone-work we must depend on compression alone.

When a lintel had been accidentally broken in two, we may suppose that the masons had set the ends of the halves upon the door-posts, and brought the broken ends

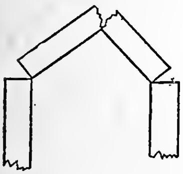

Fig. 1.

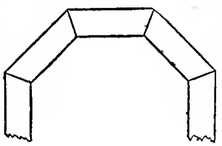

Fig. 2.

together. In this way there would be formed a support for the upper building much stronger than was the stone when entire; only there is a tendency to thrust the door-posts asunder, and means must be taken to resist this out-thrust. The transition from this arrangement to that of three or more wedge-shaped stones fitted together was easy, and thus the gradual development of the arch resulted.

So long as such structures are of small dimensions no great nicety is required in the adaptation of the parts, because the friction of the surfaces and the cohesion of the mortar are sufficient to compensate for any impropriety of arrangement. But when we proceed to construct arches of large span we are forced to consider carefully the nature and intensity of the various strains in order that provision may be made for resisting them.

Until the laws of the equilibrium of pressures were discovered, it was not possible to investigate these strains, and thus our knowledge of the principles of bridge-building is of very recent date; nor even yet can it be said to be perfected. The investigation is one of great difficulty, and mathematicians have sought to render it easier by introducing certain pre-supposed conditions; thus, in treatises on the theory of the arch, the structure is regarded as consisting of a course of arch-stones resting on abutments, and carrying a load which is supposed to press only downwards upon the arch-stones. Also cohesion and friction are put out of view, in other words, the investigation is conducted as if the stones could slide freely upon each other. Now, if the line of pressure of one stone against another cross their mutual surface perpendicularly, there is no tendency to slide; and if this condition be adhered to throughout the whole structure, there must result complete stability, since the whole of the friction and the whole consistency of the cement contribute thereto. But if, in any case, the line of pressure should cross the mutual surface obliquely, the tendency to slide thereby occasioned must be resisted by the cohesion, and so the firmness of the structure would be impaired. Hence an investigation, conducted on the supposition of the non-existence of cohesion, must necessarily lead us to the best possible construction. But we can hardly say as much in favour of the hypothesis that the load presses only downwards upon the arch-stones. In order to place such a supposition in accordance with the facts of the case, we should have to dress the inner ends of the arch-stones with horizontal facets for the purpose of receiving and transmitting the downward pressure. But if, as is usually the case, the inner surfaces be oblique, they cannot transmit a vertical pressure unless in virtue of cohesion, and then this hypothesis of only downward pressure on the arch-stones is not in accordance with the fundamental principle of stability. In a thorough investigation this hypothesis must be set aside, and the oblique pressure on the inner ends of the arch-stones must be taken into account. Since the depth of the arch-stones is small in comparison with the whole dimensions of the structure, and since the line of the pressure transmitted from one to another of them must always be within that depth, it is admissible to suppose, for the purpose of analysing the strains, that the arch-stones form an exceedingly thin course, and that their joints are everywhere normal to the curve of the arch. Eventually, however, the depth of the arch-stones must be carefully considered.

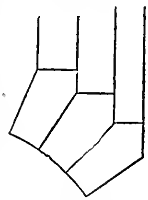

Fig. 3.

We may best obtain a clear view of the whole subject by first assuming that the load presses only downwards on the arch-stones, or that the inner ends of these are cut with horizontal facets.

Let Q′P′APQ (fig. 4) represent a portion of such an arch

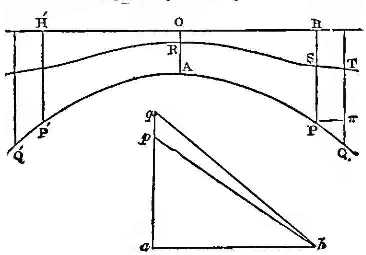

Fig. 4.

placed equally on the two sides of the crown A, then the whole weight of the structure included between the two vertical lines P′H′ and PH must be supported at P′ and P, so that the downward pressure at the point P must be the weight of the building imposed over AP. This pressure downwards is accompanied by a tendency to separate the supporting points P′ and P. Now, as this tendency is horizontal its intensity cannot be changed by the load acting only downwards, and must remain the same throughout the structure, wherefore the actual pressure at P must be found by combining this fixed horizontal thrust with the downward pressure equal to the weight of the bridge from A to P. If, then, we draw *ah* horizontally to represent this constant thrust, and *ap* upwards to represent the weight of this portion of the arch, the line *ph* must, according to the law of the composition of pressures, indicate both in direction and in intensity the actual strain at the point P. This pressure must be perpendicular to the joint of the stones, and must therefore be parallel to the straight line drawn to touch the curve at P.

Hence, if the form of the inside of the arch, or the *intrados* as it is called, be prescribed, we can easily discover the law of the pressures at its various parts; thus, to find the strain at the point Q, we have only there to apply a tangent to the curve and to draw *hq* parallel thereto; *hq* represents the oblique strain at Q; *aq* represents the whole weight from the crown A to Q, and therefore *pq* is proportional to the weight imposed upon the position PQ of the arc.

Using the language of trigonometry, the horizontal thrust is to the oblique strain at any part of the curve as radius is to the secant of the angle of inclination to the horizon; also the same horizontal thrust is to the weight of the superstructure as radius is to the tangent of the same inclination. And thus, if the intrados be a known curve, such as a circle, an ellipse, or a parabola, we are able without much trouble to compute, on this hypothesis, the load to be placed over each part.

If we use the method of rectangular co-ordinates placing x along OH and z vertically downwards, so that $P\pi$ may be the increment of x, πQ that of z, the tangent of the inclination at P is $\frac{\delta z}{\delta x}$, and therefore if h stand for the horizontal strain and w for the weight of the arch, we have—

$$w = h\frac{\delta z}{\delta x},$$

while the oblique strain is $h\sqrt{\left(\frac{\delta x^2+\delta z^2}{\delta x^2}\right)}$. Also the change of weight from P to a proximate point Q is $\delta w = h\delta\left(\frac{\delta z}{\delta x}\right)$.

Let RST be the outline which the mason-work would have if placed compactly over the arch-stones, in which case RST is called the *extrados*, then the weight supported at P is proportional to the surface ARSP, and the increment of the weight is proportional to PSTQ, hence if the weights and strains be measured in square units of the vertical section of the structure, and if y be put for PS, the thickness of the mason-work, we have—

$$\delta w = y\delta x, \text{ whence } y = h\frac{\delta^2 z}{\delta x^2}$$

When the curve APQ is given, the relations of z and of its differentials to x are known, and thus the configuration of the extrados can be traced, and we are able to arrange the load so as to keep all the strains in equilibrium.

But when the form of the extrados is prescribed and that of the intrados is to be discovered, we encounter very great difficulties. Seeing that our hypothesis is not admissible in practice, it is hardly worth while to engage in this inquiry; it may suffice to take a single, and that the most interesting case.

If the whole space between the arch-stones and the roadway be filled up, the extrados becomes a straight line, and when this is horizontal we have $y = z$, so that the form of the arch must be such as to satisfy the condition—

$$z = h\frac{\delta^2 z}{\delta x^2},$$

that is to say, z must be a function of x such as to be proportional to its own second derivative or *differential coefficient*. Now this character is distinctive of the catenarian functions, and therefore ultimately

$$z = A\left\{e^{\frac{x}{\sqrt{h}}} + e^{-\frac{x}{\sqrt{h}}}\right\}$$

where A is AO, the thickness at the crown of the arch, and e the basis of the Napierian system of logarithms. In this case, since $\delta w = z\delta x$,—

$$w = A\sqrt{h}\left\{e^{\frac{x}{h}} - e^{-\frac{x}{h}}\right\},$$

so that the form of the arch and also its weight may readily be computed by help of a table of catenarian functions.

Let us now consider the case when the ends of the arch-stones are dressed continuously, while the imposed load is formed of stones having vertical faces. The weight of the column PSTQ resting on the oblique face PQ is prevented from sliding by a resistance on the vertical surface QT, which resistance goes to partly oppose the horizontal strain transmitted by the preceding arch-stone; and thus the out-thrust of the arch, instead of being entirely resisted by the ultimate abutment, is spread over the whole depth of the structure. In this case the horizontal thrust against QT is to the weight of the column as $Q\pi$, the increment of z, is to $P\pi$, the increment of x; wherefore, putting H for the horizontal thrust at the crown of the arch, and h for that part of it which comes down to P, the decrement of h from P to Q is proportional to the rectangle under PS and $Q\pi$, that is to say,

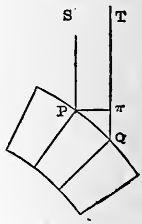

Fig. 5.

$$\delta h = y\delta z.$$

Now, the whole decrement from the crown downwards is the sum or integral of all such partial decrements, and therefore the horizontal thrust transmitted to P is expressed by the symbol—

$$h = H - \int y\delta z,$$

while the whole weight supported at P is the analogous integral

$$w = \int y\delta x.$$

But the resultant of these two pressures must be perpendicular to the joint of the arch-stones, or parallel to the line of the curve; wherefore ultimately we obtain, as the condition of equilibrium in such a structure, the equation—

$$\delta z(H - \int y\delta z) = \delta x\int y\delta x.$$

Since the vertical pressure at P is w, while the horizontal strain is h, the intensity of the oblique strain at P must be $\sqrt{\{w^2+h^2\}}$. Now, in passing to the proximate point Q, w becomes $w+\delta w$, while h is reduced to $h - \delta w\frac{\delta x}{\delta z}$, so that the oblique strain at Q must be—

$$\sqrt{\left\{(w+\delta w)^2 + \left(h - \delta w\frac{\delta x}{\delta z}\right)^2\right\}},$$

or, neglecting the second power of the infinitesimally small increment δw, $\sqrt{\left\{w^2+p^2+2w\delta w - 2h\delta w\frac{\delta z}{\delta x}\right\}}$, but

$w = h\frac{\delta z}{\delta x}$, wherefore the strain at Q is $\sqrt{(w^2+h^2)}$, or exactly the same as that at P. This result might have been obtained from the consideration that the thrust upon the surface PQ is perpendicular to the oblique strain, and can tend neither to augment nor to diminish it. Hence, as a characteristic of this arrangement, we have the law that the tension across the joints of the arch-stones is the same all along, and therefore is equal to H, the horizontal tension at the crown of the arch.

From this it at once follows that if r be the radius of curvature at the point P, y being the vertical thickness of the mason-work there, $H = ry$, so that if R be the radius of curvature at the crown of the arch, and A the thickness there, the horizontal thrust there, or the strain transmitted along the arch-stones, is $H = RAH$, being measured in square units of surface; hence also $A : y :: r : R$, or the thickness at any place, is inversely proportional to the radius of curvature there.

When the form of the intrados is given, its curvature at any point is known, and from that the thickness of the stone-work and the shape of the extrados can be found. The most useful case of the converse problem is, again, that in which the extrados is a horizontal straight line.

Let OH, figure 6, be the horizontal extrados, and A the crown of the arch; make also AB such that its square may represent the horizontal thrust there; then, having joined OB and drawn BC perpendicular to it, and meeting the continuation of OA in C, C is the centre of curvature for the crown of the arch. Or, if the radius of curvature and the thickness of the arch at the crown be prescribed, we may obtain the horizontal thrust by describing on CO a semicircle, cutting a horizontal line through A in the point B, then the horizontal thrust is equal to the weight of the quantity of the stone-work which would fill up the square on AB. The conditions of the problem require that the curve APQ be so shaped as that the radius of curvature at any point P shall be inversely proportional to the ordinate HP.

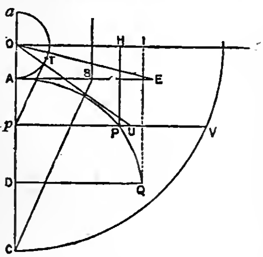

Fig. 6.

Resuming the general equation of condition—

$$\delta z(H - \int y\delta z) = \delta x \int y \delta x\,,$$

and observing that in this case $y = z$, we have—

$$\delta z(H - \int z\delta z) = \delta x \int z \delta x$$

Now the integral $\int z\delta z$ is $\frac{1}{2}z^2$, but as it must be reckoned only from A where $z = A$, the equation becomes

$$\delta z(H + \tfrac{1}{2}A^2 - \tfrac{1}{2}z^2) = \delta x \int z \delta x$$

The coefficient of δz becomes less when z increases, and when $\frac{1}{2}z^2 = H^2 + \frac{1}{2}A^2$, this coefficient becomes zero, at which time δx also becomes zero in proportion to δz; that is to say, the direction of the curve becomes vertical. Wherefore, if we make $OD = D$ such that $D^2 = A^2 + 2H^2$, we shall obtain that depth at which the curve is upright, or at which the horizontal ordinate DQ is the greatest, and then the equation takes the form—

$$\delta z(D^2 - z^2) = 2\delta x \int z \delta x\,,$$

by help of which we should be able to find x in terms of z. The computation, however, is attended with considerable difficulty, and therefore it may be convenient to attempt a graphical solution. Since, for any vertical ordinate $HP (= z)$, the horizontal thrust is $\frac{1}{2}(D^2 - z^2)$, while the oblique strain is $\frac{1}{2}(D^2 - A^2)$, the obliquity of the curve at P has for its cosine the value $\frac{D^2-z^2}{D^2-A^2}$, wherefore the angle at which the curve crosses the horizontal line pP is known. Let then a multitude of such lines be drawn in the space between BA and DQ, and let the narrow spaces thus marked be crossed in succession from A downwards by lines at the proper inclination, and we shall obtain a representation of the curve, which will be nearer to the truth as the intervals are more numerous. The beginning of the curve at A may be made a short arc of a circle described from the centre C.

Since the minute differentials thus obtained are proportional to the sides of a triangle whose hypotenuse is $D^2 - A^2$, and one of whose sides is $D^2 - z^2$, we must have—

$$\delta x = \frac{D^2 - z^2}{\sqrt{\{(D^2-A^2)^2 - (D^2-z^2)^2\}}}\delta z\,,$$

and the integration of this would give the value of x. If we put ϕ for the inclination of the curve at any point P,

$$D^2 - z^2 = (D^2 - A^2)\cos\phi,$$

$$\therefore z = \{D^2 - (D^2 - A^2)\cos\phi\}^{\frac{1}{2}}$$

and taking the differential,

$$\delta z = \tfrac{1}{2}(D^2 = A^2)\sin\phi\{D^2 - (D^2 - A^2)\cos\phi\}^{\frac{1}{2}}\delta\phi,$$

$$\therefore \delta x = \frac{H.\cos\phi.\delta\phi}{\sqrt{\{D^2 - 2H\cos\phi\}}}\,,$$

where 2H is put for its equivalent $D^2 - A^2$. The integral of this expression may be obtained by developing the radical in terms arranged according to the powers of $\cos\phi$, and then integrating each term separately. The result is a series of terms proceeding by the powers of $\cos\phi$, the coefficient of each power being itself an interminate series; and the rate of convergence is so slow as to make the labour of the calculations very great. Such expressions belong to the class of *elliptic functions*, for which peculiar methods have been devised. Fortunately the actual calculation is not required in the practice of bridge-building, and therefore we shall only refer the reader to the above-named subject.

If the horizontal thrust and the thickness at the crown of the arch be prescribed, the radius of curvature there must be the same whichever of the two hypotheses be adopted; now, if we sweep an arch from the centre C with the radius CA, the catenarian curve lies outside of it, while the curve which we have just been considering lies inside. Each of these is compatible with sound principles: the one if the inner ends of the arch-stones be dressed with horizontal facets, the other if the ends be dressed to a continuous curve; wherefore, between these two limits we may have a vast variety of forms, each of which may be made consistent with the laws of equilibrium by merely dressing the inner ends of the arch-stones at the appropriate angles. Hence an entirely new field of inquiry, in which we may find the complete solution of the general problem:—

"The intrados and extrados of an arch being both prescribed, to arrange the parts consistently with the laws of equilibrium."

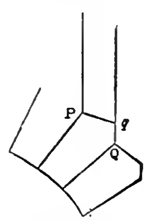

Fig. 7.

Let PQ represent the inner end of one of the arch-stones, the part Qq being vertical, and Pq being sloped at some angle which is to be found; put t for the tangent of the inclination of the joint P to the vertical, θ for that of Pq to the horizontal line, then the horizontal strain at P is $\frac{w}{t}$, while the corresponding strain at Q is $\frac{w+\delta w}{t+\delta t}$, and if Pq were horizontal these would be alike; but the obliquity of Pq causes the load δw which is placed on it to generate a horizontal pressure $\theta\delta w$, wherefore—

$$\frac{w}{t}-\frac{w+\delta w}{t+\delta t}=\theta\delta w, \text{ whence}$$

$$\theta=\frac{w}{t^2}\frac{\delta t}{\delta w}-\frac{1}{t} \text{ or } \theta t=\frac{w}{\delta w}\frac{\delta t}{t}-1$$

Now, when the forms of the intrados and extrados are both given, the values of w, t, δw, δt, are thence deducible, so that the value of θ may always be computed by help of differentiations only; excepting, indeed, that integrations may be needed for determining the value of w, which is the area included between the two curves.

In this very simple investigation we have the complete solution of the principal problem in bridge-building. The data needed for determining the shape of the inner end of the arch-stone are already in the hands of the architect, who must know, from his plans, the weight of each part and the inclination of each joint; so that, with a very small addition to the labour of his calculations, he is enabled to put the structure completely in equilibrium, even on the supposition of there being no cohesion and no friction; that is to say, he is enabled to obtain the greatest stability of which a structure having the prescribed outlines is susceptible. Even although he may not care to have the stones actually cut to the computed shape, and may regard their usual roughness and the cement as enough, he may judge, by help of the above formula, of the practicability of his design; for if at any place the value of $\theta\delta t$ come out with the wrong sign, that is, if $w.\delta t$ be less than $t.\delta w$, the building is unstable, whereas if $w.\delta t$ be greater than $t.\delta w$ everywhere, the design, as far as these details go, is a safe one.

In every possible arrangement of the details, the horizontal thrust at the crown of the arch is transmitted to and resisted by the ultimate abutments. The only effect, in this respect, of varieties in the form of construction is to vary the manner of the distribution of that strain among the horizontal courses. Hence one great and essential element of security,—the first thing, indeed, to be seen to,—is that the ground at the ends of the proposed bridge be able to resist this out-thrust. Another, and not less important one is, that the arch-stones be able to withstand the strains upon them. In this respect much depends on the workmanship; it is all important that the stones touch throughout their whole surfaces: if these surfaces be uneven the stones must necessarily be subjected to transverse strains, and so be liable to fracture. The practice, too common among house-masons, of cheaply obtaining an external appearance of exactitude, by confining their attention to a chisel-breadth around the outside, is not permissible here, nor should any reliance be placed on the layer of mortar for making up the inequalities.

The limit to the span of an arch depends primarily on the quality of the material of the arch-stones. At the crown of the arch the horizontal thrust is the weight of as much of the masonry as fills a rectangle whose length is equal to R, the radius of curvature, and whose breadth is A, the effective thickness there; now this strain has to be borne by the arch-stones, whose depth we shall denote by d, and therefore these stones must be subjected, as it were, to the direct pressure of a vertical column whose height is $\frac{RA}{d}$. This column must be much shorter than that which the stone is actually able to bear.

The ability of a substance to resist a crushing pressure is generally measured by the length of the column which it is able to support, without reference to the horizontal section; but it may be questioned whether this mode of estimation be a sound one, for it does seem natural to suppose that a block three inches square should bear a greater load than nine separate blocks each one inch square, seeing that the centre block in the entire stone is protected on all sides; and thus it is possible that we under-estimate the greatest practicable span of a stone arch. This difficult subject belongs to the doctrine of "Strength of Materials."

Arch, Skewed.—In the earlier days of bridge-building the road was led so as to cross the river or ravine perpendicularly, but in modern engineering we cannot always afford to make the detour necessary for this purpose, and must have recourse to the *skewed* or *oblique* arch, having its plan rhomboidal, not rectangular.

If AB, CD, figure 8, represent the roadway, and EF

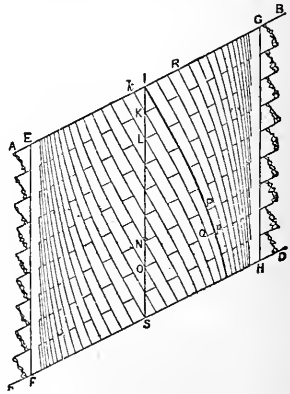

Fig. 8.

GH, the boundaries of the abutment walls placed obliquely, we easily perceive that the thrust cannot be perpendicular to the abutments, for then it would go out on the side walls which have no means of resistance; the thrust can only be resisted in the direction of the road. Hence if the structure be divided into a multitude of slices by vertical planes parallel to the parapet, the strains belonging to each slice must be resisted within that slice, and each should form an arch capable of standing by itself. The abutment, therefore, cannot have a continuous surface as in the common or right arch, but must be cut in steps to resist the oblique pressure; wherefore also the ultimate foundation stones must present surfaces perpendicular to the road.

Attending for the moment to one only of these divisions, say to a thin slice contiguous to the side wall EG, let us study the manner in which the arch-stones in it must be shaped. At the crown I the pressure is horizontal in the plane EIG, and therefore the joint of the stones there must be perpendicular to AB, and so also must be its projection on the horizontal plane.

Proceeding along the line of the curve to the point R, we observe that the pressure there must be in the direction of a tangent to the curve, wherefore the surface of a joint at R must be perpendicular to that tangent, and the exposed face of the stone must be right-angled. Now, the projection upon a horizontal surface of a right angle placed obliquely is not necessarily right; in this case it cannot be right, and therefore the course of a line of joints represented in plan must bend away from being perpendicular to the side wall towards being parallel to the line of the abutment. Thus a continuous course of joints beginning at I must be shown in plan by some curved line such as IPp.

In many of the skewed bridges actually built, the outline of the arch is divided into equal parts, as seen on the ends of the vault; the curved joint-lines IPp thus become portions of screws drawn on an oblique cylinder, and, although the arch-stone at the crown be rectangular, those on the slope cease to be so. The bearing surface is thus inclined to the direction of the pressure, and the tendency is to thrust out the arch-stones at the acute corners F and G. The fault is exactly the same as if, in ordinary building, the mason were to bed the stones off the level. The consequence is that skewed stone-bridges have not given satisfaction, the fault being attributed to the principle of the skew, whereas it should have been assigned to the unskilfulness of the design.

Let figure 9 be an elevation projected on a vertical plane parallel to AB, EIG, FSH, being the outlines of the ends

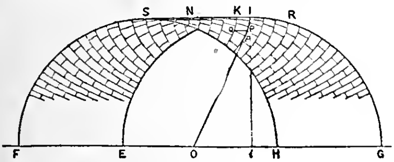

Fig. 9.

of the arch, and the sections taken at equal intervals along the crown line being also shown; then, since the projection of a right angle upon a plane parallel to one of its sides is always right, the joint at R, as seen on this elevation, must be perpendicular to the curve at R, and thus the curve IPp, representing one of the joint-courses, must cross each of the vertical sections perpendicularly. In this way each of the four-sided curvilinear spaces into which this elevation is divided must be right-angled at its four corners. This law is general, and enables us to determine the details of any proposed oblique arch.

If we draw, as in figure 9, the end elevation of the vault as intersected by numerous parallel planes, and lead a curved line crossing all these intersections perpendicularly, we obtain the end elevation of one of the joint-lines, and are able from it to prepare any other of its projections. The form and character of this end elevation IPp depends entirely on the nature of the curve EIG, but is the same whatever may be the angle of the skew. In order to examine its general character, let us take in the crown line two closely contiguous points I, K, and from these lead the joint-lines IP, KQ, of equal length, then the straight line PQ is equal and parallel to IK, on any of the projections.

If in the end elevation, figure 9, we continue the joint IP to meet the vertical section OQ in p, we may regard PQp as a small rectilineal triangle, right angled at p, while PQp is the inclination to the horizon. Now, $PQ : Qp :: R : \cos PQp$, while PQ is equal to KI, the breadth of the arch-stone at the crown, wherefore the breadth of the course at the crown is to the breadth of the same course at any other place as radius is to the cosine of the inclination there. Hence it follows, as is shown in the end elevation, figure 10, that the arch-stones gradually diminish in breadth from the crown downwards, being halved in breadth at an inclination of 60°. At a greater inclination they become

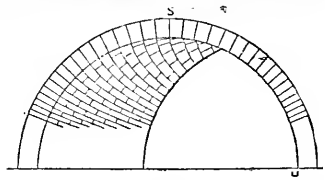

Fig. 10.

still narrower, and an infinity of them would be needed to reach the abutment of a semicircular or semi-elliptic arch, because the cosine of the inclination there is zero. In no properly-built skewed bridge can the arch-stones show equal divisions; and it is impossible to continue the arch to the complete half circle or half ellipse.

Passing from the end elevation, figure 9, to the plan, figure 8, we observe that Qp on the plan is less than the actual Qp of the elevation in the ratio of the cosine of the inclination to radius, and, therefore, on the plan, the breadth at the crown is to the apparent breadth of the course at any other place as the square of the radius is to the square of the cosine of the inclination there; so that, at the inclination of 60° the apparent breadth will be quarter of that at the crown.

Again, in figure 11, which is the side elevation of the vault, or its projection on a vertical plane perpendicular to the road, the apparent distance Qp is to the actual distance Qp of figure 9 as the sine of the inclination is to radius, wherefore, the apparent breadth Qp on this projection is proportional to

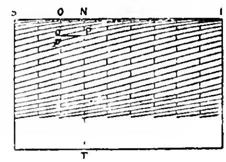

Fig. 11.

the product of the sine by the cosine of the inclination, that is, to half the sine of twice the inclination. The width on this projection is therefore greatest at an inclination of 45°, being there just one-half of the actual breadth at the crown of the arch

This reasoning is founded on the supposition that the distance IK is excessively small, and the resulting conclusions are strictly true only of an infinitely narrow course of arch-stones; they are, indeed, *differential equations* which must be *integrated* in order to be applied to actual practice. Thus we have seen that the curved line IP, figure 9, crosses the section NP perpendicularly at P, but then it does not continue in this direction for any perceptible distance. The draughtsman may attempt to trace it by making the sections very numerous, and by drawing perpendiculars across the successive intervals; but however numerous he may make these sections, he can thus only effect an approximation to the true curve. We must *integrate*, that is, we must obtain the aggregate of an infinite number of infinitely small portions in order to reach an absolutely true result.

These conclusions hold good whatever may be the outline of the arch. The most common, and therefore the most interesting case, is when the longitudinal section is circular, the cross section taken perpendicularly to the abutment being then an ellipse with its shorter diameter placed horizontally, the vault being an oblique cylinder. Figure 9 is actually drawn for the circular arch. If then O be the centre of the circular arc NP, the curve IP must at P tend towards O, so that the draughtsman, while making the step across one of the intervals, has only to keep his straight edge up to the corresponding place of the centre. If we place the paper horizontally, fix a small heavy round body at P to the end of a thread OP, and then draw the end O of that string along the straight line HEF, P would always move towards the then position of the point O, and would trace out the curve of which we are in search. The projection, then, of the joint of an oblique circular arch upon a vertical plane parallel to the road, is always the curve known by the name of the *Tractory.* All tractories have the same shape, the size merely is regulated by the length of the thread OP, that is, by the radius of curvature of the circular arch. Hence, if the delineation of it have been accurately made in one case, the curve for another case may be obtained by mere enlargement or reduction; or, still better, in all cases it may be traced by help of a table of co-ordinates, such as that subjoined, which shows the dimensions of the tractory as represented in figure 12, in decimal parts of the radius of curvature of

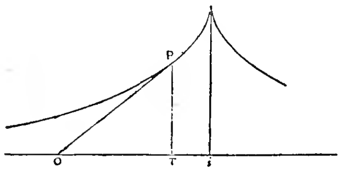

Fig. 12.

the arch. The computations have been made for equal motions of the point O, corresponding, therefore, to equal distances measured along the crown-line of the arch. The headings of the columns sufficiently explain their contents. By help of these the form of the tractory may easily be obtained, and with a piece of veneer or of thin metal cut to this shape, the architect may obtain all the details of the intended structure, first working out the said elevation, figure 9, and transferring the several points therefrom to the other projections.

If we put s for the angle of the skew, v for the distance IN measured along the crown of the vault, and i for the inclination at the point P, r being the radius of the arch, the distance IN or iO of figure 10 is clearly $v \sin s$, and as the result of the integration, we obtain—

$$\frac{v \sin s}{r} = \text{Nap. log tan } (45° + \tfrac{1}{2}i),$$

by help of which equation we can readily determine i when v is known, or v when i is given. The table of Napierian logarithmic tangents being very scarce, it is convenient to convert these into denary or common logarithms. Putting, as is usual, M for the modulus of denary logarithms, that is, for ·43429 44819, the above equation becomes—

$$\frac{\mathrm{M}}{r} \, . \, v \, . \sin s = \log \tan (45° + \tfrac{1}{2}i),$$

from which it is quite easy to tabulate the values of i corresponding to equidifferent values of v, because the constant factor—

$$\frac{\mathrm{M} \, . \sin s}{r}$$

has to be only once computed; i, that is, the number of degrees in the arc NP being thus computed for each of the successive sections of the vault, we have only to divide a tape-line so as to show degrees and minutes of the actual circle in order to be able at once to mark the course of the joints upon the centering of the arch; or better still, instead of the degrees, we may write upon the tape the successive values of NP, and then the commonest workman will be able to lay off the lines.

l	i		sin i	cos i	l-sin i
	°	′			
·0	0	00	·00000	1·00000	·00000
·1	5	43	·09967	·99502	·00033
·2	11	23	·19738	·98033	·00262
·3	16	56	·29131	·95663	·00869
·4	22	20	·37995	·92501	·02005
·5	27	31	·46212	·88682	·03788
·6	32	29	·53705	·84355	·06295
·7	37	11	·60437	·79670	·09563
·8	41	37	·66404	·74770	·13596
·9	45	45	·71630	·69779	·18370
1·0	49	36	·76159	·64805	·23841
1·1	53	11	·80050	·59933	·29950
1·2	56	29	·83365	·55229	·36635
1·3	59	31	·86172	·50738	·43828
1·4	62	18	·88535	·46492	·51465
1·5	64	51	·90515	·42510	·59485
1·6	67	10	·92167	·38798	·57833
1·7	69	18	·93541	·35357	·76459
1·8	71	14	·94681	·32180	·85319
1·9	72	59	·95624	·29259	·94376
2·0	74	35	·96403	·26580	1·08597
2·1	76	02	·97045	·24129	1·12955
2·2	77	21	·97574	·21892	1·22426
2·3	78	33	·98010	·19852	1·31990
2·4	79	38	·98367	·17995	1·41633
2·5	80	37	·98661	·16307	1·51339
2·6	81	30	·98903	·14773	1·61097
2·7	82	19	·99101	·13381	1·70899
2·8	83	02	·99263	·12117	1·80737
2·9	83	42	·99396	·10971	1·90604
3·0	84	18	·99505	·09933	2·00495
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The only other kind of skewed arch likely to possess any interest is the elliptic. In right arches the semi-ellipse is sometimes used on account of the grace of its form, but this reason for its adoption disappears in the case of the skew, because then we can only use a portion of the semi-ellipse. The end elevation of a joint in an elliptic skewed arch is a modified form of the tractory, and the general features of the arrangement are analogous to those of the circular arch.

The arch-stone of a common bridge is wedge-shaped, having two flat faces AacC, BbdD, inclined to suit the breadth of the course, but in the skewed bridge the corresponding faces are twisted, Cc not being parallel to Aa, and thus the dressing of them requires both skill and care. The dimensions of the stone and the inclinations of its four

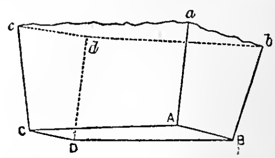

Fig. 13.

edges may easily be computed when its intended position is known, and thus the degree of twist on each of its faces may be ascertained, and the lines may then be marked off on the ends of the stone.

The theory of the skewed arch was given for the first time in the *Transactions of the Royal Scottish Society of Arts* for 1838; from which it was copied into the *Civil Engineer and Architect's Journal* for July 1840, which see. (For the history and various forms of the arch see ARCHITECTURE.) (E. S.)

ARCHÆOLOGY

ARCHÆOLOGY, from ἀρχαῖος, ancient, and λόγος, a description. The term *Archæology*, like that of *Antiquities*, has been employed, until a very recent period, in a sense so restricted and arbitrary as strikingly to contrast with the latitude admissible according to the original derivation of the word. Literally it signifies the study of antiquity or ancient things; but its precise significance has been determined from time to time by the range of study and research most in favour. To some extent it has always been recognised as embracing whatever pertained to the early history of any nation, but in its details it was applied almost exclusively to the study of Greek and Roman art, or of classical antiquities generally. The progress of geology, and the application of sound principles of induction to the study of primitive antiquities, have wrought a great revolution, and few studies now rival archæology in comprehensive interest.

In looking at the succession of strata of the earth's crust it was assumed till recently that the student of man and his remains is limited to the latest superficial formation of post-tertiary strata. To the palæontologist was assigned all ancient animal life of the fossiliferous strata, while the archæologist treated of man and his works as things essentially distinct. The diverse functions of the two sciences are still clearly recognised; but the archæologist is no longer supposed to be excluded either from quaternary or tertiary strata in his search not only for the remains of human art, but for the osteological evidences of man's presence contemporaneous with the fauna of such geological periods. One class of archæologists, accordingly, confidently anticipate the recovery not only of works of art, but of the fossil remains of man himself, in the pliocene, or even the miocene strata. So far, however, as any reliable evidence can guide opinion, it scarcely admits of question that neither has hitherto been found in older deposits than the later tertiary, or quaternary.

The actual remains of man, the specific form of his osseous structure, and above all of his skull, now receive the minutest attention; and the department of anthropology to which such investigations are specially assigned has latterly acquired a fresh interest from the inquiries suggested by novel theories as to the possible evolution of man from lower animal organisations. Nevertheless, the researches of the palæontologist and of the archæologist are based on essentially distinct evidence. The life of geological periods is investigated by means of the fossil bones and teeth which alone survive. Or if to these have to be added such illustrations of habits, food, and structure as are furnished by means of footprints, coprolites, and the like subsidiary evidence, still all are traceable, directly or indirectly, to the living organism. Man, on the contrary, in times altogether preceding history, is chiefly studied by means of his works. Archæology thus forms the intermediate link between geology and history, though the reaction, at the revival of learning in the 16th century, which tended for a time to subordinate arts and science alike to classical authority, reduced it within greatly narrower limits. Nevertheless, the fitness of the term for the most comprehensive definition in relation to all which pertains to the past could not be entirely overlooked, and it is even employed repeatedly by Dr Prichard as nearly synonymous with palæontology. In this, however, he has not been followed, and the name is now universally adopted to designate the science which deduces the history of man from the relics of the past. So comprehensive a subject necessarily admits of great subdivision. The most important general division will be treated of separately in the article on CLASSICAL ARCHÆOLOGY (p. 343, *sqq.*), while interesting branches of the study will be reviewed under the heads of Egyptian, Etruscan, Assyrian, Mexican, and Indian antiquities. Numismatics, pottery, heraldry, hieroglyphics, palæography, and other subdivisions in like manner deal with important details, and help to illustrate the comprehensiveness of the subject.

The innate cravings of the human mind for an insight into the future have shaped themselves into many forms of divination and astrology. But this desire is not more universal than that which prompts man to aim at a recovery of the secrets of the past. The question *Whence?* even more than that of *Whither?* is found to give shape to the mythic legends of the rude barbarian, and to constitute an important element in the poetry and mythology of every nation's oral and written history. With the progress of society such indices of the past are subjected anew to critical analyses; and we accordingly find abundant traces of an archæological spirit in the literature of every civilised nation. The influence of the same craving for a mastery of the past is seen adapting itself to the spirit of the age at every epoch of great progress. The revival of art and letters in the 14th and 15th centuries was signalised by a renewed appreciation of Greek and Roman models; and while the progress of opinion in the 16th century was accompanied by an abandonment of mediæval for classic art, the tendency of Europe in our own day, amid many elements of progress, has been singularly consentaneous in the return not merely to mediæval art, but to mediæval modes and standards of thought, and in the attempt to attain to higher excellence than has been yet achieved by a more perfect development of the ideal of the middle ages.

The alliance of archæology with geology, and the direction of geological research to the evidences of the antiquity of man, have largely contributed to its expansion, until in its comprehensive unity it embraces the entire range of human progress from the infantile stage of primeval arts to the earliest periods of written records. It has thus been developed into a systematic science, by which the intelligent investigator is enabled to pursue his researches with the aid of evidence older than all written chronicles, and to recover chapters of national infancy and youth heretofore deemed beyond recall. The geologist, with no aid from written records, follows out his inquiries through successive periods of the earth's history, and reveals the changes it has undergone, and the character of the living beings which animated epochs of the globe ages before man was called into being. Beginning with the traces of life in the primary fossiliferous strata, he passes on from system to system, disclosing a vast succession of long extinct life, until in the latest diluvial formations he points to the remains of animals identical with existing species, and even to traces of human art—the evidence of the close of geological and the beginning of archæological periods. Here archæological science ought to be ready to take up the narrative, and with a more comprehensive minuteness of detail and greater certainty as to the conclusions arrived at. Such, however, until very recently, has not been the case. The geologist himself long confused the records of the transitional period by his mistaken reference of all diluvial traces to the Noachian deluge; and when, pausing, as he thus believed, at the dawn of the historic period, he turned to the archæologist for the subsequent chapters of the history of life on our globe, it was only to receive a record of Roman traces at best but meagrely supplementing the minuter details of the historian. Nearly the same was the case with all historic antiquity, with the single exception of the wonderful monuments of Egypt, which preserve to us the records of a civilisation in which we can recognise the origin of arts, letters, and all else to which the culture of the oldest historical nations may be traced.

Nevertheless, the evidences of the primitive arts, and the traces of a native civilisation originating among the prehistoric races of Europe, had been long familiar to the antiquary, though he failed to form any intelligent conception of their significance as historical records. Their interpretation on an intelligent and systematic principle is mainly due to the archæologists and ethnologists of Denmark and Sweden, who from their very geographical position were happily freed from the confusing element of classical prejudices, and were compelled to seek in other than Roman sources an origin for the abundant traces of metallurgic art. Zealous British coadjutors speedily caught the hint, and freed themselves from the trammels which had so long narrowed their aim; the remains of primitive art were referred to true sources, or at least arranged under an intelligent system of chronological sequence; and thus the desultory and often misdirected labours of the antiquary have given place to researches characterised by scientific accuracy.

The system of primitive archæology thus introduced has since been modified and carried out into ampler details, as the fruit of more extended discoveries, chiefly effected in France and England; but the three primary divisions, the Stone, the Bronze, and the Iron Periods, are still retained. The arrangement is warranted alike by evidence and by its practical convenience, though later research has given to the stone period a comprehensiveness undreamt of before, and so led to its subdivision into two ages of prolonged duration, with distinctive characteristics of primitive art. (1.) The Stone Period, as the name implies, is that in which the rude aboriginal arts, which the commonest necessities of man call into operation, are assumed to have been employed entirely on such available materials as stone, horn, bone, &c. (2.) The Bronze Period may in like manner admit of subdivision, though the term is conveniently employed, in its most comprehensive sense, for that era of progress in which the metallurgic arts appear to have been introduced and slowly developed—first, by the simple use of native copper, followed by the application of fire, the construction of moulds, and the discovery of such chemical processes as the alloying of copper and tin, and the consequent production of the beautiful and useful alloy which gives name to this the earlier metallurgic era. (3.) The Iron Period marks the era of matured metallurgic arts, and the accompanying progress consequent on the degree of civilisation which is the inevitable concomitant of such a state of things. While, however, those divisions hold good in their general application, they must not in every case be applied too rigidly. The archæologist is constantly recalled to the distinction between the researches of the palæontologist, as dealing with the traces of organic life, and his own study of the works of a rational being marked by all the diversities traceable to the reasoning and volition of the individual workman. Local facilities have also modified the arts of primitive man in various ways. In some localities, as in North America, pure native copper abounds; while on the other hand, in certain districts of Africa iron occurs in such a condition that it appears to have been wrought by the primitive metallurgist from very remote times.

All those periods embrace eras concerning which no contemporary written records exist; and in relation to most of them nearly as little is known directly as of the older periods with which the geologist exclusively deals. It need not therefore excite surprise that the process of induction established on this basis has been challenged by historical writers of high standing, but whose exclusive labours on the records of periods admitting of documentary evidence and charter proof render them little disposed to sympathise with a course of reasoning relative to the history of man, such as has, in the hands of the geologist, revealed so much in relation to more ancient life. The further, however, that research is pursued, alike into the habits of living races of savages, and into the characteristics of the oldest traces of primitive art, the more clearly does such a process of development, from the first rude working in stone to the highest arts of the skilled metallurgist, become manifest.

The Australians, the Maories of New Zealand, and the whole widely-scattered races of the Polynesian Islands, the Caribs and other natives of the American archipelago, with all the nomade tribes of the New World, from Patagonia to the Arctic circle, were, when first discovered, without any knowledge of the metals as such, and supplied their wants by means of implements and weapons of stone, shell, bone, or wood. The civilised Mexicans and Peruvians, on the contrary, when first visited by the Spaniards in the 16th century, were familiar with the working of copper as well as gold,—though totally ignorant of iron, and also retaining for common purposes many of the primitive stone weapons and implements, only substituting the abundant obsidian of their volcanic region for flint. Greece passed from its bronze to its iron age within the period embraced in its literary history; and the mastery of the art of working the intractable iron ore is traceable with tolerable clearness in the early history of Rome, not very long before it came in contact with the trans-Alpine barbarians. Among most of the Germanic and Celtic tribes iron appears to have been already known when they first came in contact with the aggressive civilisation of the south; and from one of them, the Norici (in whose country, in the Austrian valleys of the Danube, this metal is still wrought with the highest skill), there is reason to believe that the Romans acquired the art of making steel.

If history is only to begin, as that of Britain has been made to do, with the date of the first collision with invading Rome, then, no doubt, stone and bronze periods are as meaningless as are eocene and miocene periods to the geologist who assigns the Mosaic deluge as the source of the earliest phenomena of his science. To those, however, who are willing to follow inductive reasoning to its legitimate conclusions it must be apparent that it is no visionary theory, but a system founded in well-established truth, which arranges the archæological records of primitive history and the remains of human art into stone, bronze, and iron periods. Even here, however, an important distinction in the employment of such materials as a basis of inductive reasoning indicates the greatness of the revolution involved in the introduction among the living creatures inhabiting this earth of a being endowed with intelligence, and supplementing the natural resources of animal life by arts even of the most primitive kind. It must indeed be borne in remembrance that geological and historical chronology are very different things, and that the idea implied in the contemporaneousness of strata bears a very slight approximation to the coincidence of contemporaneous events and productions of an historical era. The doctrine of geological continuity is indeed challenged in certain respects; but on the whole, the geological formations, with their included organic remains, may be assumed to obey a natural and unvarying order; and so, within the compass of geological periods, to be of contemporaneous origin. But, notwithstanding certain extreme assumptions, based on the theory of evolution, and involving the consequent existence of man in remote geological eras, so far as all actual evidence can yet guide us, it is correct to say that, geologically speaking, the entire history of man is embraced in one period. But in the works of art, which form the bases of archæological induction, a new element—that of mind, or the reasoning faculty, along with the imitative and social arts—is introduced, and greatly complicates its subdivisions. The stone period of Britain or Denmark is analogous to that of the Polynesian Islands. So closely do their tools and weapons resemble each other that it requires a practised eye to distinguish the stone axe or flint lance-head found in an ancient British barrow from implements brought by some recent voyager from the islands of the Southern Ocean. Nor could the most experienced archæologist undertake in every case to discriminate between the flint arrow-head dug from some primitive barrow of undated centuries before the Christian era, and the corresponding weapon brought by some recent traveller from Tierra del Fuego or regions beyond the Rocky Mountains. The inference is therefore legitimate, that in those Polynesians, Fuegians, or Indians of the North-West, we have examples of tribes in the same primitive stage as were the aborigines of Europe during its stone period. Chronologically, however, the stone period of Europe and that of the Pacific islands or the American continent are separated by thousands of years. In like manner, the bronze age of Mexico was undisturbed by all later elements when first brought into contact with the matured civilisation of Europe in the 16th century, while the close of that of Britain preceded the 1st century of our era. The same rule is applicable to the primitive archæology of all countries; and a fertile source of error and misconception has already had its rise in the assumption that because Greece and Italy, Germany, Gaul, Scandinavia, and Britain, have all had their primitive stone and bronze periods, therefore the whole must have been contemporaneous. It cannot therefore be too strongly enforced as one of the most essential points of variance in the reasoning of the geologist and the archæologist, that the periods of the latter, though synonymous, are not necessarily synchronous; but that, on the contrary, nearly all the phenomena which pertain to the *natural history* of man, and to the historic development of the race, may be witnessed in their various stages in contemporary races of our own day—from rudimentary barbarism, and the absence of all arts essential to the first dawn of civilisation, to a state of greatest advancement in the knowledge and employment of such arts.

Some progress has already been made in an approximation to certain chronological data of much importance relative to such primitive periods of the history of nations. But the archæologist, as well as the geologist, is learning to deal with periods of time which cannot always be measured either by years or centuries, but rather must be gauged by those chronological stages in the history of our planet in which epochs and periods take the place of definite subdivisions of solar time. Nevertheless, geological evidence of changes which are known to have occurred within the historic period supplies an important key to the approximate duration of certain eras characterised by traces of human art; and while by the intelligent observation of such remains in the superficial strata, mingling with the fossil evidences of extinct and familiar species of animal life, the link is supplied by which man takes his place in an unbroken chain of creative existence, sweeping back into so remote a past, the evidences of matured art pertaining to periods unrecorded by history supply later links of the same chain, and reunite the present with all former ages.

The system of primitive archæology which is found applicable to British antiquities so closely corresponds in all its essential features to that of Europe prior to the era of authentic history, that the purpose of such an abstract as this will be most conveniently accomplished by presenting its leading points as examples of the whole, illustrating these in passing by the analogous remains discovered in other countries. The apparent simplicity of a primitive stone period has been considerably modified by recent research; and the careful study of the remains of ancient art, in their relation to accompanying geological phenomena, or of the evidences of artificial deposition in caves, barrows, chambered cromlechs, cairns, or other sepulchral structures, suggests the subdivision of prehistoric archæology into a succession of epochs included within the period of non-metallurgic arts.

But before defining the archæological subdivisions of time it is indispensable to glance at the palæontological elements of the question, and the evidences they supply in relation to comparative chronology. One of the most remarkable phenomena affecting the conditions of life in Europe in recent geological epochs is the existence of a period, of long duration throughout the northern hemisphere, of a temperature resembling that of the Arctic regions at the present time. After a period more nearly approximating in its conditions the heat of the tropics at the present day, though otherwise under varying states towards the end of the tertiary epoch the temperature of the whole northern hemisphere gradually diminished, until the mountainous regions of Scotland and Wales—then probably of a much higher elevation—resembled Greenland at the present time; and this Arctic temperature gradually extended southwards to the Alps and the Pyrenees. The glaciers formed under the influence of perpetual frost and snow descended from those and other mountains into the valleys and plains over the greater portion of central Europe and northern Asia; and this condition of things, pertaining to what is known as the *glacial period*, was one of greatly prolonged duration.

After some partial modifications of this low temperature, and a consequent advance and retrocession of the glacial influences in France and elsewhere, along what was then the border lines of a north temperate zone, the glacial period drew to a close; a gradual but persistent rise of temperature carried the lines of ice and perpetual snow further and further northward, excepting in regions of great elevation, as in the Swiss Alps. This was necessarily accompanied by the melting of the vast glaciers accumulated in the mountain valleys throughout the protracted period of cold. The broken rocks and soil of the highlands were swept into the valleys by torrents of melted ice and snow; the lower valleys were hollowed out and re-formed under this novel agent; and the landscape received its present outlines of valley, estuary, and river-beds from the changes wrought in this *diluvian epoch*. The enormous power of the torrents thus acting continuously throughout a period of prolonged duration, and the vast deposits of sand, gravel, and clay, with the embedded remains of contemporaneous animal and vegetable life with which they everywhere covered the plains, were viewed till recently solely in relation to the Mosaic narrative of a universal deluge, and were referred implicitly to that source. But recent though the epoch is when compared with older geological periods, its antiquity is enormous in relation to historic chronology; and instead of being the product of a sudden cataclysm of brief duration, it represents phenomena which required a period of long protracted centuries for their evolution.

Within this late tertiary, or quaternary, period are found the remains of animal life contemporary with primeval man and his earliest arts. The very characteristics of some of the fossil mammals of the period, so diverse from all that we have been accustomed to associate with man, help to suggest ideas of even an exaggerated antiquity for the era to which they are assignable, and to relegate it to the remotest conceivable antiquity consistent with all other evidence of the oldest traces of man or his arts seemingly contemporaneous with them. Of those now wholly extinct, the mammoth or *Elephas primigenius*, the *Elephas antiquus*, the *Rhinoceros tichorinus*, the *Hippopotamus major*, and such great cave carnivora as the *Ursus spelæus* and the *Felis spelæa*, are most noticeable for their great size, and in some cases for their enormous destructive powers, in striking contrast to the seemingly helpless condition of primitive man. Yet even some of those formidable mammalia probably owed their extinction fully as much to the presence of man as to any change in temperature and consequent alteration in the required conditions of climate and habitat. We are accustomed to regard the lion, tiger, leopard, panther, and others of the great *Felidæ* as pertaining exclusively to tropical countries. They are in reality limited to tropical jungles and uncultivated regions of great extent, where the abundance of wild vegetable-feeding animals supplies their food. The existence of neither is compatible with the presence of man in any great numbers; but in his absence those beasts of prey greatly extend their range. The Indian tiger not only follows the antelope and deer in the Himalayan chain to the verge of perpetual snow, but the tiger, leopard, panther, and cheetah hunt their prey beyond that mountain range, even into Siberia.

The influence of man in the extirpation of the wild fauna is illustrated by another class of extinct animals of many historical regions, which yet survive in more favourable localities. The discovery of abundant evidence of a period in the history of central and southern France when the reindeer (*Cervus tarandus*) formed one of the chief sources both for the food of man and for the materials from which his weapons and implements were made, seems to carry us back to an era, inconceivably remote, when central France was in the condition of Lapland in mediæval or still earlier centuries. But the climate of North Britain is not even now incompatible with the existence of the reindeer, and its favourite moss abounds in many parts of the Highlands. It need not therefore surprise us to learn that traces of the reindeer are by no means rare in Scotland; and numerous examples of its horns have recently been recovered in more than one Caithness locality, with the marks of sawing and cutting for artificial use, and lying among other remains in stone-built structures of a primitive population of North Britain. How old they are may not be strictly determinable, but they help us to the acceptance of a very modern date for the presence of the reindeer there; for Torfæus states that so recently as the twelfth century the Jarls of Orkney were wont to cross the Pentland Firth to chase the roe and the reindeer in the wilds of Caithness. At the same date also we find the skin of the beaver rated for customs duties amongst articles of Scottish export specified in an Act of the reign of David I.

Another very characteristic animal pertaining to the prehistoric era of European man is the *Megaceros Hibernicus*, or gigantic Irish elk. Its bones occurred with those of the *Elephas primigenius*, the *Rhinoceros tichorinus*, the *Ursus spelæus*, and other extinct mammals, alongside of human remains and works of art, in the famous Aurignac cave of the Pyrenees; and in the recently-explored Brixham cave, on the Devonshire coast, similar remains of the fossil rhinoceros, horse, and reindeer, as well as of several extinct carnivora, lay embedded in the same breccia with flint knives. And not only have the horns and bones of the *Megaceros Hibernicus* been recovered from Irish bogs and marl-pits, with marks of artificial cutting, but a rude Irish lyre, found in the moat of Desmond Castle, Adare, has been pronounced by Professor Owen to be made from the bone of this extinct deer.

So is it with the ancient *Bovidæ*, not only adapted for the chase, but suitable for domestication; such as the *Bos primigenius*, the *Bos longifrons*, and the *Bison priscus*. Their remains have been found in submarine forests, or mingling in the drift or cave deposits with the *Elephas primigenius*, the *Felis spelæa*, and others of the most gigantic fossil mammals; while abundant traces reveal their existence not merely contemporaneous with man, but within definite historical periods.

The great alluvial valley of the river Forth has yielded another class of relics connecting the gigantic fossil mammalia of a prehistoric epoch with man. The disclosures of the Carse of Falkirk have repeatedly included remains of the *Elephas primigenius:* and in at least one case its tusks were found in such perfect condition as to be available for the ivory-turner, though lying embedded at a depth of 20 feet in the boulder clay. But in the neighbouring valley of the Forth the fossil whale (*Balænoptera*) has not only been repeatedly found far inland, buried in the alluvial soil, at levels varying from 20 to 25 feet above high-water mark, but in at least two instances the rude lance or harpoon of deer's horn lay alongside of the skeletons; and near another of them were found pieces of stag's horn, artificially cut, and one of them perforated with a hole about an inch in diameter. Flint implements, an oaken quern, and other ingenious traces of primitive art, recovered from the same alluvial soil, all tell of a time when the British savage hunted the whale in the shallows of a tide at the base of the Ochil hills, now between 20 and 30 feet above the highest tides and 7 miles distant from the sea.

There is no doubt that the disappearance of the whale from the British shores, like the reindeer from its northern valleys, is due far more to the presence of man than to any change of temperature so greatly affecting the conditions of life as to involve their extinction. Nevertheless it is convenient to recognise in the disappearance of such emigrant species from the historic areas the close of the palæontological age. The Urus, the Aurochs, the *Bos longifrons*, or native ox of the Roman period, and others of that important class of animals which man first began to turn to account for domestication, have also ceased to exist among European fauna; but this is clearly traceable to the destructive presence of man. Within three or four centuries the Urus (*Bos primigenius*) was still known in Germany; the Aurochs (*Bos priscus*) is even now preserved under special protection in Lithuania; and herds of British wild cattle in Cadzow forest, Lanarkshire, and at Chillingham Park, Northumberland, perpetuate varieties otherwise extinct.

Reverting, then, to the classification which prehistoric archæology admits of, in the light of its most recent disclosures, it appears to be divisible into four distinct epochs, of which the first two embrace successive stages of the age of stone implements.

1. The *Palæolithic Period* is that which has also been designated the Drift Period. The troglodytes, or cave-dwellers, of this primitive era were to all appearance contemporaneous with the mammoth, the woolly-haired rhinoceros, and the great cave carnivora already named. In England, France, Belgium, and other countries of Europe, numerous caves have been explored which were undoubtedly the habitations and workshops of the men of this period. These caverns vary in character and dimensions according to the geological features of the localities where they occur; but all alike involve the simple feature

of recesses, more or less ample, affording comparatively dry and commodious shelter, and so being resorted to as places of habitation alike by wild animals and by man himself But the most valuable for the purposes of the archæologist are a class of caverns which occur in limestone districts, and which, from the combined mechanical action of the water operating on a rock easily eroded, and its chemical action when charged with a certain amount of carbonic acid in dissolving the calcareous rock, are found expanded into long galleries and chambers of large dimensions. There the same chemical agents, acting under other circumstances, have dissolved the limestone rock, and sealed up the ancient flooring at successive intervals, thereby furnishing a test of the duration of long periods of alternate action and repose, and yielding evidence of the most indisputable kind as to the order of succession of the various deposits and their included bones and implements.

In Belgium, at Dordogne, and in some parts of the south of France, the caves and rock-recesses are of a much simpler character. Yet there also favouring circumstances have preserved contemporary deposits of the ancient cave-dwellers, their works of art, the remains of their food, and even their cooking hearths.

The caves of the drift period accordingly present peculiarly favourable conditions for the study of the post-pliocene period. Some of these caverns were evidently first occupied by the extinct carnivora of that period, as in the case of the famous Kent's Hole Cave of Devonshire, of which the lowest deposit is a breccia of water-worn rock and red clay, interspersed with numerous bones of the *Ursus spelæus*, or great cave-bear. Over this a stalagmitic flooring had been formed, in some places to a depth of several feet, by the long-protracted deposition of carbonate of lime held in solution in the drippings from the roof. Above this ancient flooring, itself a work of centuries, later floods had superimposed a thick layer of "cave-earth," in some cases even entirely filling up extensive galleries with a deposit of drift-mud and stones, within which are embedded the evidences of contemporaneous life—bones and teeth of the fossil elephant, rhinoceros, horse, cave-bear, hyæna, reindeer, and Irish elk; and along with these, numerous weapons and implements of chipped flint, horn, and bone—the unmistakable proofs of the presence of man. These, again, have been sealed down, in another prolonged period of rest, by a new flooring of stalagmite; and thus the peculiar circumstances of those cave deposits render them specially favourable for the preservation of a coherent record of the period. Here are the evidences of the animal life contemporaneous with the men of the caves during the drift period, here also are many of their smaller flint implements—the flint-cores and the chips and flint-flakes, showing where their actual manufacture was carried on; and the lances, bodkins, and needles of bone, which could only have been preserved under such favouring circumstances.

But besides the actual deposits in the caves, the river gravels of the same period have their distinct disclosures. The spear-heads, discs, scrapers, and other large implements of chipped flint are of rare occurrence in the cave breccia. Their size was sufficient to prevent their being readily dropt and buried beyond reach of recovery in the muddy flooring of the old cave dwelling; and the same cause preserved them from destruction when exposed to the violence involved in the accumulation of the old river drifts. In the north of France, and in England from Bedfordshire southward to the English Channel, in beds of ancient gravel, sand, and clay of the river valleys, numerous discoveries of large flint implements have been made—from the year 1797, when the first noted flint implements of the drift were discovered in the same stratified gravel of Hoxne, in Suffolk, in which lay bones of the fossil elephants and other extinct mammalia. The characteristics of the river-drift implements, as well as of the whole art of the stone age, have been minutely described and illustrated in various works, but especially in Evans's *Ancient Stone Implements, Weapons, and Ornaments of Great Britain.* It is sufficient, therefore, to refer to such authorities for details.

But besides the numerous specimens of the manufactures in flint, horn, and bone, illustrative of the mechanical ingenuity of this primitive era, special attention is due to the actual evidences of imitative and artistic skill of the sculptors and draughtsmen of the same period.

Different attempts have been made, especially by French *savans*, to subdivide the palæontologic age of man into a succession of periods, based chiefly on the character of the mammalian remains accompanying primitive works of art; and the two great subdivisions of the elephantine or mammoth age and the reindeer age have been specially favoured. Among the works of art of the cave-men of Perigord, in central France, contemporary with the reindeer, various drawings of animals, including the reindeer itself, have been found incised on bone and stone, apparently with a pointed implement of flint. But the most remarkable of all is the portrait of a mammoth, seemingly executed from the life, outlined on a plate of ivory found in the Madelaine Cave, on the river Vezère, by M. Lartet, when in company with M. Verneuil and Dr Falconer. If genuine—and the circumstances of the discovery, no less than the character of the explorers, seem to place it above suspicion—this most ancient work of art is of extreme value. The skulls and other remains of five individuals have been found to illustrate the men of this period. The cerebral development is good, and alike in features and form of head they compare favourably with later savage races. Their drawings embrace animals, single and in groups, including the mammoth, reindeer, horse, ox, fish of different kinds, flowers, ornamental patterns, and also ruder attempts at the human form. They also carved in bone and ivory. Some of the delineations are as rude as any recent specimens of savage art, others exhibit considerable skill; but the most remarkable of all is the representation of the mammoth. It has been repeatedly engraved, and as, to all appearance, a genuine contemporary effort at the portraiture of that remarkable animal, its worth is considerable. But this sinks into insignificance in comparison with its value as a gauge of the intellectual capacity of the men of that remote age. It represents the extinct elephant, sketched with great freedom of hand, and with an artistic boldness in striking contrast to the laboured efforts of an untutored draughtsman. Whatever other inference be deduced from it, this is obvious, that in intellectual aptitude the palæolithic men of the reindeer period of central France were in no degree inferior to the average Frenchman of the 19th century.

2. This first or palæolithic period, with its characteristic implements of chipped flint, belonging to an epoch in which man occupied central Europe contemporaneously with the mammoth, the cave-bear, and other long-extinct mammals, was followed by the second or *Neolithic Period*, or, as it has been sometimes called, the Surface-Stone Period, in contradiction to the Drift Period, characterised by weapons of polished flint and stone. The discovery and exploration of the ancient *Pfahlbauten* or lake villages of Switzerland and other countries, including the crannoges of Ireland and Scotland, and of the *kjökken-möddings* or refuse-heaps of Denmark, Scotland, and elsewhere, have greatly extended the illustrations of this period, and given definiteness to the evidences of its antiquity. But while it thus includes works of a very remote epoch, it also

embraces those of later regular sepulture, with the sepulchral pottery of rudest type, the personal ornaments and other remains of the prehistoric races of Europe, onward to the dawn of history. It even includes the first traces of the use of the metals, in the employment of gold for personal adornment, though with no intelligent recognition of its distinction from the flint and stone in which the workmen of this neolithic period chiefly wrought.

The nearly indestructible nature of the materials in which the manufacturers alike of the palæolithic and the neolithic period chiefly wrought, helps to account for the immense number of weapons and implements of the two prolonged ages of stone-working which have been recovered. The specimens now accumulated in the famous collection of the Christiansborg Palace at Copenhagen amount to several thousands. The Royal Irish Academy, the Society of Antiquaries of Scotland, the British Museum, and other collections, in like manner include many hundreds of specimens, ranging from the remotest periods of the cave and drift men of western Europe to the dawn of definite history within the same European area. They include hatchets, adzes, gouges, chisels, scrapers, discs, and other tools in considerable variety; axes, lances, spear and arrow heads, mauls, hammers, and other weapons and implements of war and the chase; besides a variety of utensils, implements, and ornaments, with regard to which we can but vaguely guess the design of their construction. Many of these are merely chipped into shape, sometimes with much ingenuity, in other cases as rudely as the most barbarous and massive implements of the palæolithic period. But from their association, in graves or other clearly-recognised deposits of the later period, with ground and polished implements, and even occasionally with the first traces of a time when the metals were coming into use, there is no room to question their later origin. In part they may be legitimately recognised, like the whole elements of archæological classification, to mark different degrees of rudeness in successive steps towards civilisation; in part they indicate, as in manufactures of our own day, the economy of labour in roughly-fashioned implements designed only for the rudest work, or for missiles the use of which involved their loss.

To the same primitive period of rude savage life must be assigned the rudiments of architectural skill pertaining to the *Megalithic Age*. Everywhere we find traces, alike throughout the seats of oldest civilisation and in earliest written records, including the historical books of the Old Testament Scriptures, of the erection of the simple monolith, or unhewn pillar of stone, as a record of events, a monumental memorial, or a landmark. There is the Tanist Stone, or kingly memorial, like that set up in Shechem when Abimelech was made king; the Hoar Stone, or boundary-stone, like "the stone of Bohan, the son of Reuben," and other ancient landmarks of Bible story; the Cat Stone, or battle-stone, a memorial of some great victory; and the stone set up as the evidence of some special treaty or agreement, like Laban and Jacob's pillar of witness at Galeed. To the same primitive stage of architecture belong the cromlech, the cairn, the chambered barrow, and other sepulchral structures of unhewn stone; as well as the weems, or megalithic subterranean dwellings common in Scotland and elsewhere, until, with the introduction of metals and the gradual mastery of metallurgic art, we reach the period of partially hewn and symmetrical structures, of which the great temple of Stonehenge is the most remarkable example. But it is in Egypt that megalithic architecture is seen in its most matured stage, with all the massiveness which so aptly symbolises barbarian power, but also with a grandeur, due to artistic taste and refinement, in which the ponderous solidity of vast megalithic structures is relieved by the graces of colossal sculpture and of an inexhaustible variety of architectural detail. There appears to be a stage in the development of the human mind in its progress towards civilisation when an unconscious aim at the expression of abstract power tends to beget an era of megalithic art. The huge cromlechs, monoliths, and circles still abounding in many centres of European civilisation perpetuate the evidence of such a transitional stage among its prehistoric races. But it was in Egypt that an isolation, begot by the peculiar conditions of its unique physical geography, though also perhaps ascribable in part to certain ethnical characteristics of its people, permitted this megalithic art to mature into the highest perfection of which it is capable. There the rude unhewn monolith became the graceful obelisk, the cairn was transformed into the symmetrical pyramid, and the stone circles of Avebury and Stonehenge, or the megalithic labyrinths of Carnac in Brittany, developed into colonnaded avenues and temples, like those of Denderah and Edfu, or the colossal sphinx avenue of Luxor.

Elaborately-finished axes, hammer-heads, cups, and vases of the late neolithic era serve to illustrate the high stage to which the arts of a purely stone period could be advanced, in the absence of any process of arrestment or change. But long before such a tendency to development into ornamental detail and symmetrical regularity of construction could be brought to bear on the megalithic architecture of the same era, the metallurgic sources of all later civilisation had begun to supersede its rude arts. To such remote eras we strive in vain to apply any definite chronology. At best we work our way backwards from the modern or known into the mysterious darkness of remotest antiquity, where it links itself to unmeasured ages of geological time. But by such means science has been able to add a curious chapter to the beginnings of British and of European story, involving questions of mysterious interest in relation to the earliest stages in the history of man. The very characteristics which distinguish him in his rudest stage from all other animals have helped from remotest times to perpetuate the record of his progress.

The evidences of the various acquirements and degrees of civilisation of the prehistoric races of Britain are derived not only from weapons, implements, pottery, and personal ornaments found deposited in ancient dwellings and sepulchres; but from still older traces supplied by chance discoveries of the agriculturist, miner, and builder, such as the implements of the ancient whalers of the Forth, or the monoxylous oaken canoes dug up from time to time in the valley of the Clyde, or even beneath some of the most ancient civic foundations of Glasgow. Both alike pertain to areas of well-defined historical antiquity, from the very dawn of written history, or of literate chronicles in any form; and both also have their geological records, preserving the evidence of changes of level in unrecorded centuries subsequent to the advent of man, when the whales of the Forth and the canoes of the Clyde were embedded in the alluvium of those river-valleys, and elevated above the ancient tide-marks of their estuaries. Another change of level, possibly in uninterrupted continuance of the ancient upheaval, has been in progress since the Roman invaders constructed their military roads, and built their wall between the Forth and the Clyde, in the 1st and 2d centuries of the Christian era.

By evidence such as this a starting-point is gained whence we may confidently deduce the colonisation of the British Islands, and of the north of Europe, at periods separated by many centuries from that in which our island first figures in history. The researches of the ethnologist add to our knowledge of this unrecorded era, by disclosing some of the physical characteristics of the aboriginal races, derived from human remains recovered in cave-drifts, ancient mining shafts, bogs, and marl-pits, or found in the most ancient sepulchres, accompanied by rudest evideuces of art; and the researches of Nillson, Eschricht, Gosse, Rathke, Broca, and other Continental ethnologists, along with those which have been carried on with minute care in the British Islands, disclose characteristic cranial types indicating a succession of prehistoric races different from the predominant types belonging to the historical period of Europe; and some of them probably contemporaneous with the changes indicated in the periods of archæological time.

The very latest stage of archæological antiquity, when it seems to come in contact with the dawn of historic time, was unquestionably one of complete barbarism, as is sufficiently apparent from its correspondence to that which the intercourse with European voyagers is bringing to a close among the islands of the Pacific. The ancient Scottish subterranean dwellings termed weems (Gaelic *uamhah*, a cave), or "Picts' houses," have been frequently found, apparently in the state in which they must have been abandoned by their original occupants; and from those we learn that their principal aliment must have been shell-fish and crustacea, derived from the neighbouring sea-beach, along with the chance products of the chase. The large accumulations of the common shell-fish of our coasts found in some of those subterranean dwellings is remarkable; though along with such remains the stone quern or hand-mill, as well as the ruder corn-crusher or pestle and mortar, repeatedly occur; supplying the important evidence that the primitive nomade had not been altogether ignorant of the valne of the cereal grains.

The source of change in Britain, and throughout Europe, from this rude state of barbarism, is clearly traceable to the introduction of metals and the discovery of the art of smelting ores. Gold was probably the earliest metal wrought, both from its attractive appearance, and from its superficial deposits, and the condition in which it is frequently found, rendering its working an easy process. Tin also, in the south of Britain, was wrought at the very dawn of history: and, with the copper which abounds in the same district of country, supplied the elements of the new and important compound metal, bronze.

3. This accordingly indicates the transition from the later stone age to the third or *Bronze Period*, which, beginning apparently with the recognition of the native copper as a malleable metal, and then as a material capable of being melted and moulded into form by the application of heat, was followed up by the art of smelting the crude ores so as to extract the metal, and that of mixing metals in diverse proportions so as to prepare an alloy of requisite ductility or hardness, according to the special aims of the artificer.

Along with the full mastery of the working in copper and bronze the skill of the goldsmith was correspondingly developed; and the ornaments of this period, including torques, armlets, beads, and other personal decorations and insignia of office, wrought in gold, are numerous, and often of great beauty. The pottery of the same period exhibits corresponding improvement in material, form, and ornamentation; though, considering the mimetic and artistic skill shown in the drawings and carvings of the remotest periods, it is remarkable that the primitive pottery of Europe is limited, alike in shape and decoration, to purely arbitrary forms. This in its crudest conventionalism consists almost exclusively of varieties of zigzag patterns scratched or indented on the soft clay. This primitive ornamentation seems so natural, as the first æsthetic promptings of the human mind, that it is difficult, if not in some cases impossible, to distinguish between the simple pottery of comparatively recent origin, recovered on the sites of old American Indian villages, and primitive pottery obtained from British barrows pertaining to centuries long prior to the Christian era. But the fictile ware exhibits an improvement in some degree corresponding to that of the metallurgic art, which everywhere throughout Europe furnishes weapons, implements, and personal ornaments of the bronze period, characterised by much grace and delicacy in form, and by an ornamentation peculiar in style, but not unworthy of the novel forms and material

It was long assumed, alike by historians and antiquaries, that the beautiful bronze swords, spear-heads, shields, torques, armillæ, &c., so frequently discovered, were mere relics of foreign conquest or barter, and they were variously assigned to Egyptian, Phœnician, Roman, or Danish origin. But this gratuitous assumption has been disproved by the repeated discovery of the moulds for making them, as well as of the refuse castings, and even of beds of charcoal, scoriæ, and other indications of metallurgy, on the sites where they have been found. It has not escaped notice, however, that the transition appears to be an abrupt one from stone to bronze, an alloy requiring skill and experience for its use; and that few examples are recorded of the discovery of copper tools or weapons, though copper is a metal so easily wrought as to have been in use among the Red Indians of America. The inference from this fact is one which all elements of probability tend to confirm, viz., that the metallurgic arts of the north of Europe are derived from a foreign source, whether by conquest or traffic; and that in the beautiful bronze relics so abundant, especially in the British Islands and in Denmark, we see the fruits of that experience which the more ancient civilisation of Egypt and Phœnicia had diffused. The direct intercourse between the countries on the Mediterranean and the Cassiterides, or Tin Islands,—as the only known parts of the British Islands are called in the earliest allusions which are made to them by Herodotus, Aristotle, and Polybius,—abundantly accounts for the introduction of such knowledge to the native Britons at a very remote period. Phœnician and Carthaginian merchant ships traded to Cornwall centuries before the white cliffs of Albion were first seen from the Roman war-galleys. Greece also, not improbably, proved a mediator in this all-important transfer. It is at least to be noted that the forms of weapons, and especially of the beautiful "leaf-shaped sword," as figured on the most ancient painted Greek vases, closely correspond to the most characteristic relics of the bronze period in the north of Europe and the British Isles.

In reviewing the characteristics of this bronze period, the disclosures of native art on the American continent supply some singularly interesting and suggestive illustrations. There, throughout the whole northern regions of the North American continent and in the ruder areas of South America, as well as in the West Indian archipelago, a population was found consisting exclusively of rude nomad hunters, in a pure stone period of primitive savage art. Nor does it at all conflict with this that they were to a certain extent familiar with the resources of the rich copper regions of Lake Superior, where that metal is found in enormous masses in a malleable state. This they procured, and not only themselves employed it in the manufacture of weapons, implements, and personal ornaments, but distributed it by barter far down the Ohio and Mississippi valleys, and eastward to the great lakes, to the St Lawrence valley, and to the Hudson river. Silver and lead are also found in the same rich mineral region in metallic crystals, and were not unknown to the native tribes. But everywhere those metals were cold-wrought, as a mere malleable stone capable of being hammered into any desired shape, but in total ignorance of the influence of fire or the use of alloys.

But wholly distinct from its rude Indian tribes, North America had its semi-civilised Mexicans and South America its more highly civilised Peruvians, who had learned to mine and smelt the ores of the Andes, and make metallic alloys wherewith to fashion for themselves bronze tools of requisite hardness for quarrying and hewing the solid rock. With these they sculptured the statues of their gods, and reared palaces, temples, and pyramids, graven with elaborate sculptures and hieroglyphics by a people wholly ignorant of iron, which have not unjustly suggested many striking analogies with the megalithic art of ancient Egypt. The *huacas*, or tombs of the Incas of Peru, and also their royal depositories of treasure, have disclosed many remarkable specimens of elaborate metallurgic skill,—bracelets, collars, and other personal ornaments of gold; vases of the same abundant precious metal, and also of silver; mirrors of burnished silver, as well as of obsidian; finely-adjusted silver balances; bells both of silver and bronze; and numerous common articles and tools of copper, or of the more efficient alloy of copper and tin,—all illustrative of the arts and civilisation of a purely bronze age.

4. The fourth or *Iron Period* is that in which the art of smelting the ores of the most abundant metal had at length been mastered; and so iron superseded bronze for arms, sword-blades, spear-heads, axes, daggers, knives, &c. Bronze, however, continued to be applied to many purposes of personal ornament, horse furniture, the handles of swords and other weapons; nor must it be overlooked that flint and stone were still employed for lance and arrow-heads, sling-stones, and other common purposes of warfare or the chase, not only throughout the whole bronze period, but far into the age of iron. The discovery of numerous arrow-heads, or flakes of black flint, on the plain of Marathon, has been assumed with good reason to point to the use of such rude weapons by the barbarian host of Darius; and the inference is confirmed by the facts which Herodotus records, that Ethiopian auxiliaries of the army of Xerxes, ten years later, were armed with arrows tipped with stone.

The essential change resulting from the maturing of the iron period lies in the unlimited supply of the new metal. Had bronze been obtainable in sufficient quantity to admit of its application to the endless purposes for which iron has since been employed, the mere change of metal would have been of slight significance. But the opposite was the case. The beautiful alloy was scarce and costly; and hence the arts of the neolithic period continued to be practised throughout the whole duration of the age of bronze. But iron, though so abundant in its ores, requires great labour and intense heat to fuse it; and it needed the prolonged schooling of the previous metallurgic era to prepare the way for the discovery of the properties of the ironstone, and the processes requisite to turn it to account. Iron, moreover, though so abundant, and relatively of comparatively recent introduction, is at the same time the most perishable of metals. It rapidly oxidises unless protected from air and moisture, and hence few relics of this metal belonging to the prehistoric period have been preserved in such a state as to illustrate the skill and artistic taste of the fabricators of that last pagan era, in the way that the implements of the three previous periods reveal to us the habits and intellectual status of those older times.

But the iron is the symbol of a period in which pottery, personal ornaments of the precious metals, works in bronze, in stone, and other durable materials, supply ample means of gauging the civilisation of the era, and recognising the progress of man in the arts, until we come at length to connect their practice with definite historical localities and nations, and the names of Egypt and Phœnicia, of Gadir, Massilia, the Cassiterides, and Noricum, illuminate the old darkness, and we catch the first streak of dawn on a definite historical horizon. Thus, with the mastery of the metallurgic arts is seen the gradual development of those elements of progress whereby the triumphs of civilisation have been finally achieved, and man has advanced towards that stage in which the inductive reasonings of the archæologist are displaced by records more definite, though not always more trustworthy, as the historian begins his researches with the aid of monumental records, inscriptions, poems, and national chronicles.

Within the later iron period, accordingly, we reach the era of authentic history. There is no room for doubt that whatever impetus the Roman invasion may have given to the working of the metals in Britain, iron was known there prior to the landing of Julius Cæsar. Within this archæological period, however, the examples of Roman art and the influences of Roman civilisation begin to play a prominent part. To this period succeed the Saxon and Scandinavian eras of invasion, with no less characteristic peculiarities of art workmanship, as well as of sepulchral rites and social usages. In these later periods definite history comes to the aid of archæological induction, while those intermediate elements of historical re-edification, the inscriptions on stone and metal, and the numismatic series of chronological records, all unite to complete a picture of the past replete with important elements for the historian.

The connection between archæology and geology has been indicated, but that between archæology and ethnology is of much more essential significance, and is every day being brought into clearer view. By the investigation of the tombs of ancient races, and the elucidation of their sepulchral rites, remarkable traces of unsuspected national affinities are brought to light; while a still more obvious correspondence of arts in certain stages of society, among races separated alike by time and by space, reveals a uniformity in the operation of certain *human instincts*, when developed under nearly similar circumstances, such as goes far to supply a new argument in proof of the unity of the human race.

The self-evident truths confirmatory of the principles upon which this system of primitive archæology is based, may be thus briefly summed up:—Man, in a savage state, is to a great extent an isolated being; co-operation for mutual and remote advantage, except in war and the chase, is scarcely possible; and hence experience at best but slowly adds to the common stock of knowledge. In this primitive stage of society the implements and weapons which necessity renders indispensable are invariably supplied from the sources at hand; and the element of time being of little moment, the rude workman fashions his stone axe or hammer, or his lance of flint, with an expenditure of labour such as, with the appliances of civilisation, would suffice for the manufacture of hundreds of such implements.

The discovery of the metallurgic arts, by diminishing labour and supplying a material more susceptible of varied forms as well as of ornamentation, and also one originating co-operation by means of the new wants it calls into being, inevitably begets social progress. The new material, moreover, being limited in supply, and found only in a few localities, soon leads to barter, and thence to regular trade; and thus the first steps towards a division of labour and mutual co-operation are made. So long, however, as the metal is copper or bronze, the limited supply must greatly restrict this social progress, while the facilities for working it admit of that isolation so natural to man in a rude state; and these, added to the frequent discovery of copper, in its natural condition much more nearly resembling a ductile metal than the ironstone, abundantly account for its use having preceded that of the more abundant metal.

Great experience must have been acquired in earlier metallurgy before the iron ore was attempted to be wrought. In this, co-operation was indispensable; but that once secured, and the first difficulties overcome, the other results appear inevitable. The supply is inexhaustible, widely diffused, and procurable without excessive labour. The material elements of civilisation were thereby rendered available, and all succeeding progress might be said to depend on the capacity of the race.

The simplicity which characterises the archæological disclosures of Scandinavia, Germany, Ireland, and other regions of trans-Alpine Europe lying outside of the range of ancient Greek or Roman influences, has contributed some important aids to the study of prehistoric arts; but the full significance of their teachings has yet to be tested by comparison with the primitive arts pertaining to Egypt, Greece, Asia Minor, and other ancient centres of earliest civilisation. To this certain singularly interesting disclosures of very recent date, which some have regarded as at variance with the foregoing classification of archæological epochs, help to furnish the desired materials. The researches of Dr Heinrich Schliemann on one of the most memorable sites which epic poetry has selected for the mythic beginnings of history, have brought to light what he believes to be actual remains of the Troy of the *Iliad*. Dr Schliemann began his systematic explorations in 1871, and pursued them, during the available seasons, till the month of June 1873. With patient assiduity the accumulated debris on the scene of ancient civic settlement was sifted and opened up by regular excavations, till the natural rock was exposed at a depth of upwards of 50 feet. Throughout the whole of this, abundant traces of former occupation were brought to light; and so great an accumulation of debris and rubbish upon an elevated site affords undoubted evidence of the vicissitudes of a long-settled centre of population. To this specific evidence lent additional confirmation. The foundations of a temple, supposed to be that of the Ilian Athena of the time of Alexander, along with coins, inscriptions, and numerous remains of architecture and sculpture, combined to fix the era of an ancient, but strictly historical, period. At a further depth of upwards of 6 feet, broken pottery, implements of bronze, and charred wood and ashes, showed the traces of an older settlement which had perished by fire. But the artificial character of the debris encouraged further research; and when the excavations had been carried to about double the depth, Dr Schliemann came upon a deposit rich in what may be styled neolithic remains: axes, hammers, spear-heads, and other implements of polished diorite or other stone, weights of granite, querns of lava, and knives and saws of flint abounded, associated with plain, well-executed pottery, but with only two pins of copper or bronze to indicate any knowledge of metal. Continued excavations brought to light additional stone implements and weapons; until at a depth of some 33 feet, well-wrought implements and weapons of bronze, and pottery of fine quality and execution, revealed the traces of an earlier civilisation on the same ancient site.

In all this, while there is much to interest, there is nothing to surprise us. Here, near the shores of the Hellespont, at a point accessible to the oldest known centres of civilisation,—to Egypt, Phœnicia, Assyria, Greece, Carthage, and Rome,—a civilised community, familiar with the arts of the bronze period of the Mediterranean shores, appears to have yielded to vicissitudes familiar enough to the student of ancient history. After a time the desolated locality tempted the settlement of some barbarian Asiatic horde, such as the steppes of that continent could furnish even now. They were ignorant of metallurgic arts; though probably, like the savage tribes of the New World at the present time, not wholly unaware of the manufacture of implements and weapons of bronze or other metals. Such a local alternation of bronze and stone periods in a region lying in close proximity alike to vast areas of Asiatic barbarism, and to the most important centres of ancient civilisation, in no degree conflicts with a general system of succession of archæological periods. Mexico and Peru, while in a purely bronze age, were overthrown by Spanish invaders. Large portions of their ancient territories were abandoned to utter barbarism, and even now are in the occupation of savage tribes. But the ancient city of Montezuma has been made the capital of a civilised state; the beds of its canals have been filled up, burying therein obsidian, stone, and bronze implements, pottery, sculptures, and much else pertaining to its ante-Columbian era; and it only requires such a fate as its modern history renders conceivable enough, to leave for future ages the buried strata of a civic site revealing similar evidences of the alternation of semi-civilised, barbarian, and civilised ages, on the same long-inhabited site of Toltecans and Aztecs Indian savages, and modern Mexicans and Spaniards.

That man has everywhere preceded history is a self evident truth. So long as no scientific evidence seemed to conflict with a long-accepted chronology in reference to the antiquity assigned to the human race, it remained unchallenged, though the like computation had been universally rejected in reference to the earth as the theatre of his history, and we were content to regard the prehistoric era of man as no more than a brief infancy of the race. But the investigations and disclosures of recent years in reference to the whole prehistoric period have involved of necessity a reconsideration of the grounds on which a definite antiquity of comparatively brief duration has been assigned to man; and the tendency at present is rather to exaggerate than to diminish the apparent antiquity of the race. The nature and extent of the evidence which has thus far rewarded intelligent research have been sufficiently indicated above; and as it is still far from complete, the student of archæology will act wisely in pushing forward his researches, and accumulating and comparing all available evidence, without hastily pronouncing any absolute verdict on this question. But, without attempting to connect with any historic chronology the men of the English drift, or the troglodytes of the mammoth or reindeer periods of France, it may be useful, in concluding this summary of primitive archæology, to glance at the origin of civilisation, and the evidences of the antiquity of what appear to constitute its essential elements.

Everywhere man seems to have passed through the same progressive stages: First, that of the *savage* or purely *hunter state;* a condition of precarious instability, in which man is most nearly in the state of a mere animal subsisting on its prey. It is the condition of nomad life, incompatible with a numerous or settled population; exhausting the resources of national being in the mere struggle for existence, and therefore inimical to all accumulation of the knowledge and experience on which human progress depends. In this primitive state, man is disclosed to us by the evidence with which the archæologist now deals. He appears everywhere in this first stage as the savage occupant of a thinly-peopled continent, warring with seemingly inadequate means against gigantic carnivora, the contemporary existence of which is known to us only by the disclosures of geological strata or ossiferous caves, where also the remains of still more gigantic herbivora confirm the idea of man's exhaustive struggle for existence. The nearest analogy to such a state of life is that of the modern Esquimaux, warring with the monstrous polar bear, and making a prey of the gigantic cetaceæ of Arctic seas. Through how many ages this unhistoric night of European man may have preceded the dawn of civilisation it is at present vain to speculate. But this is noticeable, that there is no inherent element of progress in a people in the condition of the Esquimaux. To all appearance, if uninfluenced by external impulse, or unaffected by any great amelioration of climate, they are likely to prolong the mere struggle for existence through unnumbered centuries, armed, as now, with weapons and implements ingeniously wrought of bone, ivory, and stone, the product of the neolithic arts of this 19th century.

To this succeeds the second or *pastoral state*, with its flocks and herds, its domesticated animals, and its ideas of personal property, including in its earlier stages that of property in man himself. It pertains to the open regions and warmer climates of the temperate zone, and to the elevated steppes and valleys of semi-tropical countries, where the changing seasons involve of necessity the wandering life of the shepherd. This accordingly prevents the development of the arts of settled life, especially those of architecture; and precludes all idea of personal property in the soil. But the conditions of pastoral life are by no means incompatible with frequent leisure, reflection, and consequent intellectual progress. Astronomy has its origin assigned to the ancient shepherds of Asia; and the contemplative pastoral life of the patriarchs Job and Abraham has had its counterpart in many an Arab chief of later times.

The third or *agricultural stage* is that of the tillers of the soil, the Aryans, the ploughers and lords of the earth, among whom are developed the elements of settled social life involved in the personal homestead and all the ideas of individual property in land. The process was gradual. The ancient Germans, according to the description of Tacitus, led the life of agricultural nomads, and such was the state of the Visigoths and Ostrogoths of later centuries. But this was in part due to the physical conditions of trans-Alpine Europe in those earlier centuries. Long ages before that, as the ancient Sanscrit language proves, the great Aryan family, of which those are offshoots, had passed from the condition of agricultural nomads to that of lords of the soil among a settled agricultural people. They had followed up the art of ploughing the soil with that of shipbuilding and "ploughing" the waves. They were skilled in sewing, in weaving, in the potter's art, and in masonry. Their use of numbers was carried as high at least as a hundred before they settled down from their nomad life. They had domesticated the cow, the sheep, the horse, and the dog, and their *pásu* or feeders already constituted their *pecus*, their wealth, before the *pecunia* assumed its later forms of currency. They had also passed through their *bronze* and into their *iron* period; for their language shows that they were already acquainted with the most useful metals as well as with the most valuable grains.

The whole evidence of history points to the seats of earliest civilisation in warm climates, on the banks of the Nile, the Euphrates, the Tigris, the Indus, and the Ganges. The shores of the Mediterranean succeeded in later centuries to their inheritance, and were the seats of long-enduring empires, whose intellectual bequests are the life of all later civilisation. But trans-Alpine Europe, which is now yielding up to us the records of its prehistoric ages, is entirely of modern growth so far as its historic civilisation is concerned, and wherever it extends towards the northern verge of the temperate zone it is even now in its infancy. Here, then, we trace our way back to the first progressive efforts of reason, and find man primeval, in a state of nature, in the midst of the abundance pertaining to a genial and fertile climate, which rather stimulates his æsthetic faculty than enforces him by any rigorous necessity to cultivate the arts for the purposes of clothing and building. Thus employing his intellectual leisure, he begins that progressive elevation which is as consistent with his natural endowments as a rational being as it is foreign to the instincts of all other animals. He increases and multiplies, spreads abroad over the face of the earth, clears its forests, drains its swamps, makes its rivers and seas his highways, and its valleys and plains his fertile fields and pasture-grounds. Cities rise, with all the fostering influences of accumulated wealth and settled leisure, and with all the stimulating influences of acquired tastes and luxurious desires. The rude pictorial art—not ruder on the graven ivory of the troglodytes of the Madelaine cave than on many a hieroglyphic drawing of the catacombs and temples of Egypt—employed in picture-writing, passes by a natural and inevitable transition from the literal representations of objects to the symbolic suggestion of ideas, to a word-alphabet, and then to pure phonetic signs. The whole process is manifest from the very infancy of Egyptian picture-writing, as crude as that with which the Indian savage still records his deeds of arms on his buffalo-robe, or carves the honours of the buried warrior on his grave-post. Letters lie at the foundation of all high and enduring civilisation, yet we can thus trace them back to their infantile origin; and so onward in their slow transformations, as in the mingled pictorial and phonetic writing of the Rosetta stone hieroglyphics of the age of the Ptolemies. Through Phœnician, Greek, and Roman modifications, they have come down to us as the arbitrary symbols of sounds which the voice combines into articulate speech.

And as it is with letters so it is with man's *arts*,—his drawing, carving, sculpture, architecture, weaving, pottery, metallurgy; and so with his *science*,—his astrology, astronomy, geometry, alchemy, and all else. The beginnings of all of them lie within our reach. We can trace back the measurements of solar time to the crudest beginnings of more than one ancient nation, with a year of 360 days. This, corrected to the definite approximation to the true solar year of a period of 365 days, became the vague year of the Egyptians, with the great Sothiac cycle of 1460 years, clearly pointing to a system of chronology which could not have been perpetuated through many centuries without conflicting with the most obvious astronomical phenomena as well as with the recurring seasons of the year.

Man is, after all, according to the boldest speculations of the geologist, among the most modern of living creatures. If indeed the theory of evolution from lower forms of animal life is accepted as the true history of his origin, time may well be prolonged through unnumbered ages to admit of the process which is to develop the irrational brute into man. But regarding him still as a being called into existence as the lord of creation, endowed with reason, the demonstration of a prolonged existence of the race, with all its known varieties, its diversities of language, and its wide geographical distribution under conditions so diverse, tends to remove greater difficulties than it creates. No essential doctrine, or principle in morals, is involved in the acceptance or rejection of any term of duration for the human race; and the idea of its unity, which for a time was scornfully rejected from the creed of the ethnologist, is now advocated by the evolutionist as alone consistent with the physical, mental, and moral characteristics common to savage and civilised man, whether we study him amid the traces of palæolithic osteology and arts, or among the most diverse races of living men.

The process of research and inductive reasoning thus applied by the archæologist to the traces of primitive art and the dawn of civilisation, is no less applicable to all periods. The songs and legends of the peasantry, the half-obliterated traces of ancient manners, the fragments of older languages, the relics of obsolete art, are all parts of what has been fitly styled "unwritten history," and furnish the means of recovering many records of past periods which must remain for ever a blank to those who will recognise none but written or monumental evidence.

Proceeding to the investigation of this later and, in most of the higher requirements of history, this more important branch of historical evidence, the archæologist has still his own special departments of investigation. Tracing the various alphabets in their gradual development through Phœnician, Greek, Roman, and other sources, and the changing forms which followed under the influences of Byzantine and mediæval art, a complete system of palæography has been deduced, calculated to prove an important auxiliary in the investigation of monumental and written records. Palæography has its own rules of criticism, supplying an element of chronological classification altogether independent of style in works of art, or of internal evidence in graven or written inscriptions, and a test of genuineness often invaluable to the historian.

Architecture, sculpture, and pottery have each their historical value, their periods of pure and mixed art, their successions of style, and their traces of borrowed forms and ornamentation, suggestive of Indian, Assyrian, Egyptian, Phœnician, Punic, Greek, Etruscan, Roman, Arabian, Byzantine, Norman, or Renaissance influences. Subordinate to those are the pictorial arts combined with sculpture and pottery, from earliest Egyptian, Greek, or Etruscan art to the frescoes and paintings of mediæval centuries; and the rise of the art of the engraver, traceable through ancient chasing on metals, mediæval niello-work, graven sepulchral brasses, and so on to the wood blocks, whence at length the art of printing with movable types originated. And as in the Old World so in the New, the progress of man is traceable from rudest arts of stone and copper to the bronze period of Mexico and Peru, where also architecture, sculpture, and pottery preserve for us invaluable materials for the elucidation of that prehistoric time which only came to an end there in the year 1492 A.D.

Heraldry is another element by means of which archæology provides trustworthy canons of criticism in relation to written and unwritten mediæval records. The seals and matrices, sepulchral sculptures, and engraved brasses, along with an extensive class of the decorations of ecclesiastical and domestic architecture, all supply evidence whereby names and dates, with confirmatory collateral evidence of various kinds, are frequently recoverable. From the same sources also the changing costume of successive periods can be traced, and thus a new light be thrown on the manners and customs of past ages. The enthusiastic devotee is indeed apt at times to attach an undue importance to such auxiliary branches of study; but it is a still greater excess to pronounce them valueless, and to reject the useful aids they are capable of affording.

No less important are the illustrations of history, and the guides in the right course of research, which numismatics supplies, both in relation to early and mediæval times. But on this and other sections into which the study of antiquities is divided, the requisite information will be found under the several heads of research. On many of those points the historian and the archæologist necessarily occupy the same field; and indeed, when that primitive period wherein archæology deals with the whole elements of our knowledge regarding it, as a branch of inductive science, and not of critical history, is past, the student of antiquities becomes to a great extent the pioneer of the historian. He deals with the raw materials: the charters, deeds, wills, grants of land, of privileges or immunities, the royal, monastic, and baronial accounts of expenditure, and the like trustworthy documents; by means of their palæography, seals, illuminations, and other evidence, he fixes their dates, traces out the genealogical relationships of their authors, and in various ways prepares and sifts the evidence which is to be employed anew by the historian in revivifying the past. Architecture and all departments of the fine arts, in like manner, supply much evidence which, when investigated and systematised by a similar process, adds valuable materials to the stock of the historian, and furnishes new sources for the illumination of past ages. Such is a sketch of the comprehensive investigations embraced under the name of archæology, which, carried on by many independent labourers, and in widely varied fields of research, have contributed important chapters of human history, and revivified ages long buried in oblivion, or at best but dimly seen through distorting media of myth and fable. (D. W.)

CLASSICAL ARCHÆOLOGY.

The province of classical archæology is to investigate and determine the results of artistic activity among the Greeks and Romans, so far as that activity manifested itself in works of form and substance as opposed to the artistic expression of thought by unsubstantial means, as in the case of poetry or music. It ranges from the Greek temple as the highest form of artistic expression in this sense to the other extreme of the simplest object shaped for a purpose by human hands. A stone, rudely hewn with some design, an artificial tumulus, and common clay utensil, each represent, in a humble fashion, a thought artistically expressed in substance, and each reflect more or less accurately the artistic spirit of the time at which they were made. It ranges also from the earliest examples of workmanship down through the historical periods of development and decline. So far classical archæology may properly be called a section of the general history of art. It owes its independent position entirely to the peculiar circumstances under which its investigations are conducted. For example, when called upon to determine the date of an inscription from the forms and disposition of its letters, which, as works of art, must reflect the taste of the period in which they were incised, it has to bring to bear on the question a knowledge of palæographical eccentricities. Or when the date of a coin has to be fixed, the standard on which it has been struck and the historical circumstances connected with it must be taken into consideration. Such, at least, is the practice of journals and societies devoted to classical archæology. On the other hand, recent writers desire to confine these collateral inquiries to within the narrowest possible limits. They have agreed to dismiss altogether mythological researches, which in Gerhard's time formed one of the principal occupations of archæologists. Most of them consent to epigraphy being classed under philology. With regard to numismatics, however, opinions are still divided as to whether it should be included under archæology, on the ground of the immense importance of coins as monuments of art, or whether, on account of their historical value, the study of them should be classed under philology. A similar question has been raised regarding topography. (See Conze, *Ueber die Bedeutung der classischen Archäologie*, Wien, 1869; Preller, *Ausgewählte Aufsätze*, pp. 384–425, *über die wissenschaftliche Behandlung der Archäologie;* Stark, in the *Philologus*, xiv p. 645, and xvi. p. 85.)

The material for the study of classical art consists of literary records and actual remains, among the former being included, though from another point of view belonging to the latter class, the inscriptions which have been found incised on sculptures, or more frequently on the bases left behind in Greece as worthless by the plundering Romans. The literary records have been collected by Overbeck, *Antike Schriftquellen*, Leipzig, 1868, and the inscriptions alone more recently by Hirschfeld, *Tituli Statuariorum Sculptorumque*, Berlin, 1871. The actual remains may be arranged under the three classes of architecture, sculpture, and painting, with the first mentioned being included the industrial arts, in which principles of construction were applied, *e.g.*, the furniture of temples and dwelling-houses, as opposed to the imitative arts. In the case of architecture proper, owing to the immovable nature of its monuments, dependence has to be placed on the trustworthiness of drawings and descriptions made on the spot by travellers. Sculpture, on the other hand, being comparatively easy of transport in all cases, and having been for centuries the object of extraordinary avidity among cultivated people, is now fairly represented in all its important stages in any one of the principal museums of Europe. Painting, in its highest sphere, may be said to exist only in the record supplied by the occasional statements of ancient writers. But these statements embody the opinions of those whose judgment in regard to sculpture we have the means of verifying, and unless there were reason to suppose that persons accustomed to exact the greatest refinement in sculpture were lightly gratified in the matter of painting, their desultory remarks will furnish some idea of the ancient manner for which the remains of wall painting at Pompeii will serve as a foundation, though apparently executed by workmen rather than artists, and that at a time when the art had sunk to its lowest ebb. The skill in drawing attained by ordinary workmen is amply displayed in the painted vases.

Without attempting to subject the history of art to systematic study, the Greeks and Romans nevertheless devoted much attention to special branches of it. The fruits of their labours have in great part perished; but from what remains, and from the notices of what is lost, it appears that their researches took the direction either of explaining the principles of art, and especially those of architecture, or of collecting facts concerning artists and their works, or of describing the works of art which existed in this or that place, as in a catalogue. Of the first class of works we have lost all—and they were many—except Vitruvius. Of the second the losses are known to have been great, and, poor though the substitute for them undoubtedly is, we are still fortunate in possessing such in the notices collected by Pliny in his *Historia Naturalis.* We have besides a long series of epigrams, for which there was no dearth of point, in the works of well-known artists. For a similar purpose the rhetoricians chose frequently to draw comparisons from or to describe works of art; but owing to the object they had in view, they have left little that is of much practical good for the history of ancient art.

The same applies to the epigrammatists. (See O. Benndorf, *De Anthologiæ Græcæ Epigrammatis quæ ad artes spectant*, Bonn, 1862.) With regard to Pliny, it seems that, though himself destitute of all critical faculty in matters of art, he frequently drew his notices from excellent authorities. The third class of ancient writers on works of art were the Periegetæ, of whom only Pausanias survives (A.D. 160–180), his Ἑλλάδος Περιήγησις, in ten books, being of the highest value from an antiquarian point of view. For the criticism of art it brings little benefit.

As to the fate of works of art during the early centuries of Christianity, the first record we possess is that of Nicetas Acominatus, of Chonæ in Phrygia, who died in 1216 (*Narratio de Statuis Antiquis quas Franci post captam, anno* 1204, *Constantinopolim destruxerunt*, Leipzig, 1830). In 1460 we have an anonymous description of Athens (Τὰ θέατρα καὶ διδασκαλεῖα τῶν Ἀθηνῶν, see L. Ross, *Archäologische Aufsätze*, i. p. 245), from which may be gathered a tolerable idea of the deep ignorance of the times. In Rome the rule was to destroy as far as possible all ancient sculptures, except such as were in some way identified with Christianity. The reaction against this manner of proceeding at first took the form of collecting ancient sarcophagi for the modern purposes of burying-grounds. By the 15th and 16th centuries this taste had developed into an enthusiasm, which spread even into the south of Germany, for the possession of ancient sculptures as models for the study of artists. In the beginning of the 17th century this enthusiasm gave way to a habit of viewing ancient works of art only as so many illustrations of ancient beliefs and modes of life, a habit in which the French and the Dutch were distinguished, and of which the results are nowhere more apparent than in Montfaucon's *L'Antiquité expliquée et representée en figures*, Paris, 1722, with its uncritical text and inaccurate engravings. The taste of the times preferred literature to art, and accordingly the collection of ancient monuments, adapted to the illustration of classical writers, and especially the poets, was assiduously followed. A typical example of the one-sidedness of this tendency is to be seen in Spence's *Polymetis, or an Enquiry concerning the Agreement between the Works of the Roman Poets and the Remains of the Ancient Artists*, London, 1755, fol. A really valuable work of the period, however, was the collection of passages in the ancient writers bearing upon artists, entitled *Catalogus Artificum*, by Fr. Junius (Francois Dujon), which retained the position of a standard work until supplanted by Sillig's *Catalogus Artificum*, Dresden, 1827, which in turn held its ground until the appearance of H. Brunn's *Geschichte der Griechischen Künstler*, 2 vols., 1853 and 1859.

Up to the middle of the 17th century no steps had been taken to visit and explore the monuments of Greece. The pioneers in this work were J. Spon, a physician of Lyons, and George Wheler, an Englishman, who travelled together in 1675–76 through Italy, Dalmatia, and Greece, and published each a separate account of their journey (J. Spon, *Voyage d'Italie, de Dalmatia, de Grèce, et du Levant*, Lyon, 1678; G. Wheler, *Journey into Greece*, London, 1682). In the year previous to their arrival in Greece, the Marquis de Nointel, French ambassador at the Porte, had paid a short visit to Athens, and set Carrey, a French artist, to work to draw the sculptures of the Parthenon and some of the buildings of the town. These drawings are now in the Bibliothèque at Paris, and though mostly sketched hurriedly, or from an awkward point of view, form an invaluable record of the sculptures of the Parthenon, destroyed shortly after (1687) by the bombardment of Athens by the Venetians under Morosini.

The discovery of Herculaneum in 1720 and of Pompeii in 1748 opened a new era in the history of archæology. The antiquarian spirit gave way to an historical and scientific method, of which Count Caylus (*Recueil d'Antiquités*, Paris, 1752–54, 7 vols.) may be regarded as the forerunner, and Winckelmann (1717–1768) as the actual founder. The fame of the latter rests on his two great

Greek Amphora, Late Style

Greek Lecythus, Good Style.
Patera, Late Style.

Greek Hydra, Good Style

Etruscan Sarcophagus. Late Style

works—(1.) the *Geschichte der Kunst des Alterthums*, Dresden, 1764, and with additions, 1767; and (2.) *Monumenti Antichi Inediti*, Rome, 1767, 2 vols. fol. It was in the former that he elaborated his two theories—first, that the quality of artistic productions is always in harmony with the character and the events of the times; and, secondly, that ideal beauty originates in the union of individually-beautiful forms observed singly and apart in nature. Whatever may be said of the narrowness or want of precision in his artistic and philosophical speculations, it still stands to his great praise and renown that he was the first to undertake a vigorous examination of the terms, beauty and ideal, in their relation to nature. It was through his influence that the history of ancient art was introduced into the course of academical study by Heyne, that Goethe, Lessing, and Herder turned each the force of his consummate genius to ancient art, and that the publication of ancient monuments with critical apparatus received a new impulse. Among the immediate disciples of Winckelmann were Zoëga (1755–1809), Visconti (1751–1807), and Millin. After Winckelmann, the next history of ancient art that appeared was Meyer's *Geschichte der bildenden Künste bei den Griechen und Römern*, Dresden, 1824–36, 3 vols.; contemporary with which the only important contributions to the subject were those of C. A. Böttiger and Hirt.

While German activity was engaged on theories of art based principally on the monuments existing in Italy, a practical view of the subject was taken in England, the first issue of which was that Stuart and Revett went to Athens in 1751, and spent nearly three years in exploring and drawing its remains, the result appearing in the work *Antiquities of Athens*, vol. i., 1762; vol. ii., 1787; vol. iii., 1794; and vol. iv., 1816. The task begun by them was taken up by the Society of Dilettanti (founded 1734), whose first expedition under Dr Chandler, Revett, and Pars, an artist, in Greece and Asia Minor, was productive of two works—(1.) *Ionian Antiquities* (published in 1769, and again, largely increased by the researches of William Gell, in 1797); and (2.) *Unedited Antiquities of Attica*, 1817. At this time, Lord Elgin, then British ambassador at the Porte, had a large force of workmen employed in removing the sculptures of the Acropolis of Athens, which, after years of tossing hither and thither in London, at last, in 1816, found a resting-place in the British Museum, of which they continue to form the greatest ornament. In 1811-12 a number of English, German, and Danish travellers (Cockerell, Forster, Stackelberg, Haller, Linckh, and Brönstedt) undertook the exploration of Ægina at their own expense, and were fortunate in the recovery of the sculptures of the temple of Athene, now in Munich.

In 1812 the temple of Apollo Epicurius at Phigalia was explored by Cockerell, its sculptured frieze recovered and obtained for the British Museum, and its architecture elucidated in the still unapproached work of Cockerell, *The Temples of Jupiter at Ægina, and of Apollo at Bassæ, near Phigalia*, 1860. Among the other researches undertaken about this period were—(1.) The French Expédition scientifique de la Morée, the chief result of which was the discovery of some fragments of the metopes of the temple of Zeus at Olympia. (2.) The excavations on the Acropolis of Athens, directed by L. Ross, in 1834–36. (3.) The excavations of Angell and Harris on the Acropolis of Selinus in Sicily in 1822–23, resulting in the recovery of three sculptured metopes of a very archaic style, and fragments of three more metopes (Samuel Angell and Thomas Harris, *Sculptured Metopes of the Ancient City of Selinus in Sicily*, London, 1826, fol.) (4.) The exploration of the same site by the duke of Serradifalco (*L'Antichità della Sicilia*, Palermo, 1834), with the further gain of four metopes sculptured in a more advanced style (O. Benndorf, *Die Metopen von Selinunt*, Berlin, 1873). These sculptures are in the Museum of Palermo. (5.) The extensive operations in Etruria from 1828 onwards, the enormous spoils of which, consisting of painted vases, bronzes, &c., led to the foundation of the Instituto di Corrispondenza Archeologica at Rome, which has continued uninterruptedly, with the support of the Prussian Government, its publication of *Annali*, *Bullettino*, and *Monumenti*, furnishing a complete repertory of archæological research up to the present day. (6.) The removal of the sculptures on the Acropolis of Xanthos (Fellows, *Asia Minor*, 1839, and *Travels in Lycia*, 1841), and the remains of the Mausoleum at Halicarnassus (Newton, *History of Discoveries*, &c., 1862, and *Travels in the Levant*, 1865), have been the principal additions of that class to our national collection, which, however, has been immensely enriched in objects of minor artistic importance, but of great archæological interest, from excavations in Greece, at Camirus and Jalyssus in Rhodes, in Sicily, in the Cyrenaica, and in Cyprus. In the Crimea the excavations of the Russian Government have brought very important treasures to light (*Antiquités du Bosphore Cimmérien conserves au Musée Impérial de l'Ermitage*, Petersburg, 1854; *Comptes Rendus de la Commission Archéologique*, from 1859).

The rapid and vast accumulation of new material after the time of Winckelmann required a new informing spirit. The first to assume this function was Thiersch, in three articles, "Ueber die Epochen der bildenden Kunst unter den Griechen," 1816, 1819, 1825, in which he endeavoured to prove the influence of the Egyptians and Phœnicians on early Greek art. Against him appeared K. O. Müller, denying altogether an exoteric influence, and comparing the development of Greek art to the organic development of plants, its various periods being coincident with the marked periods of political history. These opinions he propounded first in a series of articles (*Kleine Schriften*, ii. pp. 315–398), and afterwards in the celebrated *Handbuch der Archäologie* (1830; 2d ed. 1835; 3d ed. 1848, with additions by Welcker), which, with the plates by Oesterley (*Denkmäler der alten Kunst*), is still unsurpassed in its kind. Müller's view has continued to be adopted by all the leading archæologists since his time, among whom may be here mentioned Gerhard, Welcker, Otto Jahn, and the historians of art generally, Schnaase, Kugler, and Lübke. Besides the *Handbuch*, however, with its additional volume of *Denkmäler* by Wieseler, it is necessary, for the most recent information, to consult Brunn's *Geschichte der Griechischen Künstler*, 2 vols.; Overbeck's *Geschichte der Griechischen Plastik*, 2d. ed., 1872; Friederichs's *Bausteine*, Berlin, 1868; *Kleine Kunst und Industrie*, Berlin, 1871, by the same author; G. Semper, *Der Stil in den technischen und tektonischen Künsten*, Munich, 1860–63; C. Bötticher, *Die Tektonik der Hellenen*, 2d. ed., Berlin, 1872–3; Helbig's *Wandgemälde Campaniens*, 1868, vol ii. of Schnaase's *Geschichte der bildenden Kunste*; Helbig's *Untersuchungen über die Wandgemälde Campaniens*, 1873, the publications of the Instituto di Corrispondenza Archeologica of Rome, and the *Archäologische Zeitung* of Berlin. It is not assumed that this list exhausts the number of books that may be consulted with profit, but it is hoped that no essentially important work has been overlooked.

First Period.

The oldest remains of workmanship in Greece, if we except the series of stone implements discovered within the last few years in various localities, are the ruined walls of Tiryns and several other ancient citadels, the stupendous masonry of which, together with the primitive manner of construction by means of unhewn polygonal blocks of

Earliest Greek remains

immense size, led the later Greeks to believe that they had been the work of a mythical race of giants, Cyclopes, and to designate such masonry as Cyclopean. It was further said that these Cyclopes had come from Lycia, between which and Argolis, where the most remarkable of these walls are, there existed (whatever may be the value of this belief) a very frequent intercourse in the heroic times. Pausanias (ii. 25, 8), speaking of the walls of Tiryuth, which still, apparently, present the same aspect as when he saw them, remarks that the smallest of the blocks would be more than a load for a yoke of mules. Again (ix. 36, 5) he compares them with the pyramids of Egypt as regards the difficulty of the task of building and their colossal dimensions. Instead of the unsatisfactory Cyclopes, the Pelasgians, who preceded the Greeks in the occupation of the soil, are now accredited the authors of this primitive masonry, to which accordingly the much-abused term Pelasgic is applied. Pausanias (i. 28, 3) describes the oldest part of the walls of the Acropolis at Athens as the work of Pelasgic settlers there. In what relation of blood this race may have stood to the Greeks who succeeded them cannot be determined, but it is known that the Greeks adopted from them, among other religious beliefs and rites, those of Dodona; and since even this primitive style of masonry commended itself to them for a time, the Pelasgians must be regarded as having in some degree assisted in the artistic progress of their successors. The walls of Mycenæ furnish an example of the fine skill with which the Greeks afterwards employed the Pelasgic construction, the blocks of stone being carefully jointed and hewn on the outer surface, while the interior of the wall is filled up with mortar and small stones. Mycenæ claimed to be one of the very oldest towns of Greece, and its walls may fairly be regarded as the oldest known monument of Greek workmanship. A considerable advance of skill is noticeable in the masonry of the treasure-houses (*thesauri*), or dome-shaped and partly subterraneous buildings, which occur in several districts of Greece, and of which the treasury of Atreus (so named by Pausanias) at Mycenæ is a typical example. It is built of circular courses of evenly hewn and jointed stones, the courses narrowing towards the top, and there held together by a keystone. It is not, however, an instance of vaulting in the true sense. The most remarkable features in the building are—first, the pilasters and tablets of coloured marble, decorated with a peculiar style of ornament, the elements of which are spirals and zigzags; and secondly, the sheets of bronze with which the interior walls were plated. Of the latter little more than the nails have been found with which they were attached. Of the former a number of fragments, some of which are now in the British Museum, have come to light. The disposition, and especially the profusion of ornament which they display, differ strikingly from the simplicity of Greek work as we know it, and have given rise to a theory which is now accepted as proved, that the Greeks at this time must have been strongly influenced by the example of Oriental artists (Schnaase, *Geschichte der bildenden Künsten*, ii., fig. 28, Düsseldorf, 1866). Meantime, it is a fact of the first importance that this building, which Pausanias appears to have had good grounds for naming the treasury of Atreus, and thus assigning it to the heroic age before the time of Homer, furnishes a remarkable illustration of the descriptions of princely palaces given by the poet, according to whom the walls were plated with dazzling bronze, and the cornices, pillars, and doors enriched with work in other metals. When, therefore, a building in the remains of which a complete absence of Greek simplicity and a powerful suggestion of Oriental influence have been unanimously recognised, was found to correspond accurately with the descriptions of Homer, it was both time to inquire whether the frequent notices of works of art in his pages also point in the same direction, and reasonable to assume that his testimony elsewhere in matters of art was equally reliable. From the poet's evidence on the condition of art in his time we gather that the various processes of working in gold, silver, iron, tin, and bronze were known, with the exception of casting and soldering in the last-mentioned material, and of welding iron. Wood and ivory were carved and jointed, the art of pottery was known, and weaving and embroidery, the foundation of pictorial art, were practised. We hear of richly-ornamented articles of furniture, armour, and dresses. We read of the τέκτων, χαλκεύς, and σκυτοτόμος. Occasionally the names of particular artists are mentioned, as of Tychius, who made the shield of Ajax (*Iliad*, vii. 222), and of Icmalius, who made Penelope's chair (*Odyssey*, xix. 60). On the other hand, the work of amateurs is often praised, as the couch made by Odysseus (*Odyssey*, xxiii. 189), and the figured garments worked by Andromache and Helena (*Iliad*, iii. 125, and xxii. 441). When the workmanship of an object is of surpassing beauty and the artist unknown, as in the case of the Sidonian crater (*Odyssey*, iv. 617), it is ascribed to the artist god Hephæstus, to whom also the same honour is done when the work, as in the case of the shield of Achilles, was a poetic creation. That Homer should in the same breath speak of an object as Sidonian and the work of a Greek god, is a singular mistake, which would hardly have been committed had the articles imported from the Phœnicians differed in style from articles of the same class produced by native workmen. So far, artistic feeling seems to have been directed exclusively to the decoration of objects of daily use. It had not yet aspired to the production of one object which could rest on its merits as a mere work of art,—as, for example, a statue. We have, indeed (*Iliad*, vi. 301), mention of a statue of Pallas at Troy; but the fact that women are described as placing drapery on its knees is sufficient proof of its having been a mere rude Xoanon, such as we find frequently represented on the painted vases. The same phenomenon occurs in the remains of Assyrian art, among which, with all the wealth of sculpture in relief and of the highest excellence, there are only three or four statues, and those of such exceeding rudeness that we are compelled to suppose that they were intended to be draped like the figure of Pallas just mentioned. We have seen that the ornaments of the treasury of Atreus at Mycenæ pointed clearly to an Oriental origin. It is agreed that the relief of two rampant lions from above the gateway to the citadel of Mycenæ (Müller's *Denkmäler der alten Kunst*), which is the solitary existing instance of Greek sculpture from about Homeric times, is of an Oriental character in the composition, in the flatness of the relief, and in the design of the pillar which stands between the lions. We find further, as was pointed out by Layard (*Nineveh*, Appendix), among the many remains of the inferior arts from Nineveh, illustrations of the references to such matters in Homer, which are admirable in themselves, and are found nowhere else, except occasionally in the oldest Etruscan tombs. Now, as Assyrian art reached its culmination by about the 9th century B.C., we may assume that, contemporary with Homer, it was being practised with great activity. On the testimony of Herodotus we know that Assyrian wares were imported into Greece by the Phœnicians and sold in the heroic times; and, on the testimony of Homer, these same Phœnicians were in the habit of selling costly articles of furniture and dress to the Greeks of his time. Of early Phœnician art, however, we have no authentic remains, nor indeed any proof of its having had an independent existence at any time. We know the Phœnicians mainly as traders, and it is highly probable that in matters of art their

Connection of Greek and Oriental art.

trade lay chiefly between the Assyrians on the one hand and the Greeks on the other. "It was the Phœnicians," says Brunn (*Die Kunst bei Homer*, München, 1868), "who brought from the East to the Greeks an alphabet which they modified and employed for a language peculiar to themselves; and it was the Phœnicians who brought to them from the same quarter an alphabet, so to speak, of art, which they also modified and employed for a language of art equally their own." He proceeds to define this alphabet of art as consisting of a knowledge of the processes of weaving and embroidery, of working in wood, ivory, and the various metals, with the exception of casting in bronze —with which and with sculpture in marble, which he also excludes, commenced the art of statuary, and commenced, therefore, the independence of true Greek art. Besides these processes of working, the Greeks derived from the same source at least some of the decorative patterns which we find in use in later times, though greatly modified. But, above all, they obtained from the Assyrians that manner of sculpture in low flat relief, and in parallel horizontal bands, which they appear to have practised almost exclusively down to the 7th century B.C.,—that is, down to the collapse of the Assyrian empire,—and after that to have retained as one of the charms of their architecture. If, then, an intercourse such as is assumed actually took place in Homer's time between the Greeks and the Assyrians, who were then artistically in a very advanced condition, it will be necessary, before lightly calling the shield of Achilles a poetic dream, as has frequently been done, to see whether the poet may not have had before his mind some manner of a counterpart for it in Assyrian art. We need not suppose that such a shield ever existed. But a poet cannot create out of nothing; and it is clear from his division of the shield into five concentric bands, resembling the large bronze shields found at Cære some years ago in a tomb of very high antiquity, that he had before his mind the customary arrangement of ornaments in works of this kind. Now, on an Assyrian bronze bowl in the British Museum (Layard, plate 61), which exactly resembles in shape and is of about the same size as a boss of a shield, we have a representation of the earth and heavens which very strikingly recalls the decoration of the boss on the shield of Achilles; while in the comparatively few remains of Assyrian sculpture we have cities at war, cities at peace, and many scenes from daily life, which vividly illustrate the Homeric description of the shield (see Brunn *Die Kunst bei Homer*, who deals with the various subjects in detail). It should be observed, however, that though the evidence of the Homeric poems and the remains of Greek art from the Homeric age both point to an Assyrian influence, the Greeks of later times looked rather to Egypt as the land whence their ancestors had experienced their first impulse both in religion and in art. They believed that Dædalus, the first Greek sculptor who knew how to give movement to his figures, and was regarded as the father of Greek sculpture, had learned his art in Egypt. Diodorus of Sicily asserted that Telecles and Theodorus of Samus had visited Egypt, and on their return executed a statue of Apollo in the Egyptian style for a temple in Samus, each having made a half of it, and that apart from the other. Strabo (p. 806) compares the old Greek sculpture with the Egyptian; while Pausanias in several places (ii. 19, 3; iv. 32, 1) speaks of Egyptian statues in Greek temples, or (i. 42, 3; vii. 5, 5) of statues resembling the Egyptian in style. According to another theory, the influence of Egypt on Greek art, though admitted, is relegated to the time of Psammetichus, in whose service it is known many Greek mercenaries were employed, and through whose inclination towards the Greeks an active intercourse sprang up between the two countries. Among the Greeks who visited Egypt at that time were Thales, Cleobulus, Solon, and Pythagoras.

Remains in Asia Minor. Of the connection which is assumed to have existed between the earliest monuments of Greek art and the contemporary art of Assyria, evidence is cited from remains of undoubtedly early workmanship in the countries of Asia Minor, Lycia, Lydia, and Phrygia, of which the two latter were intimately associated with the oldest traditions and religious beliefs of Greece. The peculiar feature of Lycian art is its tombs cut in the rock, of which the oldest class are direct imitations of wooden structures such as we may conceive the primitive temples of an Oriental race to have been. In Phrygia we have another class of rock-cut tombs of very remote antiquity, of which that of Midas (Semper, *Der Stil*, i. p. 429) is the best preserved example. Here the style of decoration is obviously derived from Assyrian tapestry. In Lydia we have tombs again, but they are in the form of immense tumuli,—as, for instance, that of Alyattes near Sardis, which astonished Herodotus by its size, being 1300 feet in diameter at the base, and over 250 feet high. Similar tumuli occur among the old Chaldeans.

Progress of Architecture. With the immigration of the Dorian race commenced the development of an independent style of architecture in Greece, the first step apparently being the invention of a house supported by columns as the design for a temple From the description given by Pausanias (v. 16) of one of these early Doric temples—that of Hera at Olympia, erected shortly after the Dorian immigration—we gather that it had the form of a temple *in antis*, surrounded by columns, and with not only a *pronaos* led into by two columns, but also a similar chamber at the back. One of the two columns of this latter chamber was of wood, apparently a reminiscence of a former style of construction in that material. About the same time originated also, it is supposed, the Ionic order, which though presenting a certain Asiatic richness of ornament strongly opposed to the severe simplicity of the Doric, was still a pure Greek invention. The fact of it having first appeared among the Greeks of Asia Minor is enough to account for its admission of a greater softness and flow of lines than was admitted in the Doric. With the new movement in architecture a fresh impetus was given to the art of sculpture. **Sculpture.** At first the reports sound somewhat fabulous,—as, for example, that in which Butades the Corinthian potter is described as having hit on the idea of modelling a face in clay and baking it along with his vases. Butades himself, however, is an historical person, and Corinth is known to have been a flourishing seat of potters and other artists as early as the time of the tyrant Cypselus (650 B.C.), through whose oppression it is said the artists, Eucheir, Diopus, and Eugrammus emigrated to Etruria, which afterwards became celebrated for its sculptures in terra-cotta. At the commission of Cypselus, or of his successor Periander, a colossal statue of Jupiter was executed at Corinth, and dedicated at Olympia. But the most remarkable specimen of early sculpture, presumably Corinthian, was the chest in which the infant Cypselus was concealed, and of which a detailed description is given by Pausanias (v. 17, 5, fol.) The chest, itself of cedar, was ornamented with a wealth of figures in gold and ivory, arranged in parallel horizontal bands, and representing heroic legends and scenes from daily life, the names of the individual figures being inscribed *boustrophedon*, that is, in the manner characteristic of early times, and in what Pausanias calls very ancient letters. The François vase in Florence (*Monumenti dell' Instituto di Corrispondenza Archeologica*, vol. iv. pls. 54–58) gives a tolerable notion of what the composition must have been. Artistic activity was not then confined to Corinth. A school of sculpture in marble existed in Chius as early as 660 B.C., and there also Glaucus is said to have discovered the art of welding iron (692 B.C.), the substitute for which had previously been nails. At this period we have frequent mention of splendid metal utensils, as, for instance, the enormous cauldron (Herodotus, iv. 152), with projecting gryphons' heads and a support formed of kneeling figures, seven ells in height. As the oldest example of sculpture in bronze which he had seen, Pausanias (iii. 17, 6) describes a statue of Jupiter at Sparta, the work of Clearchus of Rhegium, whom some called a pupil of Dædalus. It was made of plates of bronze, beaten out to express the whole figure, and then fastened together with fine nails, the arts of soldering and of casting being still unknown. Of sculpture in this manner we possess only one example, the bronze bust found at Polledrara, near Vulci, and now in the British Museum. Throughout this early period the statues or images of deities seem to have retained their helpless primitive form, feelings of piety and gratitude being apparently expressed rather in gifts of metal utensils to the temples than in statues of the gods as in later times. No such statues exist now, but we have sufficient evidence of their want of artistic merit in the numerous representations of them which occur on the painted vases of a later period, when the sanctity of a spot is frequently indicated by such a figure. Apparently to this early and as yet barely historical period belongs a

FIG. 1.—Fictile vase. Brit. Mus. From Athens. Design in black, on drab ground.

class of painted vases decorated with figures of animals and flowers arranged in parallel horizontal bands, and therefore both in the choice and disposition of the decorations presenting a marked instance of Assyrian influence. From their shape it appears that many of these vases were made to hold precious liquids, such as perfumes; and it is very probable that they were imported from the East with those perfumes, the names of which in the Greek language have an obvious Oriental origin. A considerable advance is noticeable in a second class of these vases, in which the human figure is introduced as the principal subject in the decoration, the designs being in general chosen from the heroic legends of Greece. These vases still retain the shape of the former class, the method of disposition in parallel bands, and the choice of subordinate ornaments. The names of the heroes are frequently written beside them, and sometimes the artist adds his own name. The alphabet in which these names are written is the old Corinthian, and hence the vases in question are also styled Corinthian. As to their date, it is agreed that they cannot be later than 620 B.C. With the introduction of the human figure as the subject most worthy of artistic rendering, commenced in vase painting also the independence of the potter's art in Greece (Brunn, *Probleme in der Geschichte der Vasenmalerei*).

Second Period.

From the date of the earliest historical notices of sculptors, backward to that usually assigned to the Homeric poems, there is an interval of several centuries, during which it would at first sight appear that the art of sculpture had made no sensible advance, if indeed it had not declined. This being improbable, an explanation must be sought for, either with Ulrichs (*Die Anfänge der Griechischen Künstlergeschichte*, Würzburg, 1871) in the confusion which seems to reign among the dates of the earliest sculptors, or with Brunn (*Die Kunst bei Homer*) in the theory that the art of sculpture in Greece during that interval was, like the contemporary art of Assyria, strictly confined to working in relief, and that in this direction it may well have made steady progress, though particular artists are not singled out for praise. It is with sculpture in the round, and with some particular invention, as that of welding iron or casting bronze, or with some new technical procedure, as the working of marble, that the first records of artists begin. With regard to the confusion in the dates of these records, it is true that in ancient times the artistic faculty was handed down in certain families, among whom there was also a partiality for certain names. But to assume on the strength of this, as Ulrichs does, that later writers, finding a recurrence of the same name, generally identified it with the most distinguished and hence probably the latest of the artists who bore it, is a means of peopling an apparent void which ought to be supported with better evidence than that which Brunn has controverted at almost every point. For example, in treating of Theodorus of Samus, of whom it is said that he invented the process of casting in bronze, and supposed that he was a contemporary of Polycrates, Ulrichs argues that there must have been two artists of that name (and suggests that there may have been several), because the one who invented bronze-casting must have lived before 576 B.C., previous to which date this art may be inferred to have been known from the remark of Herodotus (v. 82), that the Epidaurians were ordered by an oracle to obtain figures of Damia and Auxesia, not χαλκοῦ ἢ λίθου, but ξύλου. Why χαλκοῦ should not refer to hammered as well as to cast bronze, Brunn is unable to see. Again, it was Theodorus of Samus who built the substructure of the temple of Diana at Ephesus, and Ulrichs is at a loss to conceive how the people of that town could have remained till 576 B.C. without a temple worthy of their goddess. That the previous temple was unworthy of Diana cannot be proved by us, who are ignorant of the feelings of the Greeks in these matters, and who are aware that Jupiter himself had not even in his favourite Olympia a great temple till 456 B.C.

The view taken by Brunn is, as has been said, that until the invention of casting in bronze the Greek sculptors continued to work in relief except when images were required for the purposes of worship, and that in these cases, whether the figure was of wood, stone, or bronze, the rude helpless form of ancient times was preserved. Stimulated, it may be supposed, by the achievements of the newly-invented art, sculptors now began to look to the possibility of producing in marble also a resemblance to the human figure in its substantial roundness. The scene of the first success in this direction was Chius, where a family which for three generations (Melas, Micciades, and Archermus) had been celebrated for its workers in marble, was at this time represented by the brothers Bupalus and Athenis. Works from their hands were to be seen in their native place, in Delus, Iasus, and Smyrna, and consisted, so far as we know, of draped figures of goddesses, with the one memorable exception of a statue by Bupalus intended as a caricature of the poet Hipponax, which was set up in Clazomenæ. The poet took his revenge by circulating some verses which stung the sculptor so severely as to drive him to suicide by hanging. The school of Chius had a rival in that of Magnesia on the Mæander, at the head of which was Bathycles, whose fame is associated with the reliefs and figures on the colossal throne of Apollo at Amyclæ (Pausanias, iii. 18, 9; Overbeck, *Gesch. d. Griech. Plastik*, i. p. 86). He and a number of his pupils or assistants had been purposely invited to the task, and what they accomplished was probably the best that could then be done, however short of the standard of later times it may have fallen in the eyes of Pausanias. One noticeable fact is, that after completing their work, they left behind portraits of themselves, and this, in connection with the portrait of Hipponax, may serve to show that sculptors had already begun to direct their attention to the individual features of the human face. As to the date of Bathycles, Pausanias was uncertain and modern critics are divided, some supposing him to have left Magnesia before its destruction, 636 B.C., others on the occasion of its capture by the Persians, 546 B.C. In favour of the latter date is the statement (Pausanias, iii. 10, 8) that the gold received from Crœsus (563–549 B.C.) by the Lacedæmonians was made a gift of by them for the decoration of the figure of Apollo at Amyclæ.

The new phase of art thus entered on, according to tradition, by the Ionians, was now taken up vigorously by the Doric sculptors, among whom the first to attain distinction were Dipœnus and Scyllis, natives of Crete, and members of the ancient guild of sculptors there, which took its name from the mythic Dædalus. Leaving Crete, they settled in Sicyon, probably on the invitation of the tyrant Clisthenes, and were there commissioned to execute at the public cost a group of statues of deities. Their work was, however, interrupted by a disagreement which ended in the artists having to leave the town. They established themselves in Ætolia, and were allowed to remain there until, a plague having fallen on Sicyon, the oracle traced it to the wrath of the gods at seeing their statues incomplete. Dipœnus and Scyllis were recalled, and finished their work at a greatly increased price, from which it may be inferred, perhaps, that the original dispute lay in the matter of payment. Among the many sculptures which they executed in Sicyon and other Greek towns, as Cleonæ, Argus, Tiryns, and Ambracia, some, it is said, were of wood and ivory, a combination of material which may be regarded as having suggested the chryselephantine sculpture of later times (Pliny, xxxvi. 4, 9, 14; Pausanias, ii. 15, 1; 22, 5; Brunn, *Gesch. d. Griech. Künstler*, i. p. 43). For determining their date, we have a passage of Pliny in which he says, "Primi omnium inclaruerunt marmore sculpendo;" adding, "Before Cyrus ascended the throne of Persia, about 576 B.C." From their school proceeded Doryclidas and Dontas, who executed several figures and groups of deities in cedar and gold at Olympia for the Heræum and the treasuries of the Epidaurians and Megaræans; Clearchus of Rhegium, who worked in bronze; and Tectæus and Angelion, from whom Callon, the celebrated Æginetan sculptor, learned his craft. As a work of Tectæus and Angelion, Pausanias (ii. 32, 5; ix. 35, 3) mentions a figure of Apollo at Delus, representing the god in a rigid attitude, the upper arms close to the sides and the fore-arms advanced; in his right hand a bow, and in his left a diminutive group of the three Graces. Contemporary with Doryclidas were Smilis of Ægina and Gitiades of Sparta, the former of whom is known to have executed a group of the Horæ, to be placed with a figure of Themis by Doryclidas. From his hand was also a figure of Hera at Samus. Gitiades, who was at once sculptor, architect, and poet, erected the temple of Athene Chalkioikos, and made the figure of the goddess for it. The temple was coated with plates of bronze, on which were reliefs representing scenes from the legends of Hercules and Perseus, and from mythical incidents, among them being the birth of Athene.

School of Sicyon.

Remaining sculptures.

Turning now to the remains of Greek sculpture, which may with more or less certainty be assigned to the period in which the foregoing sculptors were at work, we begin with the three metopes from the oldest of the temples on the Acropolis of Selinus, in Sicily, which up to now have been regarded as furnishing the first authentic, and as yet the clearest, glimpse of that early stage of Greek art when the foreign elements with which it had grown up were being fast eliminated, and the basis laid of a perfectly independent art. It is not within the range of absolute proof, though it is nearly so, that these metopes belonged to the temple erected by the Selinuntians soon after their settlement as colonists, 651 B.C., or, as others prefer, 628 (Benndorf, *Die Metopen von Selinunt.*) They are sculptured in tufa, and represent —(1), Perseus cutting off the head of Medusa in the presence of Athene; (2), Hercules carrying the Cercopes, bound by the heels, over his shoulders; and (3), a quadriga to the front. In the first two, while the movement proceeds from left to right, the faces are all turned broadly to the front, as if looking to the spectator for applause. It may be that the artist, in thus rendering the grimness and grotesqueness of his subjects with a more staring and vivid effect, had recourse, as is argued, to an innovation on the older manner of representing the figures altogether in profile. This much appears to be certain, from the minute attention which he has devoted to the structure of the knees, the lower parts of the legs, the feet, and the movement of the flesh on the shoulders, that the loss of half a face, entailed by a position in profile, would have grieved him. The drapery is stiff, and studiously arranged in neat folds, which are not always produced by the manner in which it is worn. The hair is disposed in a system of circular locks independent of each other. The proportions of the figures vary considerably, though uniformly characterised by a solidity and heaviness which, from the similar appearance of Doric columns, has been designated as Doric in style. The remains of colour found on these sculptures showed that the ægis of Athene had been sketched on the breast with a reddish brown, and that the same colour had been applied to the ground of the relief. The mæander pattern on the broad fold of Athene's chiton was painted brown, her eyes and eyebrows black. The eyes of the Gorgon were red. The folds of the short chiton worn by Hercules were partially left to be indicated by colour. The muscles are strongly exaggerated, so as to mark the extraordinary physical strength attributed to the heroes of the subject.

Markedly contrasting with these metopes is a marble relief found in Samothrace in 1790, and now in the Louvre, distinguished for the flatness of the figures, which present the appearance of sections of men (Friederichs, *Bausteine*, i. p. 18). The subject, as we learn from the names inscribed by each figure, consists of Agamemnon seated, with the herald Talthybius, and Epeius, the sculptor of the wooden horse, standing behind him. The figures are lean and spare compared with those of Selinus; the folds of the draperies are merely indicated, and appear to have been completed in colour.. The character of the inscriptions, which are in the old Ionian dialect, corresponds with that of the early vases. That this relief cannot be later than 500 B.C. there is no doubt; but all means of determining its date beyond that period fail. Nor is it safe to assign it higher antiquity than the Selinus metopes, on the ground that the figures are all in profile; for a position in profile was by no means an invariable characteristic of early sculpture, as may be seen by reference to fig. 2, in which are given two examples of the ex-

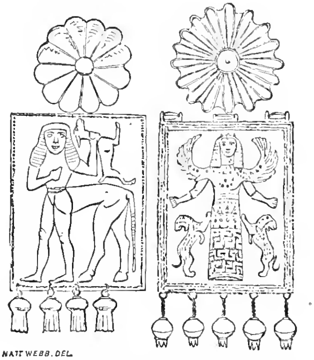

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FIG. 2.—Gold ornaments. Brit. Mus. From Camirus.

tremely early gold ornaments from Camirus in the British Museum, in all of which the figures are placed full to the front (Millingen, *Ancient Unedited Monuments*, ii. pl. 1; Müller, *Denkmäler*, pl. 11, No. 39). From the sacred way leading up to the temple of the Branchidæ at Miletus there are ten marble statues of seated figures now in the British Museum, for which they were obtained by C. T. Newton. Apart from their importance as works of art assignable to this early period, one of them possesses the additional interest of being, as we learn from the inscription on it, a portrait of Chares, a ruler of the neighbouring Teichiousa. The other important examples of sculpture in this period are—(1), the architrave of the temple at Assus, in the Troad (Friederichs, *Bausteine*, i. p. 9); (2), three statues of Apollo—one found at Thera, and now in Athens, the second found at Tenea, and now in Munich, the third in the British Museum, where it is known as the Strangford Apollo. All three stand in the Egyptian manner, resting the weight of the body on both legs. The head sits rigidly on the shoulders, the brow retires, the eyes project and slope inward towards the nose, the lips are close, and the corners of the mouth turned up, producing something like a smile. The hair appears to have been completed with colour (Overbeck, *Gesch. d. Griech. Plastik*, 2d ed., i. fig. 8; Friederichs, *Bausteine*, i. p. 5).

Retrospect. In the course of our notice of this early period certain facts have assumed a prominence which calls for remark. First, it is to be observed that the earliest important schools of sculpture arose in the islands, particularly the islands of Chius, Crete, and Ægina. To what circumstance this was due—whether, for example, to a more active intercourse with Oriental nations—remains unexplained. Next to the islands, the coast of Asia Minor, Magna Græcia, and Sicily were productive of artists. From Crete the new impulse spread to the Peloponnesus, Sicyon, Argus, and Corinth. Secondly, for some reason, the sculptors then mostly worked in pairs. Thirdly, the various materials—bronze, marble, wood and ivory, and gold and ivory—were already in use as in later times. Fourthly, the subjects were—(1), religious and mythological, the epos being the main source; and (2), portraits and statues of successful athletes. Individual artists had at last begun to assert their peculiarities in the conception of the human form. They had begun to give up those general types which bear the same resemblance to a man as does his shadow cast by the sun. In the infancy of art, as in the early morning, the shadows are grotesque. As it advances they improve, till at noon the shadow is lost in the living figure.

School of Sicyon. In the earlier part of our period it is to be observed that the Dorian race still continued to furnish the sculptors of distinction, but the main centres of the art were now in the Peloponnesus instead of the islands. In Sicyon the reputation acquired by Dipœnus and Scyllis was enlarged by Canachus, whose works were spoken of in later times (Cicero, *Brut.* 18, 70) as models of the severe restrained style of the early schools. Statues of deities were his favourite subjects. His material consisted sometimes of wood, as in the figure of Apollo Ismenius at Thebes (Pausanias, ix. 10, 2); sometimes of gold and ivory, as in the figure of Aphrodite at Sicyon (Pausanias, ii. 10, 4); and sometimes of bronze, as in his celebrated statue of Apollo Philesius at Miletus, which is said to have differed from the Apollo at Thebes only in the material. A figure of Apollo answering in general terms to the description of this statue, occurs on certain coins of Miletus and in a remarkable bronze statuette in the British Museum. The attitude of the statuette is stiff, but less pervaded with rigidity than, for example, the Apollo of Tenea. The form, which is quite nude, shows an advance in the study of proportions. The shoulders are still square, but the chest is much fuller, and apparently rendered as if with a reminiscence of its expansion and heaving after athletic exertion. Canachus worked with his brother Aristocles, also a sculptor of high reputation, though of his works all we know is that he took part with Ageladas in the execution of three statues of Muses.

School of Argus. The schools of Argus and Ægina appear to have mostly confined themselves to working in bronze. At the head of the former stood Ageladas, whose principal reputation consists in his having been the instructor of the three great masters, Myron, Polycletus, and Phidias.. Nine of his works are mentioned, including two statues of Zeus, but no description of his style is added, nor is anything regarding it to be inferred from the very diverse manner of his three great pupils. His date falls between 508 and 452 B.C. Argus had also Aristomedon, Glaucus, and Dionysius. **School of Ægina.** In Ægina, where the quality of the bronze (Æginetica aeris temperatura—Pliny, *N. H.*, xxxiv. 2, 5, 10; 8, 19, 75), as well as the artistic excellence of its sculptors, obtained a wide recognition, the first name of importance is that of Callon, a pupil, as has been said, of Tectæus, and Angelion of Sicyon, and a contemporary of Canachus (Pausanias, vii. 18, 10), with whom, in respect of the severity of his style, he has been compared. Of his works we know only of a statue of Athene at Trœzene, and a tripod with a figure of Cora at Amyclæ. Possibly, like his contemporaries, his chief study was that of the finely-developed forms of successful athletes. Greatly beyond him in distinction was Onatas, under whose hands the art of Ægina achieved a reputation which was perhaps only surpassed by that of Athens, and, owing to the political collapse of the island, was never obscured by the inferiority of later schools. His works, which appear to have been mostly of bronze, consisted of large compositions as well as of single statues of gods and heroes. After Onatas we have Anaxagoras, who was employed by the united Greek states to execute the bronze statue of Zeus (15 feet high) for Olympia, in commemoration of the battle of Platææ. On the same occasion the Greeks dedicated two other works of art—a bronze statue of Poseidon ($10\frac{1}{2}$ feet high) for his temple on the Isthmus; and a golden tripod, standing on a bronze support formed of three serpents, for the entrance of the temple at Delphi. In both cases the names of the artists are unrecorded, and probably it will not be wrong to assume that they also were of Ægina. The golden tripod was melted down during the Phocian war; but the support remained *in situ* till the time of Constantine, by whose orders it was removed to Constantinople and placed in the Hippodrome, where it still stands. In 1855 the earth which had accumulated round its base was removed by C. T. Newton, and the names of the Greek states inscribed on it revealed. (Newton, *Travels in the Levant*, ii. p. 25. For the discussion raised on the antiquity of this monument, see Friederichs, *Bausteine*, i. p. 64.)

School of Athens.

In Athens we find in this period Endœus, of whom the scanty records permit us to know almost nothing, and Antenor, the author of a bronze group representing the Tyrannicides, Harmodius and Aristogiton, and erected in the Agora at the foot of the Acropolis. That these figures were executed shortly after the incident which they were intended to commemorate, 550 B.C., is very probable. It is recorded that Xerxes carried them off to Susa in 480 B.C., and that they were restored to Athens by Alexander, or Seleucus, or Antiochus. In the meantime, to repair the loss, two sculptors, Critius and Nesiotes, were employed to replace the group (Pausanias, i. 8, 5; Arrian, *Exped. Alex.* iii. 16, 7; vii. 19, 2; Pliny, xxxiv. 19, 70). Whether the new sculptors were expected to reproduce the composition and the style of the lost figures—as, for example, Onatas did in replacing the figure of the black Demeter at Phigalia—cannot be ascertained. On the other hand, if the two marble statues in the museum of Naples (*Mus. Borbon.*, viii. pls. 7, 8) have been rightly described as copies of the new group, and if it is right to conjecture that the group represented on certain tetradrachms of Athens, and, we may add, on a Panathenaic prize vase in the British Museum, was copied from the older group, on the ground that they were executed about the time when it was recovered from Susa, and therefore probably to commemorate that event, this much at least will be clear, that the composition of both groups was very much the same. On the other hand, the frequency with which statues and groups of statues of various kinds occur on the late tetradrachms of Athens, would equally perhaps require to be explained on the same hypothesis of a restoration, and for this we are not prepared. With respect to the marble statues just mentioned, it is to be observed that the expression of physical energy in them, side by side with a spareness and sinewiness, recalls the characteristic of Myron, and accordingly may be better ascribed to the later artist Critius, than to his predecessor Antenor. As comparable in many respects with one of the statues in Naples we give fig. 3.

School of Magna Græcia.

At Rhegium, in lower Italy, the mantle of Clearchus had fallen on Pythagoras, unless it be true, as is also stated, that he had received his instruction from an otherwise unknown artist, Euchirus of Corinth. A list of the sculptures by Pythagoras (Overbeck, *Antike Schriftquellen*, *s.v.* Pythag.) shows that he worked exclusively in bronze, that his subjects, with the exception of a group of Europa on the bull, in Tarentum, consisted of male figures, and these of a kind in which either a strongly-pronounced

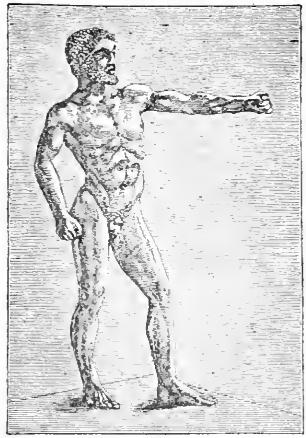

FIG. 3.—Bronze statuette. Brit. Mus. From the collection of the late Mr Woodhouse, Corfu.

muscular action, or a marked capacity for it, must have been expressed. The most famous of them was his statue of Philoctetes at Syracuse, of which the epigram writers declared that the expression of pain in it was such as to move the spectator. To disprove the conjecture that the pain might have been expressed in the face alone, there is a gem in the Berlin Museum (Overbeck, *Gesch. d. Griech. Plastik*, 2d, fig. 42) bearing what there is little doubt is a copy from the statue, from which Philoctetes appears to be suffering contortion through every limb from the wound in his foot as he tries to walk. And this, it may be added, while itself an accurate observation of the effect of such a wound, is an admirable illustration of the talent of Pythagoras for strained, and, what is more, a concentrated straining of, muscular action. From a statement of Pliny, it appears that he was the first to express the veins and sinews of the human form, and from Diogenes Laertius we gather that he was the first to apply rhythmus and symmetry to his figures. The precise meaning of these latter words it is difficult to understand, with nothing better before us than a gem copy of one of the artist's works. It will not, however, be far wrong if we take them to refer to that concentration of the entire action of the body upon one point which has been recognised in the figure of Philoctetes, and which we assume to have been the key to the composition of his groups. This interpretation is further in harmony with the statement of Pliny, seeing that an artistic purpose of this kind could not be carried out without the studious expression of veins and sinews (Brunn, *Gesch. d. Griech. Künstler*, i. p. 132).

Existing sculptures

We have seen how few of the existing monuments can be traced even conjecturally to the artists of this early period, whose names and praises have been handed down to us. Monuments of sculpture there are, manifestly assignable to this period, and some of them worthy of the fame of a great master. But whether the men who executed them were unhonoured in their time, or whether from the insufficiency of our literary records names well known in antiquity may have escaped us, or whether, in fact, the best of these works at least may really have come from the hands of men otherwise well known, remains unexplained. The last-mentioned possibility has been placed in a strong light by Brunn's discussion on the sculptures from the temple of Athene at Ægina, now in Munich. Not that he would trace them directly to the hands of the artists Callon and Onatas of Ægina. What he aims at is to connect the characteristics of the sculptures intimately with the style recorded of these two men, and to leave the rest for conjecture. (*Die Æginetische Giebel-Gruppen, Bayer. Akad.* 1869; and *Ueber das Alter der Æginetischen Bildwerke, Bayer. Akad. d. Wissenschaft,* 1867.)

Sculptures from Ægina.

Of the figures in the western pediment, in which the combat over the dead body of Achilles was represented, only one is lost. From the eastern only five complete figures remain. The subject of it was a combat corresponding in its main features with that of the other pediment. In both the central object of the strife is a fallen hero; in both the goddess Athene appears on the scene. In the one group her figure is entire; in the other only her head remains. In the eastern pediment the only recognisable figure is that of Hercules, and from his presence it has been supposed that the subject of the composition was the combat of that hero and Telamon against Laomedon of Troy. The statues of this pediment are of a bolder and more advanced style than the others, from which it has been inferred that they may have been the work of a younger man, carried away by a new movement in art, while the others may have been the work of an older artist, hardened in the traditions of his school. One thing, however, is plain from the remarkable uniformity which reigns among the figures of both groups, that the artist or artists had hitherto been limited in their study to one type of the human form, and that the nude form of finely-developed athletes. Nowhere is there individuality, but everywhere an excessive carefulness in rendering the forms. The goddess Athene has all the rigidity of the ancient figures intended for a worship which little brooked innovations. The expression on the faces is throughout the same, and the hair is always rendered in one conventional manner. The figures are spare and hard, with as little flesh as possible. In both pediments the scene—a combat over a fallen hero—is intended to stir our sympathy, but entirely fails. There is no straining of muscles, no expression of grief, and no sense of the emergency. We turn from the figures as a whole to the pleasing truthfulness with which the parts are rendered. To give them a greater air of vitality, the lips and eyes of the statues, with such accessories as drapery, sandals, and weapons, were originally coloured blue and red, while many small holes remain to show that part of the armour and ægis on the breast of Athene had been attached in metal, a fact which bears with great importance on the question of the polychromy of ancient statues. With regard to the date of these sculptures, the opinion is, that they could hardly have been executed more than fifty years before the time of Phidias (engraved, Müller, *Denkmäler*, i. pls. 6–8).

Bas-relief.

Among the other existing examples of sculpture assignable to this period we would select as most characteristic—(1.) A marble stele found (1838) in the east of Attica, and now in the Theseum at Athens (Friederichs, *Bausteine* i. p. 26), representing an armed warrior standing in profile, whose name, as appears from the inscription, was Aristion. The sculptor's name, which is also inscribed, was Aristocles. The relief is low and flat, and executed with the greatest care and attention to details, particularly those of the armour. The ground of the relief was painted red and the armour blue, the ornaments on it being picked out with red. Remains of colour were also found on the lips and eyes, while the crest of the helmet appears to have been added in metal. Altogether, Aristion presents a touching picture of the old upright and severe warrior who fought at Marathon. (2.) Another marble stele in Orchomenus, inscribed with the sculptor's name, Anxenor of Naxus, and representing, in low flat relief and in profile, a man of years wearing a mantle, and standing, resting on his staff, holding a beetle towards the dog at his feet (Overbeck, *Gesch. d. Griech. Plastik*, 2d ed., i. fig. 23; Friederichs, *Bausteine*, i. p. 29). (3.) Another marble stele in Naples (*Mus. Borbon.*, xiv. pl. 10; Friederichs, *Bausteine*, i. p. 28), in which the drapery and the forms are still archaic, though showing a considerable advance on the stele of Aristion. (4.) Part of a metope from one of the temples of Selinus in Sicily (Benndorf, *Die Metopen von Selinunt*, pl. 5), representing a goddess, either Athene or Artemis, trampling on an armed male figure, probably a giant, whom she has hurled to the ground. As an example of the archaic manner of relief in this period, this fragment has no equal among existing monuments. The anguish on the face of the giant is depicted with deep feeling; nor is our emotion interrupted by observing that the beard retains its formal trimness, and that the hair remains in graceful ringlets, in no way partaking of the confusion. (5.) Marble relief found on the Acropolis of Athens, and preserved there, representing a female figure, possibly a goddess, stepping into a car (Friederichs, *Bausteine*, i. p. 25). This relief has been supposed, but without sufficient reason, to be a fragment of the frieze of the older pre-Periclean Parthenon. With more justice has it been compared in point of style with (6), the reliefs of the so-called Harpy tomb discovered at Xanthus in Lycia in 1838 by Sir Charles Fellows, and now in the British Museum (Friederichs, *Bausteine*, i. p. 37). (7.) From Xanthus the British Museum possesses another archaic frieze of higher merit, representing a procession of chariots, in which the horses are modelled with extraordinary care (Prachov, *Antiquissima Monumenta Xanthiaca*, 1872). (8.) Marble relief in Thasus representing Apollo, Hermes, and nymphs (Overbeck, *Gesch. d. Griech. Plastik*, 2d ed., i. fig. 28). The figures have an Ionic slimness, such as we found on the architrave from Assus, but with finer proportions than that early work. (9.) Three small reliefs in terra-cotta from Melus (Overbeck, *Gesch. d. Griech. Plastik*, 2d ed., i. figs. 27, 26*a*, and 26*b*), representing Orestes and Electra at the tomb of their father; Perseus mounted on Pegasus and carrying off the head of Medusa; and Sappho,

Fig. 4.—Terra-cotta. Peleus [ΠΕ[Λ]ΕΥΣ] and Thetis. Brit. Mus. From Camirus.

seated, resting from her lyre and looking up towards Alcæus, as at the moment when he said, "You sweet, black-haired, modest Sappho, I have something to say to you." A fourth relief of this style is given in fig. 4.

The trimness and grace of these early reliefs had a charm for the artists and patrons of later times, especially the times of the first emperors, such as has been exercised in our day by the paintings of the pre-Raphaelite masters, and between the imitations then produced and the original models it is frequently difficult to draw a clear distinction. A critical list of these imitations—whether sculptured in relief or in the round—is given by Friederichs, *Bausteine*, i. pp. 71–95, and, with illustrations, by Overbeck, *Gesch. d. Griech. Plastik*, 2d ed., i. pl. 14. As examples of early sculpture in its inferior walk may be mentioned (10), a series of bronze statuettes which have served as stands of mirrors or otherwise as decorations of furniture. Those which have been or are still stands of mirrors are generally female figures, and it is to be observed that the oldest of them, as distinguished from the later examples, wear a heavy under-garment or chiton, apparently of worsted material, and over this again an ample and by no means light peplos.

Gem-engraving. If we are to credit the Greeks with having been introduced by the Assyrians to one branch of art more than another, we should say it was the art of gem-engraving. Not that we possess Greek gems which compare in style and antiquity with those of Assyria, but, if for no other reason, because we find a technical process of so great difficulty existing at all in Greece at an early period. Perhaps the earliest examples of the art in Greece possessed of artistic merit are two scarabs from Ægina, one with the figure of a bowman in pure Æginetan style, and the other bearing the inscription Κρεοντίδα εἰμί (*Bullettino d. Inst. Arch.* 1840, p. 140); three from Asia Minor, two of them being inscribed, the one Σήμονος, the other Ἀριστοτείχης (Brunn, *Gesch. d. Griech. Künstler*, ii. pp. 633 and 604). The only glyptic artist mentioned in this early period is Mnesarchus of Samus, the father of Pythagoras. In contrast with the paucity of early gems from Greek soil is the immense number of scarabs yielded by the tombs of Etruria, which at least reflect the style of this period. The material consists principally of rock-crystal, carnelian, and banded agate, and the subjects, it is worthy of remark, are mostly taken from the heroic legends of Greece, figures of deities being exceedingly scarce, as indeed is also the case on the Etruscan bronze mirrors, which, however, are obviously of a later date.

Painting, or rather colouring, as it would be more properly described in its earliest phase, in which it was entirely subservient to architecture and ceramography, is said to have been first elevated to an art by Cleanthes of Corinth, who introduced the drawing of figures in outline; by Telephanes of Sicyon, who improved on this by indicating the principal details of anatomy; and finally by Ecphantes of Corinth or Craton of Sicyon, by the introduction of colours (Pliny, *N. H.*, xxxv. 3, 15). Again we have Eumarus of Athens, who is said to have first distinguished in his paintings men from women, probably by the means adopted in the early vases, that is, by painting the flesh white in the case of women. The historical truth of these statements may be doubted; not so, however, those that refer to Cimon of Cleonæ, who made an unquestionable advance in the treatment of draperies, and in exchanging the conventional manner of rendering the human form for an approach to truthfulness to nature (Ælian, *Var. Hist.*, viii. 8; Pliny, *N. H.*, xxxv. 8, 6). Cimon appears to have been the founder of the early Peloponnesian school of painting. As the task imposed on painters at that time was mostly the decoration of the cella walls of temples, we must suppose that they executed their paintings on the prepared stucco of the wall either when it was fresh (*al fresco*), or when it was dry, by means of some binding material, *a tempera*. Like their followers down to the time of Apelles, they used only the simple colours, white, yellow, red, and bluish black, in the mixing of which to obtain other shades they seem to have advanced very little, greater attention being directed to the drawing than to the colouring. From the school of Asia Minor, which, from the proximity of the Lydians, Phrygians, and Phœnicians, with their long practice in working in colours, may have arisen earlier than that of the Peloponnesus, the first name we hear of is that of Bularchus, who, according to Pliny (*N. H.*, vii. 38, 126; xxxv. 8, 55), produced a large painting of the taking of Magnesia, which he sold to Candaules, king of Lydia, for its weight in gold. From the coast of Asia Minor our records of painting pass to Samus, an island which was conspicuous in early times for the grand scale of its undertakings. There Mandrocles, who made the bridge of boats across the Bosphorus by which Darius crossed with his army 515 B.C., executed a large historical painting of this passage of the Persians across the bridge, with Darius seated, enthroned, on the shore. This picture, according to Herodotus (iv. 88), was placed in the Heræum of Samus. To the Samian school belonged Calliphon and Agatharchus. It is also not unlikely that it had exercised some influence on Aglaophon of Thasus, the father and instructor of Polygnotus. From Corinth the art of painting, coupled with that of modelling in clay, passed to Etruria, lower Italy, and Sicily. At present the only examples of early Greek painting which we can adduce are furnished by the vases, a branch of the art which the ancients themselves regarded, it appears, with sufficient disrespect. For us, the vases, which have been preserved in great numbers, have this special value, that they present in an unbroken line, if in a comparatively degraded form, the various stages of Greek painting from its first beginnings under Oriental influence to its decline. The class which belongs to the period now before us is distinguishable from the others by the fact that the figures upon them are first scratched in outline on the red ground of the vase, and then filled in with black, the whole being covered with a varnish which seems to have lost nothing of its brilliancy. The other colours employed are white for the flesh parts of women and the hair of old men, white and a dark purple for the details of draperies and other accessories. The eyes are always placed full in profile, and the drawing of the figures is exceedingly stiff and angular. By far the greater part of this class of vases have been found in the tombs of Etruria, and for this reason they were called Etruscan, a designation which they retained till the frequency of Greek inscriptions, recording the artists' names upon them, contrasted with the total absence of Etruscan inscriptions, led to their being correctly traced to Greek workshops. As to their date, it has recently been argued by a high authority (Brunn, *Probleme in der Geschichte der Vasenmalerei*) that the greater part of these vases—in fact, all that have been found in Etruria, with at most two or three exceptions—are the production of Greek vase painters at a period not earlier than the end of the 3d century B.C., when a taste for the archaic manner must have revived. This theory has encountered much opposition. Applying it to the large collection of vases of this class from Etruria in the British Museum, one vase alone remains as a genuine example of the work of an early period. Whether we regard these vases as spontaneous productions or as imitations, they will serve to convey at best a dim idea of early Greek painting as a fine art. Of the next class of vases—those with red figures on black ground—some appear, from the severity of the drawing, to belong to the end of this period. The whole question of ancient vase-painting has been very fully and ably discussed by Otto Jahn in his Introduction to the *Vasen-Sammlung zu München*.

Painted vases.

Architecture.

In temple architecture the principles of both the Doric and Ionic orders were already fully established, the latter in Asia Minor and the former in Greece proper; and it is characteristic of the national importance attached to this branch of art, that not only was the best available talent of the time procured, irrespective of local connection, but also that architects appear to have found a public for the writings in which many of them narrated their proceedings, and described the appliances used by them in building, as did Chersiphron and his son Metagenes in regard to the temple of Diana at Ephesus; or laid down the principles they had followed, as did Theodorus with regard to the temple of Hera at Samus. Among the remains of Doric architecture assignable to this period, the first to be mentioned are the two temples at Pæstum (Major, *Les Ruines de Pæstum ou de Posidonie,* 1768; *cf.* Schnaase, *Bildende Künste*, ii. fig. 36), of which the larger derives a special interest from the two rows of columns, one above the other, with which it is furnished in the interior, for the purpose of supporting, as it appears, a hypæthral roof. Differing in many details from the Pæstum temple is that of Selinus, the sculptured metopes of which have already been described, and assigned to the commencement of this period. The columns are here slimmer, being 4½ times the lowest diameter in height; but the architrave has gained in height and heaviness. A transition from the heaviness of the old Doric temples—of Pæstum and Selinus, for example—to the graceful proportions of the Doric order in Attica is presented by the temple of Athene in Ægina, the columns of which, however, are still too short, being a little over 5 times the lowest diameter in height, and the architrave and frieze too high for the Attic-Doric style. Of the Ionic order during this period the principal example was the temple of Diana at Ephesus, the construction of which, begun by Theodorus of Samus, was carried on by Chersiphron of Crete and his son Metagenes, and completed by Demetrius and Pæonius about the time of Crœsus, 565–551 B.C., 120 years having, it is said, from first to last been consumed on the work (Strabo, xiv. 640; Vitruvius, vii. praef.; Pliny, *N. H.*, xxxvi. 14, 95). This temple having been burned by Herostratus, was restored under the direction of Alexander's architect Dinocrates. The oldest instance of the Ionic order in Greece proper, so far as we know, was found in the treasury erected at Olympia by Myron, the tyrant of Sicyon, after his chariot victory, 658 B.C. This building consisted of two chambers, the walls overlaid in the ancient manner with bronze plates, and the one executed in the Ionic, while the other was of the Doric order. The architects of this early time were not, however, restricted to the erection of temples, but had other problems to solve, as, for example, in the Scias of Sparta, a round building with tent-shaped roof, used originally for musical performances and afterwards for public assemblies. Theodorus of Samus was the architect of the Scias. Probably the Odeum erected at Athens by Solon or Pisistratus had the same round form, and was intended for meetings of the same kind. Then followed the construction of theatres, that in Athens, which was of stone, having been commenced shortly after 500 B.C.

Third Period.

The splendid victories of Salamis, Platææ, and Mycale, gave an immediate and powerful impulse towards public undertakings, and especially, so far as we are at present concerned, towards the erection of temples and monuments worthy of the just pride of the nation. A sense of freedom and relief from long and troublous fears must have been the ruling feeling of the time; and of the efforts, both intellectual and artistic, which such new-born feelings engender, history has its examples. Of all the Greeks, the Athenians had in that crisis earned the best title to patriotic emotions, and in Athens, above all Greece besides, the aspirations were highest. Nor were means wanting to second the boldest designs. The Peloponnesians had loitered in the great conflict with the Persians, and in sharing the new impulse they loitered also. The Persian invasion had not, however, been hurled back by a stroke of fortune, but, on the contrary, by the united action which discipline and severe habits of life gave to the Greek forces; and in the same way the men who thereafter achieved the first triumphs in art, who diffused freedom throughout its realm, were men who had been trained in severe schools, where close study, no less than respect for popular feeling, restrained the exercise of the imagination. Accordingly, before we can appreciate the artistic freedom established by Phidias, we must see how far his early training prepared him to fight the battle. This can only be done by examining the works of other sculptors, either pupils of the same master, as were Myron and Polycletus, or probably contemporary, though more hardened in the traditions of their school, as was Calamis the Athenian, with whom we begin, remarking that the only known approximate date in his lifetime is from 468 to 464 B.C. The works of Calamis extended over a tolerably wide field of subject, and were executed partly in marble and partly in bronze; but with the exception of two copies of his statue of Hermes Criophorus at Tanagra, on the coins of that town, and in a marble figure in Wilton House, none of our remains of ancient sculpture have as yet been identified with his style. Cicero (*Brut.*, 18, 70) and Quintilian (xii. 10, 7) speak of him as less rigid and hard in his rendering of the human form than Callon and Canachus; but the real advance with which his name is associated was in the rendering of expression in the female face, and in the treatment of draperies. A figure of Alcmene by him was highly praised (Pliny, *N. H.*, xxxiv. 19, 71), while his statue of Sosandra, on the Acropolis of Athens, is spoken of in the highest terms by Lucian (*Imag.*, 4, 6; *Dial. Meretr.*, 3, 2) for its chaste and tender expression, for its taste in dress, and for the noble bearing of the whole figure. His horses were always incomparable. To have attained the power of expressing modesty and mobile character in a figure was to have laid the foundation for idealism in its true sense; and Calamis was therefore on the same path with Phidias. Calamis

We come now to Myron, a native of Eleutheræ in Attica, and a pupil of Ageladas of Argus. With rare exceptions, he worked in bronze, and that of the Æginetan kind, while Polycletus employed the bronze of Delus. His works, which were numerous, and scattered from Asia Minor to Sicily, may be divided into the four classes of deities, heroes, athletes, and animals, with a considerable variety ranging within each of the classes. He avoided female figures almost throughout; and though he was the author of statues of Dionysus and Apollo, it should be remembered that these deities had not become soft of form till Praxiteles made them so. He preferred the well-knit figures of athletes, or of Perseus or Hercules. His animals were marvels to the ancients; and the human figures in which he succeeded best were those in which purely physical qualities were pronounced. "Corporum tenus curiosus, animi sensus non expressit," says Pliny of him. But, according to the same authority, he was careless in rendering the hair, from which it is to be inferred that his study of the human form did not lead him, as it did Pythagoras, to an anxious reproduction of all its details. Then we have the further statement of Pliny—"Primus hic multiplicasse veritatem videtur, numerosior in arte quam Polycletus, et in symmetria diligentior." As we understand "multiplicasse veritatem," it would mean that he exaggerated the truth of nature to give effect to the momentary attitude of his Myron.

figures. "Symmetria" we take to refer to the manner in which every member and part of the body was made to work together for the expression of one moment of action. Such a style at least presents a very obvious contrast to that of Polycletus, and would answer our expectations when we read that Myron's statue of Ladas seemed about to leap from its base to seize the victor's wreath, the last breath leaving his lips. (For a different interpretation see Brunn, *Gesch. d. Griech. Künstler*, sub Pythagoras). Among his figures of animals, that of a bronze cow which stood on the Acropolis of Athens, and was afterwards removed to the temple of Peace in Rome, was celebrated by numerous epigrams. Of his other works, some have been preserved in copies down to our own time. A copy of the figure of Marsyas (from his group of Athene and Marsyas) has been recognised in a marble statue in the Lateran Museum (*Mon. d. Inst.*, vi. pl. 23; *Annali*, xxx. p. 374). Of his bronze statue of a Discobolus, famous in antiquity (Quintilian, ii. 13, 10; Lucian, *Philops.*, 18) for the boldness of its movement and the carefulness of its execution, we have several copies, of which the best is the marble statue in the palace Massimi at Rome (Müller, *Denkmäler*, i. pl. 32, No. 139, *b*). Another marble copy in the British Museum has not only had its head (if original) placed on the shoulders the wrong way, but has been made smooth on the surface by a vigorous rubbing down, which has destroyed the original lines. A third copy of bronze, about a foot high, is in Munich. (For a list of his other works, known only by name, see Overbeck, *Ant. Schriftquellen*—Myron.) From the few copies of his statues which we possess, and the few ancient remarks as to his style, it seems impossible to frame a conception of his work which would justify the extraordinary reputation he enjoyed. We can picture the action of his figures, but we cannot estimate the equivalents for actual life and organism which he must have employed to have almost completely satisfied eyes accustomed to the work of Phidias. This, however, we gather from the remarks on his statue of Ladas and the Discobolus, that he seized for his representation the moment when the whole breath was held back for a final effort of strength—that moment, in fact, when the human figure is most truly statuesque. For an instant the body is then lifeless, so to speak, like the statue itself: the spectator suspends breathing, in sympathy.

We have reached the time of Phidias, and have now done with imperfections in sculpture, so far at least as they originated in want of knowledge either of the human form or of technical means. Phidias, the son of Charmides, was an Athenian, and must have been born about 500 B.C., or a little before, if we can trust the statement (Plutarch, *Pericl.*, 31) that in the portraits of himself and Pericles, which he placed on the shield of Athene Parthenos, he appeared a bald-headed old man, while Pericles appeared handsome and full of vigour (K. O. Müller, *De Phidiæ Vita et Operibus Commentationes Tres*, Gotting. 1827; Brunn, *Gesch. d. Griech. Künstler*, i. p. 157). A fragment of a marble shield in the British Museum, found on the Acropolis of Athens, and representing a combat of Greeks and Amazons, in which a bald-headed old man appears, has been recognised as a rough copy of the shield in question. Phidias began his career as a painter; then turning to sculpture, studied first under his townsman Hegias, and afterwards under the Argive master Ageladas. It may have been due to his training in this school that his first two important works were executed in bronze. The first was a large group, commissioned by the Athenians to be paid for out of their booty from the Persian war, and to be dedicated at Delphi. The second was a colossal statue of Athene, the Promachos, also commissioned by the Athenians out of the Persian booty, and when finished erected on the Acropolis, between the Propylæa and Erechtheum, the top of the spear which she held, and the crest of her helmet being visible at sea from Cape Sunium (Pausanias, i. 28, 2). On certain coins on which the Acropolis is figured occurs a statue which seems to correspond with the description, except that the goddess there stands placidly, an attitude that does not suit the idea of a Promachos. This idea is finely embodied in a small bronze statuette (fig. 5), found on the Acropolis and now in the British Museum, representing the goddess striding forward. Otherwise it has little of Phidias in it. Possibly the Promachos statue was wrongly ascribed to Phidias in ancient times. Again profiting by the Persian spoils, he was employed by the Platæans to execute a figure of Athene Areia for their new temple (Pausanias, ix. 4, 1). The figure was of wood, covered with gold; the face, hands, and feet, of Pentelic marble; the whole being of colossal proportions. He had previously made a figure of Athene in gold and ivory for a temple at Pallene in Achæa, and this must be regarded as the first of his works executed in the material in which he afterwards achieved his greatest triumph (Pausanias, vii. 27, 2).

FIG. 5.—Bronze statuette. Brit. Mus. From Athens.

We must suppose that his faculties were now at their best, that he was fully aware of the peculiarities of treatment required by the different materials in which sculptors then worked, and had found the best scope for his own talent in chryselephantine sculpture. The two works with which his fame was chiefly associated were in gold and ivory,—the colossal statues of Athene for the Parthenon at Athens, and of Zeus for the temple at Olympia. After the completion of the former statue, Phidias accepted the invitation of the people of Elis to exert his highest power in fashioning for their temple of Zeus at Olympia a statue worthy of the majesty and grandeur of the supreme god of Greece. His workshop was near the Altis or sacred grove, where through successive centuries down to the 2d A.D. it was preserved and pointed out with feelings of reverence. The finished work was over 40 feet high, and represented the god seated on his throne, his right hand holding forward a figure of Victory, and his left resting on a sceptre on which the eagle was perched. On his head was a wreath of olive. The drapery was of gold, richly worked with flowers and figures in enamel, in the execution of which he was assisted by his brother or cousin Panænus. On the footstool was inscribed the verse—

Φειδίας Χαρμίδου υἱὸς Ἀθηναῖος μ' ἐποίησε

(Pausanias, v. 10, 2). The throne was mostly of ebony and ivory, inlaid with precious stones, and richly sculptured with reliefs, and in parts painted. Of this, the greatest work of Phidias, nothing but the description now remains (Pausanias, v. 15). The figure of Zeus seated on a throne, which occurs on coins of Elis struck in Roman times, may have been intended as a reminiscence of it. On the other hand, there is in the British Museum a silver coin of Elis, struck in the best period of Greek art, on which is a head of the god so singularly powerful in type that we are tempted to believe it to be a copy from the head of the statue of Phidias, appealing to the analogy of the coins of Argus with what is accepted as a copy of the head of the figure of Hera by Polycletus. Among the existing examples of Greek sculpture there is only one which claims to be a direct work of Phidias, and that is one of the two colossal marble statues on the Monte Cavallo at Rome; inscribed respectively "opus Phidiæ" and "opus Praxitelis" (Clarac, *Musée de Sculpture*, pl. 812 A, No. 2043). Grand as both are, the marking of the pupils of the eyes and the treatment of the armour prove them to have been executed in Roman times, probably as copies of celebrated statues. The originals must clearly have been the work of one master, and the inscriptions being thus wrong in ascribing them to two, must be held as worthless. On the other hand, we possess in the sculptures of the Parthenon a large series of works in marble at least designed or modelled by Phidias, and executed under his immediate care, if not in many cases finished by his own hands. These sculptures consist of figures in the round from the pediments, the metopes in high relief, and the frieze in low flat relief. The statues of the pediments have suffered most, and that mainly from two causes—the antipathies or necessities of the early Christians, who converted the temple into a church; and the fatal explosion produced by the falling of a shell among the powder stored in it during the Venetian bombardment under Morosini, 1687. The extent of the mischief on this occasion is known from the drawings previously made of the temple as it stood, 1674, by Carrey, an artist in the employment of the French ambassador at the Porte. In 1805, Lord Elgin, then British ambassador at the Porte, removed all the sculptures that could be removed with safety to the building, shipped them to London, where, after a long dispute as to their merits, they at last, in 1815, found a permanent resting-place in the British Museum. (For a narrative of these proceedings, but especially for an exhaustive work on the Parthenon, see Michaelis, *Der Parthenon*, Leipsic, 1871; the sculptures are best engraved in *Museum Marbles*, vol. vi.; the fragments in Athens, in Laborde, *Le Parthénon*, pls. 26–28). The subject of the eastern pediment was the birth of Athene; of the western, her contest with Poseidon for supremacy over Attica; but beyond the simple statement of Pausanias to this effect, we have no ancient record to enable us to identify the personages before whom these events took place. Hence the many different names which have been proposed from time to time for the surviving figures, especially for those of the eastern pediment, from which all the principal statues had disappeared before Carrey's time. Assuming, however, with the most recent authority (E. Petersen, *Die Kunst des Pheidias*, 1874), that the birth of Athene took place in Olympus, and that the deities assembled at the birth of Aphrodite, as represented by Phidias on the base of the statue at Olympia, were the recognised Olympians of his time, we obtain, beginning from Helios on the left, Dionysus, Demeter, and Core, Iris [Apollo, Artemis, Hephæstus, Athene, Zeus, Hera, Poseidon], Nike [Ares, Hermes], Hestia, Peitho, Aphrodite, and Selene, those in brackets being missing. The western pediment has suffered a much harder fate, though the difficulty of recalling the lines of the original composition is less, owing to the preservation of drawings made by Carrey before the bombardment which destroyed it. The metopes were ninety-two in number; those of the east and west only remain on the building, but have suffered severely from malicious destruction. Those of the north side, which survived the explosion, remain in Athens in bad condition; those of the south were removed by Lord Elgin, with the exception of one now in the Louvre and some fragments in Copenhagen. The subject—a favourite one in the decoration of Greek architecture—was a combat between Centaurs and Lapithæ. Traces of red colour were found on the ground of the relief and of green on the draperies. The armour had been attached in metal, as is proved by the existing holes for that purpose. Differences in style as well as in execution prove the variety of hands employed in the work, though everywhere is apparent the oneness of design which bespeaks the overseeing master. The variety of hands is equally manifest in the frieze, but here it takes the form of insufficiency of execution, which no doubt arose from the difficulty of supervising work which had to be done up on the building. The subject of the frieze is a long festal procession, in which, though every variety of movement of horse and foot, of young and old, of men and women, perhaps of gods and goddesses, is introduced, the calm dignity of national pride and the knowledge of national worth reign supreme. Its entire length is 524 feet, its height from the ground 40 feet, its relief very low and flat. About two-thirds of it is preserved, nearly the half being in the British Museum. As to the procession itself, there are two opinions: either it is the procession with which it was usual to accompany annually the newly-made robe for Athene Polias, or it is the procession in which the victors at the Panathenaic games advanced to the Parthenon to receive their prizes and to attend a sacrifice in honour of Victory.

Sculptures of the Parthenon.

The mantle of Phidias fell on his pupil Alcamenes (Pausanias, v. 10, 8), an Athenian, or, as others said, a Lemnian, the lofty conception in his figures of deities being highly praised (Quintilian, xii. 10, 8), while in point of gracefulness in womanly forms he appears to have excelled his master. His most celebrated work was a statue of Aphrodite for her temple, ἐν κήποις, of which, however, the merit of the last touch was ascribed to Phidias (Pliny, xxxvi. 5, 16). Her cheeks, hands, and fingers were specially admired; but as to the attitude and general effect we have no information, and are not justified in accepting the Aphrodite of Melus in the Louvre as a copy of it, much less the original work. How far he may have been possessed of the power of creating new ideal types is not expressly recorded, except in the instance of his statue of a triple Hecate, probably such as we know her in later works. On the other hand, there was doubtless scope for extending the new influence of Phidias in such types as those of Æsculapius, Hephæstus, and Ares, and it has been conjectured that in his statues of these deities he succeeded in infusing the spirit of his master.

Alcamenes.

Scarcely less famous was another pupil of Phidias, Agoracritus of Parus, who so far identified himself with the master's style that two marble statues of deities by him were sometimes ascribed to Phidias. The one was a figure of Nemesis in Rhamnus; the other, a statue of Rhea in the Metroon at Athens (Pausanias, i. 3, 5). From his hand were also the bronze statues of Athene Itonia and of Zeus, in the temple of that goddess between Alalcomenæ and Coronea (Pausanias, ix. 34, 1). Next we have Colotes and Thrasymedes of Parus, both of whom occasionally aspired to retain the chryselephantine technique of the master, and finally, Theocosmus of Megara.

Successors of Phidias.

How far the immediate successors of Phidias remained, whatever their peculiarities or eccentricities, still faithful to the general sentiment and manner of the master, merely varying but always preserving essentially the theme struck by him, cannot be ascertained, unless we take the sculptures of the temple of Athene Nike at Athens, or of the Erechtheum, as typical examples of their work. And indeed they are well calculated to produce the impression of having been executed during the lull which must have followed his great impulse. (For the relief on the frieze and balustrade of the temple of Nike, compare Friederichs, *Bausteine*, i. pp. 187–193; Ross, *Der Niketempel;* Kekulé, *Die Balustrade des Niketempels*.) The treatment of the draperies has entirely lost the stiffness and formality of an early period, and become flowing, as in the style of the best times, but with the addition of a studied grace which seems due to a desire to elaborate more and more the simplicity of the draped figures of the Parthenon. The most probable date as yet suggested for this temple is 407 B.C. As to the Erechtheum, we have 406 B.C., on the authority of an inscription, as a year in which a report was made concerning the amount of work that remained to be done upon it. Of its sculptures the chief remains are the statues of the Caryatides, and certain fragments of the frieze, which had this peculiarity, that the reliefs were executed in Pentelic marble, and then attached to a ground of black Eleusinian stone. Of the original six Caryatides which supported the portico, five were in position in the time of Stuart and Revett in the first half of last century; the sixth, having been broken to pieces, was recovered in 1837. One of the five was removed by Lord Elgin, and is now in the British Museum. In the arrangement of the draperies vertical lines prevail; but only enough to show the architectural purpose of the figures, not to destroy their character as robes, or to affect their gracefulness. It is usual to compare with the sculptures of these two temples another series of reliefs which, though not found in Attica, are stated to have been the work of Ictinus, the architect of the Parthenon. We refer to the frieze from the temple of Apollo at Phigalia which was discovered in 1812, and is now in the British Museum. The subjects represented are combats between Greeks and Amazons and between Centaurs and Lapithæ. In the composition the old ethos has given way to pathos; but the figures are still large in conception, and obviously studied with a view to truth as well as effect, though in the execution probably by provincial hands, many minor details have been overlooked. The energy of action throughout is not equalled in any other ancient sculpture now in existence, while the sense of pain in the wounded, or of fright in the helpless women who run with their infants in their arms, makes the spectator shudder. From the fact that such vigour of action and intensity of pathetic expression have not been found in the metopes of the Parthenon or the frieze of the Theseum which are devoted to the same subject, but recur in a less degree in the frieze of the Mausoleum, there is an inclination to place the Phigalian reliefs by Ictinus in as late a period as possible after the erection of the Parthenon. (Engraved, *Museum Marbles*, vol. v.; Stackelberg, *Der Apollotempel zu Bassæ*, 1828; see Friederichs, *Bausteine*, i. pp. 178–181.)

The difference of temperament between the Athenians and Peloponnesians was strongly marked in the schools of sculpture peculiar to each. Political rivalry had its exact counterpart in artistic rivalry, in which Phidias

Polycletus. represented Athens, and Polycletus the Peloponnesus. The works of the latter appear to have been always chastened with an hereditary severity, to have been attractive by the purity of their style and the finish of execution, but not commanding in aspect. "Non explevisse deorum auctoritatem videtur," the judgment of Quintilian (xii. 10, 7) is endorsed by the statement, that his great work, the chryselephantine statue of Hera at Argus, yielded to the statue of Zeus at Olympia by Phidias in grandeur and imposing aspect, but outrivalled it in finish (Strabo, viii. p. 372). Copies of the head of this statue have been identified on coins of Argus, and in three marble heads of colossal size. The first, in Naples, is severe in style, and may have been executed about the time of Polycletus; the second, in the British Museum, has more freedom, but is still chastened by a severe expression; the third, in the Villa Ludovisi, bears the marks of having been executed at a still later period. It was not, however, in producing statues of deities that Polycletus delighted most; and if surpassed by Phidias in that instance, he was quite without a rival in his own province, the rendering of the form of ideal athletes. Of this class were his Diadumenus, his Doryphorus, and a third figure (unless the Doryphorus was meant by Pliny) known as the Canon. Of the first, several presumed copies in marble exist, two of them in the British Museum (fig. 7), but in no case furnishing an adequate illustration of his style. The same may be said of the copies of the Doryphorus. More in the nature of *genre* work was his bronze group of boys playing with knuckle-bones (ἀστραγαλίζοντες), which afterwards stood in the palace of Titus in Rome, and was by some regarded as the most perfect work of the master. This motive occurs in several existing sculptures, in no case characterised by a trace of the hand of Polycletus. Among them are, in the British Museum, a small group in terra-cotta of two women playing at this game, and a marble figure of a boy, part of a group, biting his companion's hand. Coupled with his statue of Hera, that of an Amazon, executed by him for Ephesus, in competition with the foremost of his contemporaries, and adjudged the prize, will prove that the range of his talent was by no means confined to figures of athletes; and this is made further apparent by his bronze statues of maidens carrying sacred vessels on their heads, afterwards in the possession of Heius the Mamertine, from whom they were taken by Verres (Cicero, *In Verr.*, iv. 3, 5), as also by his statue of the Samian, Artemon, nicknamed ὁ περιφόρητος.

FIG. 6.—Bronze statuette. Brit. Museum. From the collection of the late Mr Woodhouse, Corfu.

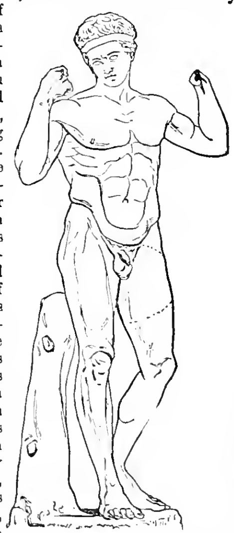

FIG. 7.—Diadumenus. Marble statue. Brit. Mus. Found at Vaison (*Vasio*), Dept. Vaucluse, France.

None of the pupils of Polycletus arrived at distinction. On the other hand, his **Pupils of Polycletus.** style appears to have been closely followed by his younger contemporary, Naucydes of Argus, who executed a chryselephantine statue of Hebe, to accompany that, of the same material, by the master already described (Pausanias, ii. 17, 5; Kekulé, *Hebe*). A pupil of Naucydes was Polycletus the younger, of Argus, who is known as the author of several statues of victors at Olympia, and of a statue of Zeus Philius (Pausanias, viii. 31, 4), in which the expression resembled that of Dionysus.

In addition to the existing sculptures already mentioned in connection with one or other of the ancient masters, there are others which, though their authorship has not been ascertained, undoubtedly belong to the period now before us. From these we select—(1.) A marble relief in Athens, found at Eleusis in 1859, and representing Demeter, Cora, and boy, for whom the name either of Triptolemus or Jacchus would be applicable (*Monumenti*, vi. pl. 45.) With the exception of a marked severity both in the composition and in the details, which may be due either to archaism or to a studied solemnity, this relief compares admirably with the frieze of the Parthenon. (2.) From Eleusis also comes the upper part of a female figure supporting a basket on her head (Calathephorus), now in Cambridge, in a large fine style (Wieseler, *Denkmäler*, ii. pl. 8, No. 92). (3.) Marble relief of Orpheus and Eurydice, in the Villa Albani, with its two replicas in Naples and Paris. (4.) Fragments of the metopes from the temple of Zeus at Olympia, found in 1829, and now in Paris. Doubtless these reliefs were executed at the time when Phidias was at Olympia engaged on the statue for this temple, and when his pupil Alcamenes was at work on the figures for the western pediment of it. In style, however, they differ considerably from that of the Attic sculptors; nor are there any means of identifying them with the style of Pæonius of Mende, who executed the statues for the eastern pediment (*Expédit. Scientifique de la Morée*, i. pls. 74, 78.) (5.) The metopes and inner frieze of the temple of Theseus at Athens are still in their original place, the style being compared with that of the metopes of the Parthenon, though the temple itself is usually believed to have been built by Cimon (Stuart's *Antiquities of Athens*, 2d ed., ii. pl. 19)

Examples of what may be called a lower branch of sculpture (gem-engraving) are exceedingly rare in this period. So far as Athens is concerned, this will appear less remarkable if we suppose that gem-engraving and die-sinking were one profession, and remember that at least the latter must have been, with few exceptions, unpractised there in the best period, the coins being allowed, probably for commercial reasons, to retain the old stamp with which people were familiar. Possibly also the high ideal of the times was above the grasp of such artists, though it was seized pretty generally by the sculptors of stelæ, who could hardly have been men of note. In the British Museum is a carnelian (fig 8) representing a youthful figure, seated, and playing on a harp-shaped instrument, which, with a little severity, admirably reflects the style of the Parthenon frieze. Of the coins of Sicily, the large piece known as the Demaretion, and struck in the year 479 B.C., furnishes an example of the rendering of horses, which compares finely, if more advanced, with the archaic frieze from Xanthus. Similarly worthy of study are the coins of Gelon, which are probably as early as 470 B.C., and certainly are anterior to 410 B.C.

FIG. 8.—Carnelian intaglio. Brit. Mus. From the collection of the late Mr Woodhouse, Corfu.

Painting. In the records of painting during the previous period it was noticeable that painters even then, in what appeared to be one of the earliest stages of the art, were accustomed to execute large compositions, such as battle scenes. The essentially decorative character of the art required that it should be so, just as in early sculpture, in which also the decorative element prevailed, our principal records are those of large compositions, such as the chest of Cypselus or the shield of Achilles. While the epos flourished, and the country was full of heroic legends, there can be little doubt but that the principal pleasure derived from works of art lay in the variety of the subject and the manner in which it was presented, that is, in the composition, and not in the truthful rendering of individual forms. To heighten the interest of the spectator, it was usual to write the name beside each of the persons that appeared in a picture, as we see it done on the early vases. The same was the case with the sculptured reliefs on the chest of Cypselus, which on this account presents a remarkable contrast to the shield of Achilles, on which, as in Assyrian sculptures, there is no prominence of individuals, and therefore no accurate study of the human form. It is not to be supposed that in the early stage of Greek painting individual forms were studied with any other view than that of rendering the characters more intelligible; but with this a beginning was made to lift the art into a higher sphere. At this stage appeared Polygnotus, a native of Thasus, and a son of the painter Aglaophon, of whose probable connection with the early Samian school mention has already been made. Attracted to Athens by the opportunity presented by the new buildings which were then being erected, Polygnotus, either owing to some family tie or through the recommendation of his own ability, found favour with Cimon, to whose zeal and taste the new impulse for the improvement of the city was due. In company with, or perhaps rather with the assistance of, the Athenian painters Micon and Panænus (the brother or cousin of Phidias), he was employed to execute wall paintings for the Stoa Pœcile, the Theseum, and the Anaceum, or temple of the Dioscuri, at the northern foot of the Acropolis. For his services, and especially for the disinterestedness of his character, Polygnotus received what was then regarded as the highest distinction—the freedom of the city of Athens. His friendship with Cimon was intimate, and led, it was said (Plutarch, *Cimon*, 4), to an affectionate acquaintance with Cimon's half-sister, the beautiful Elpinice. From Athens he was called to Delphi to execute a series of paintings for the two long walls of the Lesche, a building erected there by the people of Cnidus. The paintings, however, appear to have been commissioned by the Amphictyonic council, if it is right to be guided to that conclusion by the statement that the painter was rewarded with the rights of hospitality throughout the states included in the Amphictyonic league. On the wall to the right after entering the Lesche were painted scenes illustrative of the old epos of the taking of Troy (Ἰλίου πέρσις). On the left was the visit of Ulysses to the lower world, as described in Book xi. of the *Odyssey*. The names of most of the persons were written by the side of the figures. The various groups and incidents depicted we know from the description of Pausanias (x. 25–31); and with the help of existing works of art in which the same subject recurs, we can form an idea of the composition (O. Jahn, *Die Gemälde des Polygnotus in der Lesche zu Delphi*, 1841; Welcker on the same subject in the *Abhandlungen* of the Berlin Academy, 1847; Watkiss Lloyd, in the *Museum of Classical Antiquities*, i. p. 44). Heydemann (*Iliupersis*, Berlin, 1866) republishes, for the illustration of his other figures, the famous Vivenzio vase in Naples (*Mus. Borb.*, xiv. pls. 41, 43), which, pregnant with pathos as no other vase in existence, cannot well be identified with the style of Polygnotus, unless perhaps as regards the composition. He was employed at Thespiæ on a stoa or temple, but from some defect his work had perished so far within a century after it was

Polygnotus.

finished that it had to be restored by Pausias of Sicyon. At Platææ he painted for one of the walls of the pronaos of a temple the scene in which Ulysses appeared with the dead suitors at his feet. The companion picture was by an otherwise unknown artist, Onasias, the subject of it being the Expedition of the Seven against Thebes (Pausanias, ix. 4, 2). Lastly, Pausanias (i. 22, 6) ascribes to Polygnotus a series of paintings in the so-called Pinakotheke on the Acropolis of Athens. If he is right, the painter must then have been full seventy years of age. The subjects were—(1.) Ulysses carrying off the bow of Philoctetes; (2.) Diomede carrying off the Palladium of Troy; (3.) Orestes and Pylades slaying Ægisthus and the sons of Nauplius, who had come to his aid; (4.) Polyxena about to be sacrificed to the manes of Achilles; (5.) Achilles in Scyrus; and (6.) Ulysses meeting Nausicaa and her maids. The other pictures had become unrecognisable through the effects of time. This second mention of the decay of his works reminds us of the fleeting nature of the material with which the fame of the great painter was bound up. It was well that high honours were paid him in his lifetime. The enduring marble in which Phidias worked has preserved his fame to our times, to mock the indignities which he suffered in life. As regards the style of Polygnotus, we have the distinction drawn by Aristotle (*Poet.*, 2, 6; *Polit.*, viii. 5) between it and that of Zeuxis—a distinction which he expressed by the words *ethos* and *pathos*. By ethos, as applied to the paintings of Polygnotus, we understand a dignified bearing in his figures, and a measured movement throughout his compositions, such as the Parthenon frieze presents, compared with the pathetic rendering of scenes in the frieze from the temple of Apollo at Phigalia, or in the frieze of the Mausoleum at Halicarnassus. It was also said (Pliny, *N. H.*, xxxv. 35, 58) that in place of the old severity and rigidity of the features he introduced a great variety of expression, and was the first to paint figures with the lips open; and further, he was accredited (Lucian, *Imag.*, 7) with great improvements in the rendering of drapery, so as to show the forms underneath. He painted in monochrome on a white ground; so that, in fact, the principal charm of his work must have been in the drawing. His brother Aristophon appears to have also inherited an elevated conception and a power of carrying out large compositions. Among the younger contemporaries of Polygnotus were Dionysius of Colophon, laboriously accurate, and Pauson, the butt of Aristophanes (*Thesmoph.*, v. 949, and elsewhere), remarkable for his talent of caricature and animal painting.

Painted vases. The works of these painters have entirely perished, nor in what remains of the work of their humble imitators, the vase painters, is there much that can be justly regarded as reflecting their style. Besides the Athenian lecythi, which give some sort of an idea of the effect of colours as employed by Polygnotus, there is a class of vases, with red figures on a black ground, which, by the treatment of the drapery as a transparent substance, recall the statement to the same effect made in respect of the great painter. In many cases, also, the figures are large in conception and measured in their movement.

Architecture. The history of architecture during this period is an unexampled record of great undertakings throughout Greece, but more especially in Athens, which, if it had suffered most from the Persian invasion, had also in the end acquired the most ample means of repairing its ruins and adding fresh lustre to its aspect. Themistocles having been banished, the administration and the carrying out of works begun by him—such, for example, as the long walls connecting the city with the harbour—fell to Cimon. The city walls on the south side of the Acropolis were rebuilt, and a tower erected to command the entrance, which, however, being afterwards rendered useless by the erection of the Propylæa, was removed to make way for the temple of Athene Nike. Among the new temples the first to be mentioned is the Theseum, which is not only well preserved still, but is also the oldest existing example of the Attic-Doric order (Stuart and Rivett, *Antiquities of Athens*, iii. pl. 7). The other temples, the erection of which may with great probability be traced to Cimon, are the Anaceum, or temple of the Dioscuri, at the foot of the Acropolis, on the north side; and a small temple, now quite destroyed, on the left bank of the Ilissus, which existed in Stuart's time, and, from his drawing (*Antiquities of Athens*, i. pl. 7), is seen to have been of the Ionic order, differing from the Attic-Ionic in wanting the dentils of the cornice, in having the base of its columns composed of a trochilus between two spirals, and in having its architrave quite plain. Cimon was succeeded by Pericles, under whose administration the resources of the city, not only in means, but in the talent of using the existing means, were applied with the greatest judgment and energy, foremost among his advisers being Phidias. According to Plutarch (*Pericl.*, 133), Phidias exercised a general supervision over all the public works then going on. Apparently at this time was erected the Odeum, a building intended for musical performances, circular in form, and, as appears from the records of it (Vitruv., v. 9; Pausanias, i. 20, 4), brilliantly decorated with numerous columns in the interior, and with a tent-shaped roof of wood. It was the Acropolis, however, that was reserved for the crowning effort of architecture in this period. Within the space of probably not more than five or six years there rose on the site of an old temple of Athene, which had been destroyed by the Persians, the Parthenon, a model for all time of the Doric order, pure and perfect in its architectural forms and proportions. The architect was Ictinus, who was assisted by Callicratidas (Stuart, *Antiquities of Athens*, ii. pl. 7; Penrose, *An Investigation of the Principles of Athenian Architecture*, 1851; Beulé, *L'Acropole d'Athènes;* Bötticher, *Bericht über die Untersuchungen auf der Akropolis von Athen*, 1862; Michaelis, *Der Parthenon*, 1871). The next undertaking was the so-called Propylæa, a building which, though practically serving as an entrance to the Acropolis, aspired to a highly decorative character (Stuart, *Antiquities of Athens*, ii. pl. 42). The architect was Mnesicles. Contemporary with the building of the Propylæa, it appears, was that of the small temple of Athene Nike, on the Acropolis, which, on the removal of a Turkish structure in 1835, was recovered in almost all its parts, except some slabs of the frieze, brought by Lord Elgin to England, and now in the British Museum (Beulé, *L'Acropole*, p. 124; Kekulé, *Die Balustrade des Niketempels*). Outside of Athens the example of the Periclean activity was felt at Eleusis, where a great temple for the Mysteries was commenced, from designs by Ictinus, and carried to completion by the three successive architects, Corœbus, Metagenes, and Xenocles. The small temple, *in antis*, of Artemis Propylæa at Eleusis probably belongs to this period, as does also the temple of Nemesis at Rhamnus, of which we have still important remains. There is yet to be mentioned the Erechtheum, or temple of Athene Polias, on the Acropolis of Athens, which, though the only date we possess of it falls after the death of Pericles, bears the strongest impress, both in its architectural and sculptured forms, of the great age. The date referred to is the twenty-third year of the Peloponnesian war, and occurs in an inscription found on the Acropolis in several pieces, in which is given the report drawn up by a commission appointed to inspect the progress of the works (Inwood, *The Erechtheum of Athens*, 1827; Rangabé, *Ant. Hell.*, Nos. 56–60; *Corpus*

Inscript. Græc. No. 160). In the British Museum, besides part of this inscription, are several specimens of the architectural decoration, and one of the Caryatides (or draped female figures who supported the portico), in which the simplicity of the drapery and the dignity of the pose are quite in the spirit of the Parthenon sculptures. The temple of Apollo Epicurius at Phigalia, in Arcadia, the work of Ictinus, the architect of the Parthenon, necessarily belongs also to this period (Cockerell, *Temples of Jupiter at Ægina and Apollo at Phigalia*). The great temples at Olympia and Delphi, though begun earlier, may also be reckoned among the works of this period, to which also belongs a large séries of Doric temples in the Greek towns of Sicily and Magna Græcia, particularly those of Syracuse, Agrigentum, Selinus, Egesta, and Metapontum. Of these the most remarkable are the southern temple in the lower town of Selinus, and the somewhat more recent temple of Zeus at Agrigentum.

Fourth Period.

Since the beginning of our last period, the political and social circumstances of Greece have suffered a marked change. More or less it was then accepted as a dogma that, provided the state was flourishing, the prosperity of individuals mattered little. All were for the state, and by their union in the state's emergency had achieved a glorious freedom, the sense of which filled the national mind, and prepared it to respond with a fostering sympathy to the efforts of artists, whom it also inspired. Yet, conscious as they must have been of their own services, the men of that generation turned rather in pride to the deeds of their ancestral heroes, and in humility to the assistance of the gods. They sought to frame their conduct on the traditions of the past. They were rigorous and strong in thought. Passion was a thing to deplore, not to study, analyse, and represent. The national history was still unchequered. Nor was the house of Hellas as yet to any degree openly divided against itself. There was no need of artists—whether poet, as Æschylus, or sculptor, as Phidias—to depict the struggles of passion or other conditions of the mind. Now this is all changed. The nation has lost its unity, and the Peloponnesian war has made havoc of its resources. Æschylus has given way to Sophocles and Euripides, Phidias to Scopas and Praxiteles. Poets and sculptors of the new generation have chosen as their theme the representation of pathos and of the conditions of the mind generally. That such was the character of what is called the second Attic school of sculpture is known principally from the records of artists. Of works directly from the hand of any of the masters of this school there is no example in existence, so far as we know at present. On the other hand, there are many copies of their works, from which, with the aid of records, some idea may be formed of their style.

The first of the artists of this school was Scopas, a native of Parus, and, as it would seem, the son and pupil of Aristandrus, a worker in bronze, in which material the son appears to have commenced his career as a sculptor. An example of his work in bronze was the statue of Aphrodite sitting on a goat, in Elis (Pausanius, vi. 25, 2). This subject occurs on a fragmentary cameo in the British Museum. Marble, however, was a material more congenial to his style. The first years of his activity were spent in the Peloponnesus, and particularly at Tegea in Arcadia, where the erection of a temple, in honour of Athene Alea, in the place of one that had been burned 395 B.C., was under his direction as regards both the architecture and the sculpture. About 380 B.C. he settled in Athens, where for nearly thirty years he maintained a reputation for an unparalleled power of rendering the human or divine figure, not imposing, but attractive by the charm of bearing, and the expression of that feeling which for the moment the person was most sensitive to. Sometimes this feeling was one of excited passion accompanied by great bodily agitation, as for example, in the case of his statue of a Mænad at Athens, in the attitude of rushing with head thrown back and streaming hair, and holding a slain kid in her hand. At other times the passion he sought to express was one of peaceful inspiration, as in the statue of Apollo Citharœdus, with long flowing robe and head thrown back as in a dreamy enjoyment of the strains from his lyre. When considerably advanced in life, possibly over sixty years of age, Scopas was invited by Artemisia, the queen of Caria, to assist or direct the sculptures for a monument which she was erecting at Halicarnassus in memory of her husband Mausolus. Accompanied by Bryaxis, Leochares, and Timotheus (or Praxiteles, as others said), he proceeded thither, but as to what part he had in the work we have no information. The site of the Mausoleum was discovered and excavated by Mr C. T. Newton in 1856–7, the result being the recovery of an important part of the sculptures, which, with the slabs of the frieze previously known, now constitutes the principal illustration of the art of that time (Newton, *Discoveries at Halicarnassus, Cnidus, and Branchidæ*, 1862). While occupied on the Mausoleum, or after its completion, Scopas executed several sculptures for other towns in Asia Minor, as at Cnidus, Ephesus, and Chryse in the Troad. In a temple of Neptune, erected in Rome by Cn. Domitius Ahenobarbus, was a large composition by Scopas, representing Poseidon, Thetis, and Achilles, attended by nereids riding on dolphins and hippocamps, and by tritons and other marvellous creatures of the sea. Not as a copy of this work, but as reflecting vividly the manner of this sculptor, has been accepted the large marble relief in Munich (O. Jahn, *Berichte der Sächs. Ges. d. Wiss.*, 1854, pls. 3–8), representing the marriage of Poseidon and Amphitrite. How far the merit belongs to Scopas of having introduced into Greek art the ideal types of those marine beings who personified the element of the sea, is unknown. In a temple of Apollo at Rome there was further a large composition, representing the slaughter of the children of Niobe, about the authorship of which there were two opinions,—the one ascribing it to Scopas, the other to Praxiteles. While this dubiety is itself proof that the two artists were rivals in the power of expressing pathos and suffering, there is a considerable probability that the composition in question was more adapted, of the two, to the genius of Scopas. Of this work there exists what is believed to be a more or less complete copy in the series of marble statues in the gallery of the Uffizi at Florence. The work is very uneven throughout, as might be expected in Roman copies; but the dramatic character of the action, and the powerful rendering of pain and suffering in the faces, still bespeak the style of the original sculptor, who, whether Scopas, Praxiteles, or another, was certainly an Athenian artist of the first half of the 4th century B.C. (Friederichs, *Bausteine*, i. pp. 230–246). Another example of the style of this period, in the combination of beauty with a lovable and touching expression of face, is the so-called statue of Leucothea, in the Glyptotheke of Munich, which there are grounds for assigning to Cephisodotus, the father, it would seem, of Praxiteles, who is recorded to have made for Athens a statue of Irene with the boy Plutus in her arms, which, as it appears on the coins of Athens, closely resembles the Leucothea. This Cephisodotus, standing as he did in the period between the old and the new Attic schools, seems to have shared the qualities of both, but to have inclined rather to the latter.

Praxiteles.

That Praxiteles was directly a pupil of Scopas is not proved even by the fact that he worked in the same artistic vein and spirit, with a result which rendered his style undistinguishable from that of the older master to the eyes of Roman connoisseurs. Still, it will be safe to assume that he was largely influenced in his youth by the then favourite sculptures of Scopas. The scene of his labours was mostly Athens and the neighbouring towns. That he accompanied Scopas to Halicarnassus to assist with the sculptures of the Mausoleum, as is stated, is probably true; but from the fact that elsewhere in place of his name occurs that of Timotheus, it has been inferred that he may there have abandoned his original intention, and confined himself to the execution of those statues for towns in that district of which we have records. About 340 B.C. he returned to Athens, and there remained till his death, studying, with Phryne as his model, the expression of sensual beauty in its highest type. Like Scopas, he had little taste for bronze in comparison with marble, with its surface finely sensitive to the most delicate modulation. Unsatisfied with even this, he endeavoured to soften the asperity of the marble in the crude parts by a process of encaustic, in which, or perhaps rather in the colouring of the draperies, he employed in difficult cases the contemporary painter Nicias (Pliny, *N. H.*, xxxv. 39, 122). That he was peculiar in thus tinting the marble, and an exception among other Greek sculptors, cannot be meant, in the face of so many instances as we now have of the application of the *circumlitio* in the remains of Greek sculpture and architecture (Semper, *Der Stil*, i. pp. 498 and 514). The fact, however, of his being mentioned in connection with it may be taken as a proof that the process was an exceedingly refined one, since his favourite subjects were those of youthful or feminine ideal beauty, in which it is to be supposed that the tints corresponding to those in nature would appear almost evanescent in their delicacy. Of his works, the number of which was unusually large, the most celebrated were—(1.) The marble statue of Aphrodite at Cnidus, of which the more or less modified copies, as the Venus of the Capitoline Museum and the Venus de Medicis, together with the ancient records, show that the goddess was represented standing nude at the moment when she has left her bath, and, being sensitive to the air, presses her left leg against her right, and looks towards the drapery which she has already laid hold of with her left hand. Originally commissioned by Cos, but declined on account of its nudity, this statue was replaced by another of Aphrodite, with which the marble statue in the Louvre, found in Melus in 1820, has frequently been compared. But before accepting it as an illustration of the type of Aphrodite by Praxiteles, or of the more highly praised figure of the goddess by Scopas, it is necessary to bear in mind that on a base found with it, which, though now lost, is vouched for on creditable authority, was inscribed the name of the artist, Alexandrus, son of Menides of Antioch, who must have lived after Alexander the Great (Friederichs, *Bausteine*, i. pp. 331–334). (2.) A statue of Aphrodite at Thespiæ; beside which was placed (3) a portrait statue of Phryne; and (4), a statue of Eros, in Parian marble, of which there are two accounts,—either that it was given by him to Phryne in token of his admiration, or that she contrived to obtain it by a ruse, and then dedicated it at Thespiæ. The figure of Eros was here not that of a boy, as in later art, but was taken from the period of youth at which love is purely ideal, and the whole being is pervaded by an elevating ardour. Apparently exhibiting the same refinement of youthful form was his statue known as the "Celebrated Satyr," in Athens. Of his Apollo Sauroctonus several copies of inferior merit exist. His statue of Artemis Brauronia at Athens had a mouth inviting to a kiss.

The ablest of the contemporaries of Scopas and Praxiteles were Bryaxis, Timotheus, and Leochares, of whom the last worked chiefly in bronze, and travelled over a wide field of conceptions, including deities, portraits, mythological and allegorical subjects. Another new type which belongs to this period is that of Serapis by Bryaxis. From the time of Philip and Alexander the Great, portrait statues furnished a large part of the occupation of sculptors, and in this they were not confined to living models, as we gather, for example, from the portraits of Sappho and Corinna by Apollodorus, a sculptor of this time,—a fact from which it may be inferred that portraiture was still inclined to idealism, though doubtless a strong tendency to realism had already set in.

Argive-Sicyonian school.

The development of the art of sculpture in the Argive Sicyonian school, corresponding to that just described in the second Attic school, was begun by the Corinthian Euphranor, whose principal study was directed with the view of modifying the hitherto canonical proportions of Polycletus, to suit the changed tastes with which he had probably become impregnated during his long stay in Athens. To this end he introduced a smaller head and a slimness of the arms and legs which gave a greater lightness to the figure, and which, under the hand of his follower Lysippus, became the favourite type of ideal athletic statues. Lysippus, a native of Sicyon, and originally employed as an ordinary worker in bronze, rose by dint of study to the position of a sculptor of the first order. Nor was the quality of his work more surprising than the quantity. About 1500 statues and groups in bronze were counted as having been produced in his workshop, and among them two at least of colossal size—the statue of Jupiter at Tarentum, 60 feet high, and that of Hercules in the same place. The masterpieces which he appears to have studied most were those of his townsman Polycletus. Like Euphranor, however, he was compelled to seek a new system of proportions,—to exchange the immovable dignity and repose by which the old masters suggested the possession of physical power, for new attitudes, in which the exercise of physical power should be made apparent by its effect on the body and on the face. The colossal frame of Hercules was a favourite study with Lysippus, for this reason especially, we presume, that of all the ancient heroes he was represented in the legends as bearing about with him always the effect of the arduousness of his labours. There was no gaiety or elasticity in his composition. A figure of an athlete in the act of scraping the sweat and dust from his body, Apoxyomenus, which enjoyed a high reputation in Rome, where it stood before the baths of M. Agrippa, has an additional interest for us in the fact that a marble copy of it still exists, which, though of inferior work, forms an admirable illustration of the statements re

FIG. 9.—Bronze figure, originally applied as a relief. Brit. Mus. Found at Tarentum. Apparently in the style of Lysippus.

garding the proportions adopted by Lysippus, viz., a small head and comparatively long slim arms and legs (*Monumenti d. Inst. Arch.* v. pl. 13; Friederichs, *Bausteine*, i. p. 286). That he was also equal to the times in the production of allegorical figures may be gathered from the description (see Overbeck, *Schriftquellen*, Lysippus) of his bronze statue of Cairus, a personification of what is vulgarly called the "nick of time." It remains to point out, with reference to the style of Lysippus, that he confined himself mostly to the rendering of male forms, and that in regard to the few female figures by him there is no mention of the charm of sensual beauty which characterised the second Attic school; nor, again, do we find that other characteristic of theirs, the expression of pathos, in the male figures by him. His *animosa signa* must be taken as expressing physical life—*anima*, not *animus*.

Among the remaining sculptures which belong to this period the most remarkable are—(1.) The sculptnres of the so-called Nereid monument discovered at Xanthus, in Lycia, by Sir Charles Fellows, and now in the British Museum. These sculptures consist of (*a*) a series of female figures in the round, about the size of life, wearing a thin long drapery through which the forms are entirely visible; (*b* and *c*) a broad and a narrow frieze, both representing battle scenes. While the design of the narrow frieze is singularly Assyrian in conception, that of the broader frieze and the statues in the round is purely Greek, at one time suggesting the style of the Parthenon sculptures, at another the refining and movement of the second Attic school (Fellows, *An Account of the Ionic Trophy Monument excavated at Xanthus*, London, 1848; W. W. Lloyd, *The Nereid Monument*, London, 1845). (2.) The reliefs on the monument of Lysicrates, a round building in Athens, popularly known as the Lantern of Demosthenes. The victory which it was erected to commemorate was gained in the year 334 B.C. The subject is Bacchus and his suite transforming the Tyrrhenian pirates into dolphins. The figures are powerful, but light of foot and tall. The unusually large spaces between the groups and figures is suggestive of the lonely distances on the sea-shore, and in this respect the frieze seems to encroach on the province of painting (*Marbles of the British Museum*, ix. pls. 22–26). (3.) A series of portrait sculptures, for which reference is made to Friederichs, *Bausteine*, i. pp. 290–308. The great bronze head (fig. 10) placed here may, on further consideration, require to be moved to an earlier period, though the pany carelessnesses in details which it exhibits seem at present to render such a step unadvisable.

Silver-smiths. Besides sculptors, otherwise famous, who applied themselves to toreutic art, there were others who made this their principal occupation. Of these we know Mys, who executed the designs on the shield of the bronze Pallas of Phidias on the Acropolis of Athens; and, more celebrated, Mentor, who worked chiefly on silver bowls and cups, for which fabulous sums were afterwards paid by Roman collectors. He must have lived before the time of Alexander the Great, since some of his works perished in the burning of the temple of Diana at Ephesus. Two other cælatores apparently of this period were Acragas and Bœthus.

Die-sinking. A branch of art allied to the cælatura is that of die-sinking and gem-engraving. Of the former the finest examples during this period are the silver coins of Syracuse, especially the decadrachms with the head of Arethusa on the obverse and a quadriga on the reverse. The presence of the engraver's name on many of these coins is testimony of the value attached to their work. From this source we know the engravers Cimon and Euænetus. Other names, such as Euclides, Eumenus, Eumelus, Phrygillus, and Sosion, also occur on smaller silver coins. With the exception of Athens, where the archaic type was preserved, there is a general feeling for beauty throughout the Greek coinage of this period, the specimens most deserving of

Fig. 10.—Colossal bronze head. Brit. Mus. Said to have been found at Satala in Armenia.

study being those of Arcadia, of the Opuntian Locri, of the Macedonian kings Philip and Alexander, of the Chalcideans of Thrace, of Cydonia in Crete, where the name of

Fig. 11.—Marble head of Alexander the Great. Brit. Mus. From Alexandria.

the engraver Neuantus occurs, and of Lesbus. **Gem-engraving.** In gem-engraving during this period the fame of Pyrgoteles is known, but of all the existing gems which bear his name it may be questioned whether one reflects adequately his style. It may be taken as certain that some of them are from his hand. He was the court engraver of Alexander the Great, whose portrait he made on an emerald. The marble head here given (fig. 11) shows a distinctly realistic tendency, compared with the head on the coins. Possibly the portrait of Alexander which appears on the coins of his successor Lysimachus was in some way drawn from the gem (Brunn, *Gesch. d. Griech. Künstler*, ii. p. 629). Among the few examples of gems that can be unhesitatingly assigned to this period is the chalcedony with the figure of a crane found in K tch, and now in the Hermitage, St Petersburg, bearing the signature of Dexamenus of Chius, ΔΕΞΑΜΕΝΟΣ ΕΠΟΙΕ ΧΙΟΣ (*Compte Rendu de la Comm. Arch. pour l'ann.* 1861, p. 147, pl. vi. 10).

In painting, the transition from the style of Polygnotus to that of the new school was again, as has been said, a transition from ethos to pathos, from character and noble bearing to beauty and effect. The change, as elsewhere, was in harmony with the spirit of the times; but of the steps by which it was brought about two deserve attention; the first is the exigencies of scene-painting, on which Sophocles, and, after his example, his older contemporary Æschylus, laid great value. In this direction the artist of the day was Agatharchus of Samus, who also wrote an account of the decorations executed by him, and by this led to the investigation of the principles of perspective in painting by Democritus and Anaxagoras. The second step was the gradation of light and shade and of colours introduced by Apollodorus, who for this service is regarded as the founder of the new school. At the door opened by Apollodorus entered Zeuxis, as he himself is reported to have said, into the sanctuary of art. Not that Zeuxis was directly a pupil of the older master. All that is known of their relations to each other consists of mutual compliments. That the charm of Zeuxis's popularity was in great part due to novelty of situation and effect might be inferred from the statement regarding his picture of a centauress suckling her young, the spectators of which forgot the painter in the subject. On the other hand, the story of his having constantly before his eyes five of the most beautiful maidens of the town of Croton while he was painting his figure of Helena, suggests that he must have been a close student of form and perhaps also of colour. His figures were of a large mould, as in the earlier school, and for this reason his heads and limbs appeared a little coarse to Roman connoisseurs accustomed to the elegance of a later time. In this direction a great step in advance was made by his contemporary Parrhasius of Ephesus, who like Zeuxis also lived some time in Athens, enjoying the society of Socrates, and vaunting his personal appearance as well as his artistic powers. The dominant faculty of drawing in Parrhasius led him to choose his subjects from male heroic figures, and led him also, it will be charitable and not without analogy to conjecture, to produce the immoral scenes with which his name is connected. From excellence in drawing and colouring the next step was towards a just conception of the subject on hand, and this step was taken by Timanthes, of the island of Cythnus. One of his great pictures was the tragic scene of the sacrifice of Iphigenia, in which the expression of sorrow was rendered with a masterly gradation, from the bystanders (Calchas, Ulysses, Ajax, and Menelaus) up to Agamemnon, in whom the deep grief of a father was expressed by his covering his face and turning it away from the spectator. This subject, with various modifications, and particularly with the absence of the gradation of grief among the bystanders, but still obviously preserving the profound pathos of a great original, occurs in Pompeian paintings, and on a Greek relief in the gallery of Florence (O. Jahn, *Archäol. Beiträge*, p. 378). Whether or not a resident at Ephesus, the centre of Asiatic painting, it is clear that Timanthes stood in close relation to the school there. Contemporary with the Asiatic school existed in Greece proper two schools of painting, of which the one, with its seat in Sicyon, seems to have studied most drawing and a system of form and proportions; while the other, centred at Athens, but including some Theban painters, looked rather to the expression of pathos and the emotions of the mind. The founder of the Sicyonian school was Eupompus (401–381 B.C.) It was, however, to his pupil Pamphilus that it owed most of its reputation, and became a school for practical instruction which attracted students from remote quarters. From his distinction in mathematics and geometry, and from the fact of his having introduced drawing as a general element of instruction for youth, it is inferred that his teaching was mainly directed to the reproduction of form. On the other hand, it is also known that his researches led to an improvement in the colours employed in encaustic painting, and further that this art was carried to its highest perfection by his pupil Pausias. In a middle position between the Sicyonian and Attic schools stood Euphranor the Corinthian, of whom as a sculptor mention has already been made. His subjects were of the higher grade of historical painting, being mostly large compositions of mythological scenes or historical events, of which an example was to be seen on the portico of Zeus Eleutherius in the Agora of Athens. In Thebes, where since the recovery of freedom from the Lacedæmonians a new impulse for art as well as politics had been felt, a school of painting was formed, apparently at first under the influence of that of Sicyon. At its head was Nicomachus, a son and pupil of Aristiæus. A greater fame was achieved by his son Aristides, as an example of whose work, Pliny (*N. H.*, xxxv. 36, 98) quotes a picture from the capture of a town in which a mother appeared mortally wounded, and with a harrowing expression of dread on her face lest the child clinging to her breast should suck blood instead of milk. His activity extended to portraiture and to *genre* subjects; but he worked by preference in the encaustic process, the credit of inventing which has been wrongly ascribed to him. Among the other painters of note who followed the manner of the second Attic school of sculpture there remains only Nicias, a son of Nicomedes of Athens, and a pupil of Antidotus, from whom he learned the extreme care of execution originally taught by Euphranor.

In the person of Apelles, the son of Pytheas, a native of Colophon, were combined, if we may judge from his reputation, all the best qualities of the hitherto existing schools of painting. It should, however, be remembered that what we know of him comes entirely from Roman and late Greek sources, and represents rather the taste of these times than a critical judgment on his works. He was a pupil of the otherwise unknown painter Ephorus of Ephesus, which town, already celebrated as a centre of painting, he adopted as his home. But so high was then the reputation of the Sicyonian school, headed by Pamphilus and Melanthius, that on completing his studies at Ephesus he repaired to Sicyon, either to see for himself or to profit by the fame of these masters. From Sicyon he proceeded, perhaps through the influence of Melanthius, to the court of Macedonia, where he was employed, first by Philip, and afterwards, under circumstances of the greatest intimacy, by Alexander, whom he accompanied as far as Ephesus on his expedition into Asia. Of the figures of deities painted by him the most renowned was that of Aphrodite Anadyomene, originally in the temple of Æsculapius in Cos, represented rising out of the sea, and wringing the wet out of her hair, with swelling bosom and an expression of desire in her eyes. A second figure of the goddess, also intended for Cos, remained unfinished at his death. Of personifications and allegorical figures or groups, such as delighted the age in which he lived, we have examples—of the former in his group of Bronte, Astrape, and Ceraunobolia; and of the latter in his famous picture of Calumny. Partly of this character also were his two pictures of Alexander grouped with Castor, Pollux, and Victory; and Alexander in a triumphal car, beside a personification of war, in the form of a captive with hands bound behind back and seated on armour. The execution of subjects of this nature, for which thought and reflection are mainly required as opposed to the poetic and spontaneously creative faculty of a true artist, has been urged as detracting from the greatness of Apelles, and to this extent, no doubt, he was subject to the weakness of his times. Like Correggio, with whom he has been compared, he lived at a time when the great creative spirit had passed away, and it remained for him, as for the Italian master, to discover the last resources of his art for the attainment of powerful effect and absolute finish simultaneously. To refine the harmony of his light and tones, as well as to protect his paintings from dirt, he employed a peculiar black glaze which broke the sharp contrasts of colours (Pliny, *N. H.*, xxxv. 97) required for such powerful effects as the appearance of Zeus hurling lightning. With regard to his colours little is known. The statement that he used only four (Pliny, *N. H.*, xxxv. 50, 92) may or may not be correct (Cicero, *Brut.*, 18). Of his mere skill we have an example in the figure of Hercules, afterwards in Rome, of which it was said that the face, though turned away from the spectator, was suggested almost as vividly as if it had been actually painted (Wustmann, *Apelles' Leben und Werke*, 1870). In technical skill Apelles confessed himself equalled by his contemporary Protogenes the Rhodian, claiming, however, as his own special superiority, that he knew when to stop. The fault of Protogenes was over-elaboration. On one painting he is said to have worked seven or eleven years, finishing it with four separate glazes to protect it from injury. Of the painters of this period there are still to be mentioned Antiphilus, a native of Egypt, and a pupil of Ctesidemus; Theon of Samus, who was praised for his happy choice of the right moment at which to seize an action; and Aetion.

Though the works of the masters of this period have wholly perished, there remain two sources from which some idea may be gathered of their manner,—first, a number of Pompeian paintings, which, though executed in a later age, and often intentionally varied from the originals, are still copies of the spirit and manner of the works of this time; and secondly, a large series of painted vases, which, though the production of inferior workmen, display a wonderful facility of execution, a splendour of glaze, and an application of colours which show that the example of the great painters had not been neglected. The figures stand out in red from the black ground of the vase; for the accessories, red, yellow, violet, black, blue, green, and gilding are employed. It is not, however, alone from their possession of certain traits which are assumed to have characterised the style of painting in this period that these vases are assigned to it. There exists a small but increasing series of painted vases which had been gained at the Panathenaic games at Athens, on several of which is inscribed the name of the archon for the year in which they were obtained. We have thus the exact years in which these vases were made, and at the same time specimens of the art of the time, from which a comparison is easily made with the larger series of undated vases (see Catalogue of the Vases of the British Museum).

Architecture.

With the close of the Periclean period in Athens the public desire for more temples seems to have ceased; so that the architecture of the period now before us is to be traced rather in works of utility, whether public or private. Of the former class are—(1), the stadium at Agræ for the athletic competitions at the Panathenaic festival; (2), the gymnasium; (3), the store-house at the Piræus, built to contain the equipments of 1000 ships. From private sources were (4), the temple of the Muses, said to have been erected by Plato, in the Academy; and (5), the choragic monument of Lysicrates, which is the only existing example of Athenian architecture of this time (Stuart, *Antiquities of Athens*, i. pls. 23–30). A greater architectural activity prevailed in the Peloponnesus. At Tegea was erected, under the direction of Scopas, a temple which scarcely yielded in splendour to that of Zeus at Olympia. The laying out and building of new towns which followed upon the recovery of freedom by Thebes under Epaminondas, gave abundant scope for architects. A remarkable example of this was Megalopolis in Arcadia, which was built in an elliptical form, on the principle laid down by Hippodamus of Miletus, and carried out in the Piræus, Thurium, and Rhodes. A more magnificent example of a new town erected in this period was Alexandria, founded by Alexander to be the first city of the world of which he was master, and built in that spirit by his favourite architect Dinocrates. The model of Alexandria was adopted by the successors of Alexander for the many new towns raised by them, as, for example, Antioch on the Orontes, the architect of which was Xenæus. The temples of Asia Minor erected in the time of Alexander may be judged from the ruins of those of Athene Polias at Priene, of Artemis at Magnesia on the Mæander, and of Artemis at Ephesus, of which last the site has lately been excavated, with the result of confirming the few existing statements regarding its dimensions and style. The Mausoleum at Halicarnassus, and the Nereid monument of Xanthus, are instances of temple architecture modified for the purposes of a tomb.

Fifth Period.

The conquests of Alexander had opened to the Greek gaze the East, gorgeous in its personal attire and equipments, and unlimited in its resources for the encouragement of personal vanity. Alexander appeared in Asiatic costume, and what became the monarch was shortly found becoming to the subject. Under his successors, in what is called the Macedonian, or, better, the Hellenistic period, the opulence and taste for luxury of the times led artists to aim at producing works conspicuous for picturesqueness; not, however, that picturesqueness which is born of a fine fancy, but that which originates in a studied effort to throw a gleam of romance over a plain historical incident. The creation of ideal types of deities ceased, and the production of allegorical figures, which had found acceptance in the preceding age, took its place. These figures were simply studies of character, and implied a faculty of observation which the existing portraits of this period on coins and in marble warrant us in estimating highly. To this, no doubt, was added a power of generalisation which enabled the artist to deduce a type from a number of individuals, as, for example, in the type of Gauls introduced by the school of Pergamus. In figures of deities or heroes the old types were retained. It was in portraiture that the essential characteristic of the time consisted. With art in this condition Græcia Capta enthralled her Roman captors, and the further development of this phase of art was transferred to Rome. For this reason we shall here follow the unusual plan of classing the Hellenistic and Roman art under one period.

The two principal schools of sculpture of the last period

School of Athens. are represented in this by the sons of the two great masters of each,—the Athenian school by the sons of Praxiteles,

FIG. 12.—Bronze statuette of a Philosopher. Brit. Mus. Found in harbour of Brindisi (*Brundusium*).

Cephisodotus and Timarchus, who worked together. The former appears to have been the more gifted of the two, if we may judge from the pains bestowed on certain statues of deities by him alone. Of their contemporaries little is known beyond that their chief occupation was in portrait sculpture. School of Sicyon. The traditions of the Sicyonian school were left in the hands of the sons and pupils of Lysippus, of whom the ablest was Euthycrates, who preserved the severity of the older schools in opposition to the tastes of his times. The effect of this upon his pupil Tisicrates led to so close a reproduction of the manner of Lysippus, that in many cases it was difficult to distinguish his work from that of the old master. In the same spirit, and with greater success, worked Eutychides of Sicyon, and Chares of Lindus in Rhodes. From the hands of Eutychides we know of a bronze statue of the river Eurotas, in which the mobility of water was finely suggested in the human form (Pliny, *N. H.*, xxxiv. 8, 78), and a highly-praised statue of Tyche (Pausanias, vi. 2, 7) for the town of Antioch, of which several copies exist, including a small one in silver in the British Museum. School of Rhodes. Chares is known mainly as the author of the bronze Colossus of Helius at Rhodes, a statue 105 feet high, which after standing a marvel to all for fifty-six or sixty-six years, was broken across the knees and thrown to the ground by an earthquake. The rising importance of Rhodes encouraged the foundation of a school of sculpture which adopted the manner of Chares, and aimed at effect by colossal proportions and picturesque situations. To this school belonged Apollonius and Tauriscus, the authors of a colossal marble group which has been identified with that in the museum of Naples, known as the "Farnese Bull," and representing Amphion and Zethus in the act of binding Dirce to the horns of a bull in presence of their mother Antiope, and, whether copy or original, an admirable illustration of the Rhodian school. The moment seized by the artists is one of profound pathos; but, justly deserved as the punishment of Dirce may have been, it is impossible to look upon it without pain. The same feeling, it may be imagined, was awakened in the spectator by the bronze group of Athamas seized with insanity after slaying his son Learchus, by Aristonidas, another artist of the Rhodian school. From the instances of subjects in which cruelty and deep emotion were combined, it has been argued that the group of Laocoön, which was the work of three Rhodian artists—Agesander, Athenodorus, and Polydorus—may properly be assigned to the Rhodian school of this period. On the other hand, it is argued by critics of seemingly equal competence, that the subject of the Laocoön is too harrowing for the Greek taste even then, and must have been executed under the influence of the favourite cruelties practised in the Roman circus. The decision between these two opinions is left entirely to taste, owing to the ambiguity of the words of Pliny. School of Pergamus. From Rhodes we pass to Pergamus, where, under the courtly influence of Attalus I. (241–197 B.C.) and Eumenes II. (197–159 B.C.), was formed a school of sculpture which derived a vigorous impulse as of a new life from the strange class of subjects it was called upon to undertake. It was called upon to glorify the decisive victory of Attalus over the Gauls (239 B.C.) by groups and large compositions of battle scenes, in which the first difficulty was to produce the type of these barbarians, and to carry it out consistently in the various attitudes and incidents of a battle; as, for example, in their dogged submission under captivity, or their grim expression under pain; or, again, the abject misery of their wives when a battle had been lost. Nor was Attalus content to adorn his own capital with artistic productions. To Athens he made a present of four groups representing battles between gods and giants, between Athenians and Amazons, between the Greeks and Persians at Marathon, and between his own army and the Gauls in Mysia, showing in each case the defeat of a barbarous race. The height of the figures was 3½ feet, and that there must have been a considerable number of them is clear from this, that the occurrence of Bacchus in the group of the Gigantomachia presupposes the existence of the other superior deities. Of the entire series nine figures have been identified in various museums (Engraved, *Monumenti dell' Inst. Arch.*, ix. pls. 19–21; Brunn, *Annali dell' Inst. Arch.* 1870, pp. 292–323; and *Bullettino*, 1871, pp. 28–31; Clarac, pl. 280, No. 2151); while to the same school belong the dying Gaul in the Capitoline Museum, known as the "Dying Gladiator," and the group of a Gaul and his wife in the Villa Ludovisi (Müller, *Denkmäler*, i. pl. 48, No. 218).

New Attic School. After the loss of national independence little remained for the Greeks to do but to profit by the liberal patronage of their Roman masters, whose cupidity in matters of art was by no means satisfied with carrying off as many as possible of the existing sculptures. The increased demand led to a new energy, of which Athens was at first naturally the centre, whence the term "New Attic" is applied to the sculpture of this period. As, however, this new energy was chiefly directed to the reproduction of the favourite types of the old masters, the result was not, as under other circumstances it might have been, the formation of a new school properly so called. At this time the principal sculptors were Polycles of Athens, his son Timarchides, his grandson Dionysius, and another Dionysius, all of whom, after earning a reputation by their work in various parts of Greece, appear to have followed Metellus to Rome, which now became the artistic centre of the world. Towards the end of the republic there lived in Rome a sculptor, Pasiteles, who, if not superior to the artists of the new Attic period in point of creative power, was certainly more gifted than they with skill and carefulness in the execution of his work, which ranged over statuaria, sculptura, and cælatura, including chryselephantine figures, for which a taste had revived. As, however, none of his works exist now, we can only judge of his manner by that of his pupil Stephanus, from whose hands we have the statue of Orestes in the Villa Albani (*Annali dell' Inst.* 1865, pl. D; Friederichs, *Bausteine*, i. p. 112). It is called Orestes from its resemblance to the male figure in the group of Orestes and Electra in Naples, with which, as an imitation of the archaic style, it may be compared. In both, however, it has been observed that the archaism is limited to the proportions, attitude, and general aspect, but that the details of anatomy have been worked in from the living model. This, which constituted the peculiarity of Stephanus, is assumed to have characterised the school of Pasiteles, first, because Stephanus, in an unusual manner, describes himself on the base of the statue as a pupil of Pasiteles; and secondly, because the same peculiarity to some extent is found in the group of Orestes and Electra in the Villa Ludovisi by the sculptor Menelaus, who again describes himself as a pupil of Stephanus (Friederichs, *Bausteine*, i. p. 427). Doubtless this affectation of archaism was to meet the taste of the time, for which also archaic works were collected from Greece. By the extreme elaboration of his work, Arcesilaus, who lived in Rome in Cæsar's time, obtained considerable fame, but, on the other hand, limited greatly his productivity. Of his two principal statues, the Venus Genetrix and the Felicitas, the latter was never finished. Copies of both exist, but they are of too mean a kind to suggest a proper estimate of the sculptor's merit. While in ideal sculpture the artists of this time were content to copy, with trifling varieties of detail, the works of the old masters, they appear to have disclosed considerable original talent in realistic sculpture, that is, in portraiture and in the historical representations with which triumphal arches and other like buildings were decorated, though here again they had models ready to hand in portraits, battle scenes, and triumphs of the Hellenistic period. A sculptor who had to celebrate a Roman victory over barbarians had his model in works of the same class by the school of Pergamus. When he introduced an ideal figure, as that of Victory writing on a shield, he adopted an old type. In the grouping of his figures there is this peculiarity, that they are frequently arranged on the principles of painting rather than of sculpture, and it is supposed that this originated in the earlier Roman custom of celebrating victories by paintings hung up in public places, which paintings appear to have been based on those of the Alexandrian period, and, at any rate, were sometimes executed by Greek artists. (For a thorough investigation of this subject see Helbig, *Campanische Wandmalerei*, Leipzig, 1873.)

Arcesilaus.

Silversmiths.

When public encouragement of art takes the form of a desire for reproduction from ancient masterpieces, it is natural that such minor arts as those of cælatura and gem-engraving should flourish. The production of silver vases adorned with subjects in relief had become a profitable occupation in the wealthy times of Hellenism. It was not, however, till the latter half of this period that truly fabulous sums came to be paid for work of this kind, in which Pasiteles and Arcesilaus, already mentioned as sculptors, achieved great success. Besides them we hear of Posidonius of Ephesus, Zopyrus, Pytheas, and Teucrus. Among the many existing examples of silver work of this period, one—a vase found in 1761 at the Porto d'Anzo, and belonging to the Corsini family—has been identified as a copy of the silver vase by Zopyrus representing the acquittal of Orestes before the Areopagus. The immense number of existing statuettes, vases, utensils of various kinds in bronze and silver, dating from this period, are evidence of its artistic activity, and at the same time of the closeness with which Greek models were adhered to.

Gem-engraving.

Under the influence of the luxurious tastes in the times of the Ptolemies, gem-engravers aimed mostly at effect, and to this end sought out specimens of onyx and sardonyx which from their own splendour would lend a charm to the work. A gem was now a thing to be worn flauntingly. Hence the chief examples of the art are the cameos, of which from the latter half of this period we have still some magnificent examples. Of these, the most important, artistically, is the large cameo, now in Vienna, representing, in a partly allegorical and partly literal fashion, the suppression of the Pannonian revolt by Tiberius and Germanicus (Müller, *Denkmäler*, i. pl. 69, No. 377). Larger and richer in figures, but much inferior in work, is the cameo in the cabinet of medals in Paris (Müller, *ibid.* No. 378). Besides producing cameos for personal ornament, the gem-engravers of this period were also employed on the production of drinking-cups of onyx and other precious stones, of which the tazza Farnese in Naples is the best existing example (*Mus. Borb.*, xii. pl. 47). When stones were too costly, glass was used, as in the famous Portland vase in the British Museum, and in numerous cameos. Compared with the cameo-engravers, who, as if conscious of the inferiority of their work, withheld their names from it, the engravers of intaglios very frequently asserted their merit by adding their names. Among the names thus handed down are those of Dioscurides, his son Eutyches, Athenion, Protarchus, Solon, Euodus, and others of lesser note.

Painting.

In the history of painting during this period few names of importance occur. In the earlier part of it the traditions of the school of Sicyon were maintained by Nealces, from whose hands we know of a picture of Venus, and of a naval engagement between Persians and Egyptians on a river which was localised as the Nile, by the presence of a crocodile and an ass drinking at the edge; and Timanthus, who painted a battle between the troops of Aratus and the Ætolians. In the Athenian school, Athenion, though dying young, produced some works which were favourably compared with those of the older master, Nicias. About this time the production of painted vases, driven out of fashion by vases in silver and other metals, so far ceased to attract skilled workmen, that it can hardly be fair to regard the large number of so-called Apulian vases belonging to this period as evidence of the contemporary style of painting. The ornament and the colours are always florid, the figures are drawn mechanically as from a set design, and the dimensions are very frequently large. According to the theory advanced by Brunn (*Probleme in der Gesch. der Vasenmalerei*), almost the whole of the vases found in Italy with black figures on red ground, which previously were considered archaic, were produced about this time, and are but feeble imitations of the early style made to please the Roman taste for archaic work. As to the general feebleness that prevails among them there can be little question. It remains to be seen, however, whether Brunn has not placed them at too late a period.

Painting in Italy.

With the scanty records of painters, and the depreciatory remarks in regard to the art of their time made by Pliny and Petronius, we have to compare the immense series of paintings from this period still existing in Italy, and particularly those of Pompeii and Herculaneum, an examination of which will show that the painters then, like the contemporary sculptors, drew their inspiration, and apparently to a tolerably close extent their models, from more ancient works. Had they been gifted with original genius, they could not have excluded, when painting landscapes, the views of the immediate neighbourhood; and yet on all the walls of Pompeii or Herculaneum there is perhaps not more than one subject which can be positively identified as local. Nor would they have avoided so systematically as they have done subjects from the national Roman legends, which were then in high favour, and attracted poets like Virgil and Ovid. But while a complete dearth of imaginative power may be denied them, these painters were possessed of a fine eye for pictorial effect, and of a refined taste in the management of their colours (Helbig, *Wandgemälde Campaniens*, to which is prefixed an elaborate inquiry into the technical processes employed; and Helbig, *Campanische Wandmalerei*, 1873, where the sources from which these painters drew are fully pointed out).

Mosaics. Closely allied to painting is the art of mosaic-working, which, though occasionally employed for the pavements of the earlier temples, as in the pronaos of the temple at Olympia (*Expédition de la Morée*, i. pl. 63), did not till after the time of Alexander assume an importance which entitled it to be ranked as an independent art. The first mosaic artist of consequence whom we hear of is Sosus of Pergamus, celebrated as having introduced the practice of decorating floors of houses with imitations of characteristic objects, such, for example, as the accompaniments of a feast in a dining-room. From Pergamus, Ephesus, Alexandria, and the chief towns of the Macedonian period, the art was afterwards transferred to Rome, where the numerous villas and palaces furnished it with abundant occupation. As an example of the work of this later time we have the large mosaic found on the Aventine in 1833, and now in the Lateran, which bears the name of Heraclitus as its author, and which, with its representations of all manner of remains from a feast, is an illustration of the class of subjects introduced by Sosus. We still possess a splendid example of their rendering of historical subjects in the mosaic found in 1831 in the Casa del Fauno at Pompeii, representing a battle between Alexander and the Persians (Müller, *Denkmäler*, i. pl. 55, No. 273).

Architecture in Greece. What was said of the progress of architecture at the close of last period should be here borne in mind, as it continues to apply to the first half of the period now before us. While the building of Alexandria supplied a model and an impulse, which the successors of Alexander availed themselves of, in the construction of new towns, the example of boundless luxury, in the decoration of even temporary monuments, which was set by Alexander in the erection of a funeral pyre for Hephæstion in Babylon, was also eagerly followed by his successors. From the work of Callixenus on Alexandria we have (Athenæus, v. p. 196) a description of the tent erected by Ptolemy Philadelphus for a Dionysiac festival, and of the splendid colossal barge of Ptolemy Philopator on the Nile (*ibid.* p. 204, *d*). Still more magnificent and stupendous in its dimensions was the ship of Hiero of Syracuse, with its granaries, dwelling-houses, towers, gymnasium, and park, for the construction of which Archimedes and the Corinthian Archias were employed. Greece proper, however, shared little in this prodigality. Thebes was, indeed, restored after its destruction by Alexander; and Athens, still the eye of Greece, obtained many marks of favour from the princes of the time, who sought to identify their names with her glory by erecting public monuments of various kinds.

Architecture in Rome. The presence of countless specimens of Greek art in Rome, carried off by plunderers like L. Mummius, produced a general craving for Greek architecture also. The first step in this direction was taken by Q. Cæcilius Metellus, who brought a Greek architect, Hermodorus of Salamis, to Rome to build a temple to Jupiter Stator in the pure Greek style. The public favour with which this was viewed may be gathered from the fact, that shortly after we find D. Junius Brutus employing Hermodorus to build a temple to Mars. Of the Roman architects who during the republic adopted the Greek style, the most distinguished were Cossutius and C. Mutius. The Greek had either supplemented or become blended with the native Roman architecture when the extraordinary activity in building, of which Pompey and Cæsar were the leaders, set in, not only in Rome, but throughout the provinces of the empire. The building of temples and monuments, which under Augustus had been the chief occupation of architects, gave way under his immediate successors to constructions of a more useful and sometimes of a colossal type, such as bridges, canals, aqueducts, and harbours. The enlargement of the imperial palaces on the Palatine, particularly the construction of the golden house of Nero, gave scope to the boldness of design and extravagance of execution possessed by the architects Celer and Severus. In the following times those of Vespasian, Titus, and Domitian were characterised by a series of buildings which had not their equal in the architectural history of Rome, as, for example, the Colisseum, a building erected to contain 87,000 spectators, and still in its ruins the most striking monument of imperial Rome. While the chief interest of Trajan was in the construction of roads, bridges, and harbours, his successor, Hadrian, was not only himself ambitious as an architect, but gave a new impetus to the erection of splendid buildings throughout the empire. From this time onward Roman architecture began to sink rapidly, its original tendency to florid decoration obtaining more and more free rein, till finally discrimination was abandoned. The ruins of Palmyra and Baalbec (R. Wood, London, 1827), the arch of Severus, the baths of Caracalla and Diocletian, and the arch of Constantine, are evidence of this.

For Etruscan Archæology, see ETRURIA. (A. S. M.)

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ARCHANGEL, a government of European Russia, lying between lat. 61° and 71° N., and long. 29° and 68° E. It is bounded on the N. by the White Sea and Arctic Ocean, on the W. by Finland and Olonetz, on the S. by Vologda, and on the E. by the Ural Mountains. It comprehends the islands of Nova Zembla, Waigatz, and some others. Its area is estimated at 286,739 square miles, and its population in 1867 was 275,779. The climate is for the greater part of the year intensely cold. That part of Archangel which lies within the arctic circle has a very desolate and sterile aspect, presenting little to the eye but extensive plains of sand and moss. The winter is long and severe, and even in summer the soil is frozen at a little depth below the surface. The rivers are closed in September, and scarcely thawed before July. South of the arctic circle the greater part of the country is covered with immense forests, with extensive lakes and morasses, while other parts afford excellent pasturage. The spring is moist, with cold, frosty nights; the summer, a succession of long foggy days; the autumn moist; and the rivers are closed from October to April. The northern districts are incapable of being cultivated, and the inhabitants support themselves by fishing and the chase. In the southern districts considerable quantities of hemp and flax are raised, but grain crops are little attended to, and the bark of trees is ground with corn to eke out the scanty products of the harvest. Potatoes are grown as far north as 65°. The principal wealth of the government consists in its immense forests, furnishing materials for shipbuilding, which is carried on to a considerable extent. The horses and cattle are diminutive, except in the district of Kholmogory, where excellent cattle are reared. The calves are sent to the St Petersburg market, where the veal is especially prized. Gold is found in the circle of Cola, naphtha and salt in those of Kem and Pinega, and coal, or rather lignite, in several places in Mezen. The preparation of pitch and tar is an active branch of industry; and in the districts around Archangel coarse linens are manufactured to a considerable extent, as well as cordage, mats, leather, tallow, turpentine, and potash. This government is divided into eight circles, viz.—Archangel, Shenkursk, Mezen, Cola, Onega, Pinega, Kholmogory, and Kem. Its chief rivers are the Onega, Pinega, Dwina, Mezen, Petshora, and Ousa. Sulphurous springs are found in the circles of Kholmogory and Shenkursk. The population was originally Finnish, but it is now chiefly Russian, with some Samoides and Laplanders.

ARCHANGEL, the chief town of the Russian government of the same name, is situated at the head of the delta of the Dwina, on the right bank of the river, in lat. 64° 32′ 8″ N., and long. 40° 33′ E. As early as the 10th century the Norsemen had commercial settlements in the district; but the modern town may be said to date from the visit paid by the English voyager, Chancelor, to the monastery of St Nicholas, whither he was driven by stress of weather in 1553. An English factory was soon after erected there by consent of Ivan II., and in 1584 a fort was built, and a town gradually gathered round it, which received the name of *Arkhangelskoi-Gorod*, from a monastery dedicated to the archangel Michael. The town long remained the only seaport of Russia, and enjoyed remarkable prosperity. Czar Boris Godunoff (1598–1605) made the trade through Archangel to Moscow open to all nations, and Holland and Germany took advantage of the permission. In 1655 the exports amounted to 600,000 roubles. In 1668 the great bazaar, or "*Gostinnoi-Gorod*," a strong building of stone, was commenced at the command of Alexei Michaelovich, and employed the labour of thousands of Tatar prisoners for 16 years. In 1693–94 Peter the Great visited the town, which was then at the height of its prosperity; the average annual value of the exports from 1691–1700 to England alone amounting to £112,210. When, in the beginning of the 18th century the czar was establishing St Petersburg, he did all he could to divert the population and prosperity of Archangel to the new metropolis, causing many of the wealthier inhabitants to remove, and imposing heavy taxes on the commerce. As a natural consequence, the northern city declined. In 1762 it received the same immunities as St Petersburg, and since that time has gradually recovered its former prosperity. It is the seat of an archbishop and of a civil and a military governor, and has one Protestant and ten Greek churches, an ecclesiastical seminary, a gymnasium, academies for navigation and engineering, a naval hospital, and a Government bank. The manufactures are linen, leather, canvas, cordage, mats, sugar, and beer. The exports are flax, flax-tow and codilla, oats, linseed, wheat, deals, tar, pitch, rosin, mats, beef and pork, calf and seal skins, train-oil, cordage, feathers, and linseed cakes. Flax, in large quantity, is used in the spinning factories in the interior. The imports are coal, oil, wine, coffee, sugar, tea, logwood, furs, lead, salt, and fish. The total value of the exports in 1874 amounted to £1,234,390 in 472 ships, of which 62 were steamers and 220 coasting vessels, a large proportion being carried to Great Britain. The coasting trade between Archangel and Norwegian Finmark is extensive. The domestic trade consists chiefly in meat, fish, train-oil, game, and furs. By river and canal Archangel is in connection with a large part of European Russia, and a telegraph line unites it with St Petersburg. The harbour is at the island of Solombaly, about a mile below the town, and is open only from June to October. A bar at the mouth of the Dwina, with only 13 or 14 feet of water, obliges vessels of greater draught to load and unload outside by means of lighters. About 12 miles below the town there is a Government dockyard, with slips for building vessels, and also some warehouses belonging to merchants in the city. The best season of the year in Archangel is from the middle of June to the middle of August. After that period the nights become cold; and in September it is often stormy. The shortest day has only 3 hours 12 minutes, the longest 21 hours 48 minutes. Population in 1867, 19,936.

ARCHBISHOP, the title of a church dignitary of the first class. Archbishops were not known in the church before the 4th century after Christ, when the term "Archbishop" was introduced in the East as a title of dignity, which did not necessarily imply any superiority of jurisdiction over a bishop. Athanasius, bishop of Alexandria, appears to have been the first who made use of the term in applying it as a mark of personal honour to Alexander, his predecessor in the see of Alexandria, and Gregory Nazianzen applied the term in like manner to Athanasius. In the following century the title of archbishop seems to have been applied to the bishops of the more important sees, as the names of several archbishops are recorded in the list of church dignitaries, who were assembled in the Council of Chalcedon in 451 A.D. In the Latin Church the title was hardly known before the 7th century after Christ. Isidore of Seville (Hispalensis) is the first writer who speaks of archbishops, distinguishing them as a class from patriarchs, metropolitans, and bishops. Archbishops in the present day are for the most part either patriarchs or metropolitans; but an archbishop is not necessarily a patriarch or a metropolitan, and there are metropolitans who have only the title of bishops. The ecclesiastical government of the Church of England is divided between two archbishops,—the archbishop of Canterbury, who is primate of all England and metropolitan of the province of Canterbury, and the archbishop of York, who is primate of England, and metropolitan of the province of York. The jurisdiction of the archbishop of Canterbury as primate of all England extends in certain matters into the province of York. He exercised the jurisdiction of *legatus natus* of the Pope throughout all England before the Reformation, and since that event he has been empowered, by 25 H. VIII. c. 21, to exercise certain powers of dispensation in cases formerly sued for in the court of Rome. Under this statute the archbishop continues to grant special licences to marry, which are valid in both provinces; he appoints notaries public, who may practise in both provinces; and he grants dispensations to clerks to hold more than one benefice, subject to certain restrictions which have been imposed by recent statutes. The archbishop also continues to grant degrees in the faculties of theology and law, which are known as Lambeth Degrees. His power to grant degrees in medicine, qualifying the recipients to practise, has been practically restrained by 21 and 22 Vict. c. 90. The province of Canterbury consists of twenty-one dioceses—St Asaph, Bangor, Bath and Wells, Canterbury, Chichester, St David's, Ely, Exeter, Gloucester and Bristol, Hereford, Lichfield, Lincoln, Llandaff, London, Norwich, Oxford, Peterborough, Rochester, Salisbury, Winchester, and Worcester. The bishops of the above-mentioned dioceses constitute the Upper House of Convocation of the prelates and clergy of the province of Canterbury. The archbishop is president *ex officio* of this Convocation, which is summoned by him pursuant to a royal writ whenever the Parliament is called together (see CONVOCATION), and it is prorogued and dissolved whenever the Parliament is prorogued or dissolved.

The archbishop of Canterbury exercises the twofold jurisdiction of a metropolitan and of a diocesan bishop. As metropolitan he is the guardian of the spiritualities of every vacant see within the province, and he presents to all benefices which fall vacant during the vacancy of the see, and through his special commissary exercises the ordinary jurisdiction of a bishop within the vacant diocese. He exercises also an appellate jurisdiction over each bishop, which in cases of licensed curates he exercises personally under 1 and 2 Vict. c. 106; but his ordinary appellate jurisdiction is exercised by the judge of the provincial court of appeal, which from the circumstance of its having been held in former days in the church of St Mary of the Arches (Bow Church), which was a peculiar of the archbishop, has come to be called the Arches Court of Canterbury. The judge of this court, who is appointed by the archbishop, is properly styled the Official Principal of the Arches Court, but he is commonly called the Dean of the Arches, from a peculiar jurisdiction, now abolished, which he formerly exercised in the name of the archbishop over fifteen churches in the diocese of London. The archbishop had formerly exclusive jurisdiction in all causes of wills and intestacies, where parties died having personal property in more than one diocese of the province of Canterbury, and he had concurrent jurisdiction in other cases. This jurisdiction, which he exercised through the judge of the Prerogative Court, has been transferred to the Crown by 20 and 21 Vict. c. 77. The Arches Court was also the court of appeal from the consistory courts of the bishops of the province in all testamentary and matrimonial causes. The matrimonial jurisdiction has been transferred to the Crown by 20 and 21 Vict. c. 78. The Court of Audience, in which the archbishop presided personally, attended by his vicar-general, and sometimes by episcopal assessors, has fallen into desuetude. The vicar-general, however, exercises jurisdiction in matters of ordinary marriage licences and of institutions to benefices. The Master of the Faculties regulates the appointment of notaries public, and all dispensations which fall under 25 H. VIII. c. 21.

The first archbishop of Canterbury was Augustine the monk, whose preaching converted King Ethelbert. Augustine was consecrated a bishop for England in 597 A.D., and received the *pallium*, which is the distinguishing mark of the metropolitan's office, from Gregory the Great in the following year. He was subsequently constituted *legatus natus* of the apostolic see, and his successors enjoyed various *jura regalia* by grant from the Crown. They had also precedence over all subjects of the Crown not of royal blood, and the archbishop still retains such precedence over every Peer of Parliament. It is also his privilege to crown the kings and queens of England. He is entitled to consecrate all the bishops within his province, and was formerly entitled, upon consecrating a bishop, to select a benefice within his diocese as his option for one of his chaplains, but this practice has been indirectly abolished by 3 and 4 Vict. c. 111, § 42. He is entitled to nominate eight chaplains, who had formerly certain statutory privileges, which are now abolished. He is *ex officio* an ecclesiastical commissioner for England, and has by statute the right of nominating one of the salaried ecclesiastical commissioners.

The archbishop exercises the ordinary jurisdiction of a bishop over his diocese through his Consistory Court at Canterbury, the judge of which court is styled the Commissary-General of the city and diocese of Canterbury. The archbishop holds a visitation of his diocese personally every three years, and he is the only diocesan who has kept up the triennial visitation of the dean and chapter of his cathedral.[1]

The province of York consists of six dioceses in England, Carlisle, Chester, Durham, Manchester, Ripon, and York, to which may be added the diocese of Man, which was annexed under that title by 33 Henry VIII. c. 31, to the province of York. The latter diocese has been entitled in recent Acts of Parliament the diocese of Sodor and Man, and it is now generally so designated. The bishops of the above seven dioceses constitute the Upper House of Convocation of the prelates and clergy of the province of York, of which the archbishop is *ex officio* president, and which is convened, prorogued, and dissolved under the same conditions as the Convocation of the province of Canterbury.

The archbishop of York has immediate spiritual jurisdiction as metropolitan in the case of all vacant sees within the province of York, analogous to that which is exercised by the archbishop of Canterbury within the province of Canterbury. He has also an appellate jurisdiction of an analogous character, which he exercises through his provincial court, whilst his diocesan jurisdiction is exercised through his consistorial court, the judges of both courts being nominated by the archbishop. His grace's ancient testamentary and matrimonial jurisdiction has been transferred to the Crown by the same statutes which have divested the see of Canterbury of its jurisdiction in similar matters.

The first archbishop of York was Paulinus, to whom Pope Honorius I. sent the *pallium* in 634 A.D. in fulfilment of the intention of Pope Gregory the Great. The successors of Paulinus exercised metropolitan jurisdiction over the bishops of Scotland until the latter part of the 15th century, when Pope Sixtus IV. raised the bishopric of St Andrews into an archbishopric, and constituted the archbishop of St Andrews primate of all Scotland, and *legatus natus* of the apostolic see in Scotland. The archbishop of York takes precedence over all subjects of the Crown not of royal blood, next to the lord high chancellor of England, who is preceded by the archbishop of Canterbury. He is *ex officio* an ecclesiastical commissioner for England.

The first archbishop of St Andrews was Patrick Graham, who successfully disputed the superiority of the see of York, and was constituted metropolitan over all the diocesan bishops of Scotland in 1474 A.D. His successors continued to exercise metropolitan jurisdiction throughout Scotland until 1491 A.D., when Pope Innocent VIII. sent the *pallium* to the bishop of Glasgow, and constituted him metropolitan over the dioceses of Argyle, Dunblane, Dunkeld, Galloway, and Glasgow, whilst the archbishop of St Andrews continued to exercise metropolitan jurisdiction over the dioceses of Aberdeen, Brechin, Caithness, Edinburgh, Moray, Orkney, Ross, and St Andrews, until the Episcopal form of church government ceased to have any legal authority in Scotland.

[1] The Court of Peculiars is no longer held, inasmuch as the peculiars have been placed by Acts of Parliament under the ordinary jurisdiction of the bishops of the respective dioceses in which they are situated.

The Church of Ireland was united, by the fifth article of the Act for the Union of Ireland with Great Britain, into one Protestant Episcopal church with the Church of England, and it had at that time four archbishops, who took their titles from Armagh, Dublin, Cashel, and Tuam. The archbishop of Armagh was primate of all Ireland and metropolitan of the province of Armagh, and the other archbishops were primates of Ireland and metropolitans of their respective provinces. By 3 and 4 Will. IV. c. 37, and 4 and 5 Will. IV. c. 90, the metropolitans of Cashel and of Tuam were reduced to the status of diocesan bishops, and, with the then existing eighteen bishops, were reduced in number to ten bishops by the consolidation of their dioceses, so that each of the two archbishops had five diocesans subject to his metropolitan jurisdiction. By 32 and 33 Vict. c. 42, the union between the Churches of England and of Ireland was dissolved, and the Church of Ireland has ceased to be established by law. (T. T.)

ARCHDEACON. The office of archdeacon is of ancient institution in the Christian church, as archdeacons are mentioned in the 4th century after Christ. The title was originally given to the chief deacon in each diocese, who had the charge of the temporal affairs of the church, and the supervision of all matters which appertained to the order and decency of divine service. In the course of time the archdeacons encroached upon the episcopal jurisdiction, but their encroachments were restrained in England by the Council of London, 1237 A.D, and in other countries by ecclesiastical councils held in the 13th and 14th centuries.

There was originally one archdeacon in every English diocese, but there are at present by statute 6 and 7 Will. IV. c. 97, at least two archdeaconries in each diocese, and in some dioceses there are four archdeacons. The archdeacons are appointed by their respective bishops, and they are by 3 and 4 Vict. c. 27, § 27, required to have been six full years in priest's orders. The functions of the archdeacon are in the present day ancillary in a general way to those of the bishop of the diocese. The archdeacon is sometimes styled "Oculus Episcopi," and it is his especial duty to inspect the churches within his archdeaconry, and to hold annual visitations of the clergy and churchwardens of each parish, for the purpose of ascertaining that the clergy are in residence, of admitting the newly-elected churchwardens into office, and of receiving the presentments of the outgoing churchwardens. It is his privilege to present all candidates for ordination to the bishop of the diocese. It is his duty also to induct the clergy of his archdeaconry into the temporalities of their benefices after they have been instituted into the spiritualities by the bishop or his vicar-general. Every archdeacon is entitled to appoint an official to preside over his archidiaconal court, from which there is an appeal to the Consistory Court of the bishop. The archdeacons are *ex officio* members of the Convocations of their respective provinces. See CONVOCATION.

It is the privilege of the archdeacon of Canterbury to induct the archbishop and all the bishops of the province of Canterbury into their respective bishoprics, and this he does in the case of a bishop under a mandate from the archbishop of Canterbury, directing him to induct the bishop into the real, actual, and corporal possession of the bishopric, and to install and to enthrone him; and in the case of the archbishop, under an analogous mandate from the dean and chapter of Canterbury, as being guardians of the spiritualities during the vacancy of the archi-episcopal see. (T. T.)

ARCHDUKE, a title borne during the Middle Ages by the dukes of Austria, Lorraine, and Brabant. All three archduchies having devolved to the imperial family of Austria, the sons of that house are styled archdukes, and the daughters archduchesses.

ARCHELAUS, a Greek philosopher, was a native most probably of Athens, though some say he was born at Miletus. Nothing is known of his life, but as he was a pupil of Anaxagoras, he must have lived about 450 B.C. By several writers he is said to have been the teacher of Socrates, but this report has no support from Plato, Aristotle, or Xenophon, and probably has no foundation save the wish to connect Socrates closely with preceding philosophy. So far as the opinions of Archelaus are known, he seems to have followed with some deviations his master, Anaxagoras. With him he admitted a primitive matter, consisting of infinite particles similar in nature to the bodies formed from them. He further admitted a ruling mind; but he attempted to overcome the dualism of Anaxagoras, and in so doing, more nearly approached the older Ionic physical philosophers. He thought that matter was mingled with mind, and identified the primitive matter with air. His first principle was thus air endowed with mind. Out of this air, by the processes of thickening and thinning, arose cold and warm, or water and fire, the one passive, the other active. From the action of fire on water are formed the atmosphere and the mud, out of which the earth and the heavenly bodies are developed. Living, organised beings, at first of a low type, spring out of this mud, and gradually the races of animals are formed. Man is superior to other beings by his moral and artistic powers. To Archelaus are attributed some ethical doctrines, such as, that right and wrong are not by nature but by custom. This is a well-known proposition of his contemporaries, the Sophists, and in all probability it is attributed to Archelaus erroneously. Ethical teaching was no doubt ascribed to him merely to explain the completely ethical character of the philosophy of his supposed pupil Socrates. No fragments of Archelaus remain; his doctrines have to be extracted from Diogenes Laërtius, Simplicius, Plutarch, and Hippolytus.

ARCHELAUS, natural son of Perdiccas, king of Macedonia, seized the throne in 413 B.C., after having murdered his uncle, his cousin, and his half brother, the legitimate heir. His reign was remarkable for the many improvements he introduced. He fortified cities, constructed roads, and thoroughly organised the army. He endeavoured to spread among his people the refinements of Greek civilisation, and invited to his court many celebrated men of the time—as Zeuxis, Timotheus, Euripides, and Agathon. In 399 B.C. he was killed by one of his courtiers, Craterus; according to some, designedly, according to others, accidentally while engaged in hunting.

ARCHELAUS, a general of Mithridates, commanded his army in the war against the Romans. He was sent into Greece with an army of 120,000, and after three days' fighting with Bruttius Sura, occupied the Piræus. Here he was attacked by Sulla, and after a hard struggle was compelled to withdraw into Bœotia. Sulla followed, and at Chæronea, 86 B.C., completely routed him. A fresh army was sent by Mithridates, but at Orchomenos, after a two days' battle, Archelaus was again defeated. Peace was soon afterwards concluded, but as Archelaus found that he had incurred the displeasure of Mithridates, he fled over to the Romans, by whom he was well received. He is not heard of again in history, but several of his descendants of the same name held high posts under Pompey, Antony, and Augustus.

ARCHELAUS, son of Herod the Great, had the kingdom of Judæa left him by the last will of his father, though a previous will had bequeathed it to his brother Antipas. He was proclaimed king by the army, but declined to assume the title until he had submitted his claims to Augustus at Rome. Before setting out, he quelled with the utmost cruelty a sedition of the Pharisees, slaying nearly 3000 of them. At Rome he was opposed by Antipas and by many of the Jews, who feared his cruelty, but Augustus allotted to him the greater part of the kingdom with the title of Ethnarch. He married Glaphyra, the widow of his brother Alexander. This violation of the Mosaic law and his continued cruelty roused the Jews, who complained to Augustus. Archelaus was deposed (7 A.D.) and banished to Vienne. The date of his death is unknown.

ARCHELAUS, son of Apollonius, a sculptor of Priene, is celebrated by his bas-relief representing the apotheosis of Homer. From the style of the work, and from its having been found in the palace of the Emperor Claudius at Bovillæ, it may be concluded that it belongs to the 1st century of the Christian era. For some time the bas-relief was in the possession of the Colonna family, but in 1819 it was purchased for £1000, and placed in the British Museum.

ARCHENA, a town of Spain, in the province of Murcia, of interest on account of its hot mineral springs and old Roman baths. It is fairly built, and contains a palace of the Corbora family. Population about 2000.

ARCHERY, the art or exercise of shooting with a bow and arrow. The origin of the bow as an instrument of war is lost in obscurity. With all the ancient peoples, both civilised and barbaric, the bow was a favourite weapon, and skill in the use of it was regarded by the Scythians as a princely accomplishment. The Greeks and Romans employed archers to draw the enemy into action, and the exploits of the ancient Egyptians rivalled those of the archers of the Middle Ages.

There is no record of the use of the bow in France until the reign of Charlemagne, in the beginning of the 8th century, although we have evidence that in England both the Anglo-Saxons and the Danes employed it in the chase, as well as in battle against the primitive inhabitants of England, many years before the Conquest. The probability is that it was first introduced as a military weapon into Britain by the Romans; but it was under the Norman rule that the practice of archery in this island was not only greatly improved, but generally diffused throughout the country, so that England soon became famous for its archery, and her archers took precedence of those of every other nation. To preserve this superiority by constant practice appears to have been the study of many of our monarchs; and numerous statutes for enforcing and regulating the use of the bow among the people were enacted from early times until after the invention of fire-arms. Many laws were also made for securing the presence in distant and obscure parts of the country of persons skilled in the manufacture of bows and all the apparatus appertaining to archery, for guarding against fraud by those artificers, and also for the procuring of a constant supply of bow-staves from abroad. These laws appear to have been absolutely necessary, for in the olden time the English chiefly depended for their success in battle upon the bravery and expertness of their archers, whose appearance in the field generally led to success. William the Conqueror is reputed to have been so admirable an archer that few could bend the bow he used, and his victory at Hastings was certainly due to the skill and intrepidity of his archers. Richard I. performed great exploits with his archers in the Holy Land, where, according to Gibbon, 300 archers and 17 knights, headed by the king, sustained the charge of the whole Turkish and Saracen army. It was in his reign that the renowned Robin Hood flourished in Sherwood Forest. Edward II. levied a company of "Northumbrian archers" in the year 1314, for the invasion of Scotland.

The battles of Cressy and Poitiers were gained by the English archers in the years 1346 and 1356 respectively. Edward III. was extremely jealous of the honour of the bow, and anxious that its glory should be maintained. In the early part of his reign it was ordered that most of the sheriffs of England should each provide 500 white bows and 500 bundles of arrows for the then pending war with France. In the following year this order was reissued, with the difference that the sheriff of Gloucester should furnish 500 painted bows in addition. This king embodied a company of soldiers, whom he called the "Archers of the Guard." Edward III. also, in 1363, commanded the general practice of archery on Sundays and holidays by the people in lieu of the ordinary rural pastimes, which were forbidden on pain of imprisonment. In this reign the price of bows was regulated by Government; a white bow was 1s., a painted bow 1s. 6d., a sheaf (24) of sharp arrows 1s. 2d., and a sheaf of blunt arrows 1s. Richard II., in 1392, directed that none of his servants should ever be unfurnished with bows and arrows, and that they should avail themselves of every opportunity of practising archery. At the same date an Act of Parliament compelled all persons employed as servants to shoot with bows and arrows on Sundays and other holidays. In the year 1402 the English archers won the battle of Homildon; and in 1403, at the battle of Shrewsbury, where Hotspur was slain, the most terrible havoc was created by the archers on both sides. In the reign of Richard III., it was enacted that for every ton of Malmsey or Tyne wine brought into England, ten good bow-staves should also be imported, under penalty of 13s. 4d. for every deficient stave; and to encourage the import of bow-staves, those above 6½ feet long were freed from duty.

For the manufacture of bows yew was generally preferred to all other woods, but to prevent a too rapid consumption of yew, bowyers were ordered to make four wych-hazel, ash, or elm bows, to one of yew; and no person under 17 years of age, except those possessed of portable property worth 40 marks, or the sons of parents owning an estate of £10 per annum, was allowed to shoot with a yew bow, under penalty of 6s. 8d. for each offence. That distant counties might be properly supplied with bows and arrows, the king claimed and exercised the prerogative of sending, if necessary, all arrow-head, bow-string, and bow makers, not being freemen of the city of London, to any part of the realm that required the services of such artificers; and neglect of an order to visit a place after the receipt of instructions to repair thereto, was punishable by a fine of 40s. for every day the workman remained away.

In the reign of Henry IV. it was enacted that all arrow-heads should be well brased and hardened at the points with steel, and stamped with the name of the maker, under penalty of fine and imprisonment, and forfeiture of the arrows, &c., in default; and by another statute passed in the same reign, it was enacted that persons from places whence bow-staves were derived, should import four bow-staves for every ton of merchandise taken on board, under penalty of 6s. 8d. for every bow-stave deficient. In this reign the highest price permitted for a yew bow was 3s. 4d. In the reign of Edward IV. it was enacted that every Englishman, and every Irishman living with an Englishman, should have an English bow of his own height; and also that in every township shooting butts should be set up, at which the inhabitants were commanded to practise on holidays, under the penalty of one halfpenny for each neglect. In the same reign the king, in preparing for a war with France, directed all sheriffs to procure a supply of bows and arrows for the service of the state. In 1405, it was made penal to use bad materials in the manufacture of bows and arrows. In 1417 the archers of the army of Henry V. won the battle of Agincourt. This king directed the sheriffs of counties to take six wing-feathers from every goose for the feathering of arrows. In 1478 archery was encouraged in Ireland by statute. In the year 1424 James I. of Scotland, who was himself an excellent bowman, revived the practice of archery among his subjects. Richard III. lent 1000 archers to the duke of Bretagne. The same troops afterwards fought at the battle of Bosworth. In 1485 Henry VII. instituted the yeomen of the guard, who were then all archers, and in the 19th year of his reign the use of the cross-bow was forbidden by Act of Parliament, because the long bow had been of so much greater benefit to the nation. In this reign archery occupied an important position in the fashionable pastimes of the kingdom, and upon the occasion of the marriage of Henry with the Princess Elizabeth it formed a great feature among the nuptial festivities, the king himself joining in the shooting with heartiness and glee.

Several Acts were passed in the reign of Henry VIII. for the encouragement and promotion of archery; one ordered that butts should be erected and kept in repair in all townships, and that the inhabitants should practise shooting at them on holidays. The same Act directed that every able-bodied man, not being an ecclesiastic or a judge, should practise shooting with the long bow; and the guardians and employers of youth were ordered to bring up the boys in their charge to the practice of archery, neglect being punishable by fine. In this reign the practice of archery was strongly advocated from the pulpit by Bishop Latimer; and so jealous were the English of rival nations competing with them, that aliens were forbidden to use the long bow. The English victory at the battle of Flodden Field was due to the skill and courage of the archers. Edward VI. devoted much of his time to the practice of archery as an amusement, and his Journal, in which are many allusions to his successes and disappointments at matches, is still preserved in the British Museum.

Archery continued to be an object of attention and solicitude with the Legislature during the reign of Elizabeth, and the price of bows was again regulated by statute; also, bowyers were commanded to keep in hand always a sufficient stock of bows. Charles I. issued commissions to prevent the enclosure of fields near London, so "as to interrupt the necessary and profitable exercise of shooting with bows and arrows," and also for the restoration of all shooting-marks that had been already removed. And the earl of Essex, at the beginning of the civil war, raised a company of archers for the defence of the king. In the time of Charles II. archery was a highly fashionable and popular recreation with all classes of society, and the "Merrie Monarch" used frequently to take part with the ladies and gentlemen of his court in toxophilite meetings. Queen Catherine also showed deep interest in the fascinating pastime, and in the year 1676 she presented a silver badge to the "Marshal of the Fraternity of Archers." Both the king and queen frequently reviewed the numerous associations of archers then existent. In the spring of 1682 a grand fête was given by the London Artillery Company at the Artillery Grounds, at which there were present upwards of 1000 archers, and it is said that the gala outshone anything of its kind that had previously been seen in England; but from that time until the beginning of the present century, the attractions of archery appear to have been overlooked, and its practice neglected. In the *English Bowman*, a small book published in the year 1801, we find the following reason given as the cause of its revival in London :—

"About the year 1776, Mr Waring, who then lived with Sir Ashton Lever at Leicester House, and who may justly be styled the father of modern archery, having, by continual business, contracted an oppression upon his chest (arising principally from sitting too closely at his desk and pressing his breast too much against it, and which the most eminent in the faculty had in vain endeavoured to remove), resolved to try the effects of the bow in affording relief. He accordingly made it a regular exercise. and in a short time derived great benefit from the use of it, and ascribed his cure, which was perfect, to the practice of archery. Sir Ashton Lever, perceiving the good effects which so engaging an amusement had upon the constitution, followed Mr Waring's example, and took up the bow; he was soon joined by several of his friends who, in the year 1781, formed themselves into a society, under the title of the Toxophilites, and met regularly at Leicester House, having butts erected in the gardens belonging to it.

That society was the parent of the numerous societies of archers known about that period (*i.e.*, 1790). "The enthusiasm," says Hansard, in his *Book of Archery*, "can only be compared with that which animated the admirers of Shakspeare and the drama generally during the Garrick era."

There is now no means of ascertaining precisely the period at which the bow was relinquished entirely in these kingdoms as a weapon of war. Grose informs us that it was commonly used by the English soldiery for more than two centuries after the introduction of fire-arms, and indeed, long subsequently to the adoption of guns, the bow remained the favourite weapon of the army,—a fact which is not surprising when we learn, on the authority of Neade, a celebrated archer of Charles I., that the ordinary range of the bow was from 16 to 20 score yards, and that so rapid was the shooting of the archers, or so slow the firing of the musketeers, that an archer could shoot six arrows in the time occupied in charging and discharging one musket.

But although the bow has long been disused as a military weapon, it has ever been cherished in Great Britain, and particularly among the upper classes of society, as an instrument of delightful and healthful recreation; and it would be impossible to overrate the physical and moral advantages accruing from the regular practice of archery—one of the few "out-door" amusements that are as suitable for delicate ladies as for strong men. "There is," remarks Mr H. A. Ford, "no exercise more healthy or more rational, or which returns more true and genuine gratification to the man who practises it." As an exercise for ladies it brings all the muscles generally into healthy action, and is, in Mr Ford's opinion, admirably suited to meet the requirements of the fair sex,—"general and equal, without being violent—calling the faculties, both of mind and body, into gentle and healthy play, yet oppressing none—withal most elegant and graceful."

Another era in the annals of the art may be dated from the year 1844, when a national meeting of the archers of Great Britain and Ireland was held at York, since which time archery has assumed much importance as a national pastime, and year after year the wider competition which such assemblages have secured has brought forward bowmen and bowwomen, who, by their persistent efforts in carrying off honours, and that by the most remarkable achievements, have carried the art as nearly as possible to perfection. Under the auspices of the "Grand National Society" archery has been conducted through all the stages of actual revival and establishment as a favourite British pastime. Rapid progress has, in every respect, marked its modern career. It was only in the year 1845 that ladies began to compete publicly with men for the prizes offered at "The National," but at some of the matches, which have, without interruption, annually taken place since then, as many as 130 archeresses have participated in match-shooting, whilst at least an equal number of gentlemen have competed with them on some occasions, with a guaranteed prize list of about £400. These anniversaries have been held four times at Leamington and at Cheltenham; thrice at York and at Derby; twice at Shrewsbury, at Exeter, and at Bath; once at Edinburgh, Liverpool, Worcester, Oxford, the Alexandra Park (London), Clifton, Norwich, Birmingham, Hereford, Brighton, and Winchester. After the establishment of the Grand National meeting it was found necessary to fix an order of shooting; hence the origin of "The York round," on which all public competitions by archers are now conducted, and which, for gentlemen, consists of 6 dozen arrows at 100 yards, 4 dozen at 80 yards, and 2 dozen at 60 yards; and for ladies, 4 dozen arrows at 60 yards, and 2 dozen at 50 yards. By this arrangement archers living in various parts of the three kingdoms can ascertain their relative proficiency. It is upon two days' shooting, or the result of a "double round," that the Grand National prizes are awarded on "value" alone, as the best criterion of good and central shooting. The principal of these prizes are the champion's gold medal for gentlemen, and the challenge silver bracer and brooch for ladies. These much coveted honours are awarded by a majority of points only; and the points for the champion's medal are reckoned as follows:—Two for the gross score, two for the gross hits, one for best score at 100 yards, and one for the best hits at ditto, and the same at 80 and 60 yards—making ten points in all. The ladies' challenge bracer (presented by the West Norfolk Bowmen) is awarded on the same principle, namely, for the greatest number of points—eight in all. The highest score ever made by a champion was 1251, with 245 hits, at Cheltenham in 1857, by Mr Horace A. Ford, the author of *The Theory and Practice of Archery*, who won the medal of Great Britain as many as eleven times, and is, without doubt, the finest shot England has seen since the days to which legends and distance lend a somewhat doubtful glory, his scores being absolutely without parallel. He has now retired from public life as an archer. The nearest approach to any of his victories has been made by Major Hawkins Fisher, who carried off the medal in 1871 with 955, and has been champion in the years 1871-72-73-74. Mr Peter Muir, the greatest archer, probably, that Scotland has produced, at any rate in modern days, was the champion in 1863, scoring 845. Mrs Horniblow became the possessor of the lady champion's bracer no less than ten times, and the highest score she ever made in obtaining it was 764, at Leamington, in the year 1873. To this lady is due the honour of having signally demonstrated that the bow really was a weapon adapted to woman's use, and capable of evidencing, in their hands, not the perfection of grace only, but that of skill and talent also. To the Grand National Society, in the first instance, is this great increase of skill mainly owing, but beyond this, increased skill has led to increased taste and liking for the amusement, till, in an ever widening circle, nearly every county of England has become included within it. This has led to the establishment of other great meetings, till, at the time the present article is written, besides numberless meetings of private clubs, there are several public matches open to all, where formerly there were none. Thus we have the Grand National itself, the Leamington and Crystal Palace meetings, the Grand Western (where two handsome challenge prizes reward the shooting both of the champion and championess of the west of England), and a Scotch national meeting, where a champion gold medal, presented by Mr T. Macfarlane of New Zealand, and exclusively confined to Scotland, is annually shot for, being awarded to the successful bowman, according to the rules for the champion medal of Great Britain.

There are several societies of archers in the three kingdoms, but the most noted of the kind now existing are the following:—

The Royal Company of Archers.

The king's body guard for Scotland was first constituted in its present form in the year 1676, by an Act of the privy council of Scotland. An earlier origin has been claimed for the company, it being said by some that it was originally formed by the commissioners for enforcing the exercise of archery appointed by James I. of Scotland, who picked out the most expert bowmen in the various counties, and constituted them into a body of guards to defend the king's person, in which distinguished station they displayed great devotion and bravery at the battle of Flodden, the body of the king being afterwards found surrounded by those of his attached archers' guard. This, however, is mere tradition, no authentic record of their existence being found until the above-mentioned year 1676, when the minutes of the Royal Company begin by stating, that owing to "the noble and usefull recreation of archery being for many years much neglected, several noblemen and gentlemen did associate themselves in a company for encouragement thereof . . . . . and did apply to the privy council for their approbation, and after several meetings, did adjust and concert several articles and regulations of the said company, and did further apply to the privy council for their approbation, which was granted." The minutes of the company have been kept with great regularity from that time down to the present, with the exception of a period of about twenty years at the end of the 17th century, during which time there are no records. It is not supposed that the company was extinct at that time from what can be gathered from the succeeding minutes. It is probable, however, that during the Revolution the Royal Company was principally composed of upholders of the house of Stuart, and that on this account their existence was for a time suspended. This may be true, as we find that the company was subsequently a strong Jacobite body, but whether it is the case or not, it is certain that the records recommence in 1703 by informing us of the election of a captain-general to succeed John, second earl of Argyle, who held that office from the formation of the company in 1676, and who had just died. The new captain-general was Sir George Mackenzie, Viscount Tarbat, afterwards created earl of Cromarty. Owing to his exertions while principal secretary of state for Scotland in 1703, he procured for the company a new charter from Queen Anne, renewing all their former rights and privileges, and conferring others, all which were to be held of the Crown for the *reddendo* of a pair of barbed arrows. This *reddendo* was paid to George IV. at Holyrood, when he visited Scotland in 1822, and to the present sovereign, Queen Victoria, on a similar occasion in 1842.

The history of the Royal Company since 1703 has been one of great prosperity. Large parades were frequently held, and were attended by numbers of archers dressed in the uniform of the body, which, in the last century, consisted of a green tartan coat and white knee-breeches. On such occasions the whole population of Edinburgh and the surrounding districts turned out to view the procession, as the company, with music and colours, marched down the Canongate to Leith Links, there to shoot for a prize. Many distinguished men marched in their ranks, and, both at their competitions and at the mess table, the utmost hilarity and good fellowship prevailed. Several of the leading insurgents in 1745 were members, but the company was not at that time suspended in any way, and a few years later no subjects more loyal or more attached to the constitution could be found in Great Britain.

In 1777 the Royal Company erected a large and handsome hall in the vicinity of their shooting-ground in the Meadows, Edinburgh. They meet there periodically for the transaction of business and to dine. The hall is decorated with several very fine portraits of eminent members of the body, in various uniforms, according to the rank which they held in the company and the time in which they lived. Among them are some masterpieces of Raeburn, Watson, Gordon, Grant, P.R.A., Macnee, &c.

In 1822, when king George IV. visited Scotland, it was thought appropriate that the Royal Company should act as his Majesty's body guard during his stay. Consisting as the company did, and still does, of representatives of almost all the noble families of Scotland, together with a large proportion of landed gentry, professional men, and others, it was considered that no fitter body could be chosen, especially as there was a tradition, as we have seen, that the Royal Company had at a former period acted in a similar capacity. On the landing of the king he was received by a detachment of the body, who surrounded his carriage inside the cavalry escort and marched up with it to Holyrood. They occupied the same position in subsequent state processions; while at the levee and drawing-room held by his Majesty they lined the staircase and presence chamber, performing the duties usually assigned to the band of gentlemen-at-arms. When Queen Victoria visited the Scottish capital in 1842, the Royal Company again did duty, and the last time they were called out in their capacity of royal body guard was in 1860, on the occasion of the great volunteer review in the Queen's Park, Edinburgh.

King George IV., besides authorising the company to take, in addition to their former name, that of "The King's Body Guard for Scotland," presented to the captain-general a gold stick, thus constituting the company part of the royal household. In virtue of this stick the captain-general of the Royal Company takes his place at a coronation or similar pageant immediately behind the gold stick of England, who, with the exception of the officers on guard for the day, is next the sovereign's own person. The lieutenants-general of the company have silver sticks; and the council, which is the executive body of the company, possess seven ebony ones. George IV., in addition to the grant of a gold stick, appointed a full dress uniform to be worn by members of the company at court, when not on duty as guards, in which latter case the ordinary field dress is used. The court dress was scarlet and gold, but was changed in 1831 to a green coat with green velvet facings richly embroidered with gold thistles and arrows, gold epaulettes, crimson silk sash, gold-laced trousers, and cocked hat with green plume. The officers wear a gold sash in place of a crimson one, and an *aiguillette* on the left shoulder. All ranks wear swords. The shooting uniform has been frequently changed. We are not told what colour the coat was at the formation of the company, but there was a distinctive dress introduced about that time. In 1715 a green tartan was adopted (now the 42d tartan), which continued, with several modifications and alterations, to be the uniform down to 1829, when it was changed to green cloth. The present field dress consists of a dark green tunic with black braid facings, with a narrow stripe of crimson velvet in the centre; shoulder wings and gauntleted cuffs similarly trimmed; dark green trousers with black and crimson stripe; a bow case worn as a sash, of the same colour as the coat, with a centre ornament of two arrows crossed saltierwise in a garter tie, surmounted by a crown; a black leather waist-belt, with richly chased gold clasp; a short sword, gilt hilted, made after the fashion of a Roman gladius, Balmoral bonnet, with thistle ornament and eagle's feather. The mess uniform consists of a dark green dress coat with velvet collar and gilt buttons, with a crown on them, white waistcoat, and black trousers.

The Royal Company possess two sets of colours. The first banner was got in 1714, and bears a representation of the common seal of the company, viz., a yew tree *proper*, supported dexter and sinister by an archer with a bow in one hand and an arrow in the other. The second was procured in 1732, and bears on one side a lion rampant *gules*, on a field *or*, with the motto "*pro patria dulce periculum*," and on the other a St Andrew, with a large thistle above his head, with the motto, "*Nemo me impune lacessit.*" King William IV. presented the company with a new stand of colours in 1832. The one banner combines the old ones, and the other has the Royal Scottish arms, with the words "King's Body Guard for Scotland."

The following are the noblemen who have held the office of captain-general since 1676:—

1676–1703, John, second earl of Atholl.
1703–1714, Sir George Mackenzie, first earl of Cromarty
1715–1720, David, third earl of Wemyss.
1724–1743, James, fifth duke of Hamilton and Brandon.
1743–1756, James, fourth earl of Wemyss.
1756–1778, Charles, third duke of Queensberry.
1778–1812, Henry, third duke of Buccleuch.
1812–1819, Charles, fourth duke of Buccleuch.
1819–1823, John, fourth earl of Hopetoun.
1824–1830, James, third duke of Montrose.
1830–1838, George, ninth earl of Dalhousie.
1838– The present duke of Buccleuch.

Most of the prizes shot for by the Royal Company are held for a year by the winner, and in some cases he receives a grant of money to enable him to affix a silver or gold medal with his name and crest inscribed thereon to the prize. The only prize which becomes the winner's absolute property is one of £20, presented annually by her Majesty to be expended in the purchase of a piece of plate. This prize was first given by the Scottish privy council at the very beginning of the company. It was not, however, continued for many years, but was revived by his Majesty George III. in 1788, and has since been shot for regularly. The following is a list of the principal prizes shot for by the company:—

1. Musselburgh Silver Arrow, given by the magistrates of that town, and first shot for so far back as 1603. Now the competition is confined to members of the Royal Company, but at that time it was probably open to all comers. 2. Peebles Silver Arrow, shot for at that town. This arrow bears medals extending back to 1626, but it was not shot for by the Royal Company until 1786. 3. Silver Arrow presented to the company by the magistrates of Edinburgh in 1709, and shot for from that time. 4. Selkirk Silver Arrow, first shot for by the company in 1818, but in itself a very ancient prize. 5. Silver Punch Bowl and Ladle, subscribed for by members in 1720, and having the gold medal of the winner of each year attached. 6. Dalhousie Sword, a richly ornamented Indian sword, presented by captain-general the earl of Dalhousie, in 1833. 7. The Hopetoun Royal Commemoration Prize, a handsome silver vase and gold medal, presented by captain-general the earl of Hopetoun, to commemorate George IV.'s visit to Scotland in 1822. 8. Spens Anniversary Medal, shot for in honour of the memory of Dr Nathaniel Spens, an old and favourite member in the end of last century. 9. Prize given by the town of Biggar 10. Silver Arrow, presented by the magistrates of Montrose. All these prizes are shot for in the field at a distance of 180 yards. There is, however,—11. St Andrew's Cross, presented in 1801 by Sir George Mackenzie of Coul, Bart.; shot for at 200 yards. There are two prizes shot for at 100 yards, namely, 12. A Gold Medal made out of "pagodas," being part of the money paid by Tippoo Sultan at the treaty of Seringapatam, presented by Major James Spens in 1793; and 13. A Silver Bugle Horn, presented in its present shape in 1830, by Sir Henry Jardine, Knt., but shot for for some time previously in a less handsome form. There are three prizes shot for at butts, at a circular piece of card-board four inches in diameter, at a distance of 100 feet. The most ancient of these is—14. The Goose Medal, or the Goose. The old mode of competing for this was by building a live goose in a turf butt, the head only being exposed to view, and he who hit the head and killed the goose was entitled to have her Of course, this barbarous practice has been long discontinued, though it remained till after the middle of last century. In place of the goose's head, a small glass globe is put into the centre of the card-board mark on the butt, and he who breaks the globe with his arrow receives a gold medal, to be worn for the ensuing year. 15. Papingo or Popinjay Medal, presented in 1831, and originally competed for by shooting at a stuffed bird, a parrot or popinjay, fixed to the top of a high pole. He who brought the bird down was adjudged victor. It having been found inconvenient to shoot for the prize in this manner, it is now competed for in the ordinary fashion at butts. 16. A Gold Medal, held for a year by the person making the greatest aggregate score on three appointed days.

The affairs of the company are managed by a council of seven, who are elected by the whole company annually. Although the company has a right, as a body, to elect their own officers and admit new members, yet both those powers have for many years been left in the hands of the council. The fees of entry to the Royal Company are £25, and the entrant has also to be balloted for by the council. There are several "uniform" dinners held in the course of the year, which are very popular both with members and their friends. Smaller and less pretentious, though not less pleasant, are the "match" dinners held once a month by the shooting members, after a friendly match shot at rovers or butts. The average number of members belonging to the Royal Company is between 500 and 600.

The Royal Toxophilite Society is now established at the Archers' Hall, Inner Circle, Regent's Park, London, where it has a handsome building for the use of its members, and ample shooting ground. It was founded in 1781 by Sir Ashton Lever, and represents the two ancient bodies, "The Finsbury Archers" and "The Archers' Company of the Honourable Artillery Company," and possesses, among other plate, the large silver shield given to the Archers' Company by Queen Catherine of Braganza (consort of Charles II.), and also silver arrows of the same and of earlier periods. The Royal Toxophilite Society have occupied their present ground (about six acres in extent) since 1832, when they obtained possession of it from the Woods and Forests, and erected on it their "Archers' Hall." The entire cost of the building, laying out the grounds, furnishing, and finishing, amounted to £4548, 9s. 6d. The society has for many years enjoyed special royal patronage. King George IV., who was fond of archery, shot, when Prince of Wales, with the members in their gardens at Leicester House, and on his becoming patron of the society in 1787, it assumed the title of "Royal," by which it has ever since been distinguished. King William IV. was also its patron, as was the late Prince Consort. The Prince of Wales is at the present time the patron of the society, of which the earl of Dudley is the president.

The Woodmen of Arden hold their meetings at Meriden, in Warwickshire. The society was revived, after a long interval, in the year 1785. The number of members is limited to 80; but the standing rules relating to the election of a member were, by general consent, suspended in the case of the late Sir Robert Peel. This occurred at the jubilee festival in 1835. The earl of Aylesford is lord warden of the society, whose shooting grounds, which are in the forest of Arden, consist of about 12 acres of land. A forest hall was erected in 1844. The Woodmen, exercising a nominal, as their predecessors did a real authority, over vert and venison, give appropriate designations to their officers. Of these, the lord warden is chief; and they have likewise master foresters and verderers. At the grand target, or annual wardmote, whoever hits the gold first is styled (for the year ensuing) Master Forester; and whoever gains the second gold becomes the Senior Verderer for the same period. In 1787 the silver bugle horn of Arden was presented to the society by the earl of Aylesford; it is never shot for at a less distance than nine score yards, which may be extended to twelve score. In 1788 the countess of Aylesford presented to the society the "silver arrow," to be annually shot for at nine score yards. Gold and silver medals are also presented to the master forester and senior verderer; and there are the Digbean gold medal, *optime merenti*, the possessor of which ranks as Captain of Numbers, he having gained the greatest number of prizes at the grand target; and the Digbean silver medal, *bene merenti*, which confers the Lieutenancy of Numbers upon the member who gains the next greatest number of prizes. The winners of these medals, which are shot for at 100 yards, take rank, for the year thereafter, next to the senior verderer.

Practical Archery.

Implements for the practice of archery are principally made in London and Edinburgh, and are of various degrees of excellence. It cannot be too strongly impressed upon archers that they should select their gear from a maker of undoubted "good report." In the choice of a bow preference should be given to one which is under, rather than over, the strength which an archer can use without difficulty. The power required to draw an ordinary bow, for a gentleman, ranges from 40 to 60 ℔ (*i.e.*, power to draw the arrow to the point)—46 to 50 ℔ being the average power used for the "York Round." The "Royal Archers" at Edinburgh and the "Woodmen of Arden" are the only clubs shooting longer distances than are recognised by "the York." These longer distances are 180, 200, and 220 yards, requiring bows of from 56 to 64 ℔ power. Gentlemen's bows are 5 ft. 10 in. and 6 feet long. Ladies' bows, of course, are lighter, and can be drawn by a power of from 24 to 32 ℔, the length being from 5 ft. 3 in. to 5 ft. 6 in. Bows are made of various kinds of wood, such as lancewood, snakewood, washaba, and yew,—the last being generally preferred for sweetness of material and steadiness of cast, though lance and other woods are found to be more durable, much cheaper, and quite as well adapted for practice. Bows are made of three pieces, two pieces, and one piece, and are called three-woods, two-woods, and self. Self bows usually follow the string. Two-wood and three-wood bows being made a little reflex, should retain their shape. It is important that all bows should be preserved from damp, especially those constructed of two or three pieces, as, not only does moisture affect the wood and cause it to warp, but it also dissolves the glue by which the parts are united, and renders the implement useless. For correct and precise shooting an archer must possess himself of the best arrows he can procure. These should be of a weight adapted to the power of the particular bow for which they are intended, and must be alike in thickness, shape, and stiffness. The standard length of an arrow used by gentlemen is 28 inches, and its weight is equal, in standard silver coin, to from 4s. to 5s.; those weighing from 4s. 6d. to 4s. 9d. being used with bows of from 46 ℔ to 50 ℔. The lady's arrow is 25 inches long, and weighs, in silver coin, from 3s. to 3s. 6d. Arrows are manufactured generally of red-pine timber, and the best are footed with a piece of hard wood—usually bullet-tree—glued on one end, upon the point of which the iron pile is fixed, and into the other end is inserted a wedge-shaped piece of horn, called the nock, in which a notch is made for the reception of the bow-string when the archer is shooting. The feathering of arrows depends in some measure upon the taste of the shooter. An arrow has three feathers—now generally taken from a turkey's wing—affixed edgewise at the nock end, about an inch from the end, equi-distant from each other, and parallel to the flight. The wings are much shorter than they were formerly, ranging from $1\frac{3}{4}$ to $2\frac{1}{2}$ inches in length, as the shooter may desire. One feather on each arrow is of a different colour from the rest, and is placed perpendicularly to the line of the nock; it is called the guide-feather (or "cock-feather"), as it enables the archer more readily to place the arrow on the bow-string. By using feathers of the right or left wing for the same set of arrows, the natural curve of the feather is sufficient to impart to the arrow in its passage through the air a rotatory motion equivalent to the flight of a rifle ball. The best shaped arrow is nearly the same thickness from the pile to the under end of the feathers, from which it tapers off slightly to the nock. The full-shouldered, or nearly parallel-shaped pile, is to be preferred.

In addition to his bow and arrows an archer, to be fully equipped, must have a drawing-glove to protect the fingers of the right hand; an arm-guard made of stout calf, morocco, or other leather, to shield the left arm from the stroke of the string after the discharge of an arrow; a waist-belt in which to carry the arrows when shooting, and to which are attached a green worsted tassel for the removal of dirt, &c., from the points of discharged arrows; and an ivory grease-pot, containing grease for the drawing fingers of the glove, of which there are various kinds, every archer using that which suits him best. A doeskin glove, with the first three fingers tipped with smooth, firm calf or pig skin, about $1\frac{1}{4}$ inch long, upon the fingers, and having a strap to buckle round the wrist, is about the easiest and best for use. The flat tab covering the three fingers allows them perfect freedom; but the ordinary draw-glove, with cylindrical points and straps up the back of the hand and around the wrist is perferred by many archers, whilst others again prefer screw tips, fitting each finger separately, and with a strap on the front. Then there is the quiver, which is generally made of Japanned tin. It is used to preserve the arrows from damp, &c., also for keeping the reserve arrows in, as only three are used when shooting in company; it is never worn except when roving.

Targets consist of straw basses with painted canvas faces sewed on them. The "National" targets are 4 feet in diameter, and they have on their faces five circles or divisions, the centre one being gold, and scoring 9; the red scores 7; blue, 5; black, 3; and the white or outer circle, 1. These targets are placed on stands constructed of three ribs of iron jointed at the top; the two side ribs have spikes on the front edge on which the targets rest: the centre rib is thrown behind, as a spur to support the triangle. There should always be a pair of targets provided by an archer in practising, in order to save time and trouble; and a young archer has always been advised to practise at a short distance, and to lengthen it as he progresses—commencing at 20 yards, till he is able to hit the smallest mark, which will prove that he has attained command over his bow.

To enable an archer to keep a record of his shooting the following scoring-card will be found useful (the marks may be made with the point of a pin or pencil):—

Shooters.	Gold.	Red.	Blue.	Black.	White.	Hits.	Value.
A.	... .	....	....	....	....	41	167
B.	....	...	...	.....	.....	19	79
C.							

There is no "royal road" to archery, and more real progress towards proficiency in the bow may be gained in a few hours under the practical guidance of an adept in the art, than can possibly be imparted by all the treatises upon the subject that ever were written; yet, for those who would master the rudiments of the science, a few words may be useful upon what have ever been considered the "five points of archery," which Ascham in his celebrated work describes as "standing, nocking, drawing, holding, and loosing."

1. Roberts, in his *English Bowman*, remarks upon the difficulty of conveying by verbal description so accurate a representation as the pencil can give of an archer drawing his bow. It is a model of gracefulness, the attainment of which is so pointedly recommended by Ascham. Mr Ford in his disquisition, says the "heels

should be about six or eight inches apart. . . . . . The feet must be flat and firm on the ground, both equally inclining outwards from the heels, ... the position of the feet being such that a straight line drawn from it would intersect both heels. . . . . The knees must be perfectly straight, not bent in the slightest degree. . . . . The weight of the body should be thrown equally on both legs. . . . In short, the footing must be firm, yet at the same time easy and springy, and the more natural it is the more likely it is to possess these qualities." The accompanying woodcut will best illustrate the attitude which an archer should assume.

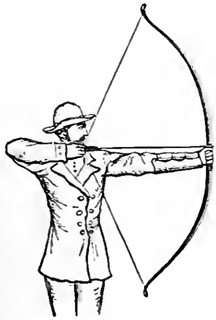


Fig. 1.

2. To string a bow, take it by the handle in the left hand, with the flat side (or back) towards the wrist; place the horn of the under end in the hollow of the left foot; then put the palm of the right hand on the back of the upper end of the bow, below the loop of the string, with the thumb on the one side, and the forefinger *bent* on the other side of the bow, and with the left hand fixed as the fulcrum. Then with the right hand press the string upwards until it reaches the notch in the horn, and the bow is strung, and should exhibit a space of about 5½ inches between the string and the interior of the handle.

"Honora Spencer (Mrs Sharpe), who wrote specially upon archery from a lady's point of view, in alluding to the stringing of the bow, remarks:—'Whilst the right wrist is pressing the bow downwards the other hand should be pulling your bow towards you, each hand with equal pressure, each hand with equal strength. At the same moment that you press and pull, you must use your first two fingers (of course of the right hand) in slipping the string into the groove intended for its reception.' Another mode is recommended, and we are told 'to press the thumb and forefinger closely against the sides of the bow, whilst you pull smartly at the handle.' This, I believe, is the accepted method among gentlemen; but a lady has not often sufficient power in her thumb and forefinger to bend the bow and string it at the same moment; besides this, the pressing of the bow with the wrist is far more graceful for a lady. The same remark and advice apply to the unstringing of the bow, only that the string has to be slipped *out* of the groove. If you find, after some half-dozen attempts that this method of stringing strains neither the right nor left wrist, you may safely conclude that your bow is suited to your strength."

Fig. 2.

3. The bow being now ready to receive the arrow, the archer must "nock," or place it on the string at a spot prepared for it (which should be about ⅜ths of an inch above the upper end of the handle) with the guide feather furthest from the bow, catching the string with two or three fingers, and the arrow between the first and second.

4. He must then take a firm position with his left shoulder towards the target, turning his head only from his neck, and looking over his left shoulder. He must then raise the bow with his left hand, keeping the upper end inclined one or two degrees from his body, and with his right hand draw the arrow to the level of his chin, and below his ear, to which point the arrow should always be drawn while the left hand and arm should be elevated or depressed, according to the distance to be shot, or the strength of the bow.

5. When the arrow is fully drawn, dwell for a moment or two to steady the aim; then "quit" or discharge the arrow, by allowing the string to pass smoothly over the finger points without jerking. The position which a lady should assume whilst in the act of discharging her arrow is illustrated by the annexed figure, the correctness of which might have been increased by the elbow of the left arm, in which there should not be the slightest bend, being held straighter.

Fig. 3.

Except for line there is no accepted theory of taking aim. Due regard must be paid to the weather. When it is calm, the archer must fix the position of the target in his vision, and experience will soon tell him how to find the line and degrees of elevation. In wind, the line and degrees must be varied to suit the conditions of the atmosphere; in a cross wind there must be an adaptation to the direction of the wind; whilst in an up and down wind more or less elevation must be taken according to the strength of the current.

The following is a summary of points well worthy of being remembered by every shooter:—Have the string straight on your bow. *Always* nock on the same place. Place the arrow *over* the string, not between it or the bow. Do not have the arrow too tight on the string. Draw slowly and evenly. Turn your elbow a little upwards. Slant the bow a little to the right. Always draw the arrow the same length. Draw a little below the right side of the chin. Always, while drawing, keep the elbow of your right arm level with the shoulder. Keep the "point of aim" always *directly* in view. Look along the *whole length* of the arrow. Be carefnl to point it perfectly straight. Do not shut the left eye; yet do not aim with it. Make the *left* arm always that by which you change the elevation. Do not hold the bow long *fully* drawn. Never let the fingers of your right hand follow the string. Do not jerk, but loose smoothly. Be certain that your bow-arm does not move when loosing.

"Flight" and "clout" shooting has ceased, and "roving" is now practised only in Britain by the two clubs previously mentioned. They use a target 3 feet in diamater, and count arrows four bow lengths from the target; the nearest arrow counts two. Shooting at butts is still practised, the butts being from 80 to 100 feet apart; the mark is a round piece of pasteboard 4 inches in diameter. The shooting is nearly point blank. (J. SH.)

A Glossary, or Explanation of Terms, &c., made use of in Archery.

ALLOW, ALLOWANCE.—An archer is said to *allow*, or make allowance for the wind, when he shoots somewhat wide of the mark, and on that side of the mark nearest the wind, in order that the wind may bring his arrow into the line of the mark.
ARROW, BEARING.—An arrow which possesses a steady flight.
ARROW, BOB-TAILED.—An arrow increasing in bulk, in a regular proportion, from the nock to the pile.
ASCHAM.—A sort of cupboard, or case, to contain bows, and sometimes arrows, and other implements of archery.

B.

BACK OF A BOW.—The exterior, or flat side.
BELLY OF A BOW.—The interior, or rounded side of a bow
BOW-ARM.—The arm employed in holding the bow.
BOW, SELF.—A bow made of one entire piece of wood.
BOW-SHOT.—The distance which an arrow flies from the bow.
BOWYER.—A maker of bows.
BUTT.—A mound of earth, upon which a mark to shoot at is placed.

C.

CAST, TO.—To become warped.
CAST, THE.—The right of shooting the first, by winning at the last shot, which is called getting the cast.
CHRYSAL, or CRYSAL.—A kind of pinch or crack in a bow.
CLOUT.—A small white target, placed near the ground.
CLOUT-SHOOTING.—Shooting at clouts.
COCK-FEATHER.—That feather on the arrow which is uppermost, and of the darkest colour.
COMPASS, TO KEEP.—To observe a due elevation.
CUT THE MARK, TO.—An arrow is said to cut the mark, when it flies straight towards it, but falls under it.

D.

DRAWING THROUGH THE BOW.—This signifies drawing so far that the point of the arrow comes within the belly of the bow.

E.

ELEVATION.—The act of raising the bow in shooting at the mark.
END.—The place where a mark is fixed.
EYE OF THE STRING.—That part of it which occupies the upper horn of the bow.

F.

FAST.—A word used to caution persons from passing between the shooter and the mark, and to direct them to stand still.
FLETCHER.—An arrow-maker.
FLIGHT.—The distance or path in which an arrow flies.
FOLLOW THE STRING.—A bow is said to follow the string, when, by its use, it has lost its original straightness, and has obtained a curve or inclination forward.

G.

GONE.—An arrow is said to be gone, when it may from its flight be judged to fall wide of, or far from, the mark.
GRAFTED BOW.—One made of two pieces of wood joined at the handle.

H.

HE! HE!—This exclamation is said to have been an archer's word of call, handed down from very ancient days.
HIT.—A stroke in the target or mark.
HOME.—An arrow is said to be drawn home when it is drawn as far as it ought to be.
HORNS OF THE BOW —The ends of the bow, which are tipped with horn.

I.

INCHES.—A distance allowed round the butt-mark, within which an arrow must fall to count.

K.

KEEPING A LENGTH.—Shooting the exact distance, although not straight.

L.

LENGTH.—The distance to be shot.
LIMBS.—The part of the bow above and below the handle.

M.

MARK.—Any object shot at.

N.

NOCK.—An ancient word still used by archers for notch; nocks, therefore, are the notches in the horns of bows and arrows.
NOCKING POINT.—That part of the string on which the arrow is placed.
NOOSE.—The end of the string which occupies the lower horn.

O.

OVER-BOWED.—An archer is said to be over-bowed when the power of his bow is above his command.
OVER-HAND.—Shooting over-hand is to shoot at the mark over the bow-hand.

P.

PAIR OF ARROWS.—In archery three arrows are termed a pair, on account of the liability of one to break.
PETTICOAT, OR SPOON.—The ground of the target beyond the white.
PILE.—The head of an arrow, usually made of steel or iron.
POPINJAY.—A wooden bird, used as a mark, particularly in Scotland.

Q.

QUIVER.—A case in which arrows are kept or deposited, generally made of tin.

R.

ROVING.—Shooters at rovers, which are casual marks, of uncertain distance.

S.

SELF-BOW.—One made of a single piece of wood, or grafted.
SHAFT.—An arrow, so called when it wants only the head.
SHAFTMENT.—That part of the arrow occupied by the feathers.
SHOOT, A.—An arrow shot.
SINKING A BOW.—Reducing its force or stiffness.
SNAKE.—An arrow is said to snake when it works itself under the grass.
STANDING BOW.—A bow that stands well without sinking.
STELE.—An arrow without feather or head.

T.

TAB.—A piece of flat leather, used instead of the fingers of the shooting glove.
TARGET.—A mark to shoot at, consisting of divers coloured circles.
TARGET-CARD.—A card coloured in the same manner as the target, containing the names of the shooters, and used for scoring their respective hits.

U.

UNDER-BOWED.—Using a bow that is too weak to shoot well with

W.

WEIGHT OF A BOW.—The weight or power which a bow requires to draw it properly up.
WHIPPING, THE.—The material used to enwrap the nocking point.
WIDE ARROW.—One that falls wide of the mark
WIND, DOWN.—When the wind blows directly from the shooter down to the mark.
WIND, SIDE.—When it blows directly across the line of mark.
WIND, UP.—When it blows directly from the mark to the shooter

ARCHES, COURT OF THE. This court derives its name from its ancient place of judicature, which was in the church of St Mary of the Arches (*de Arcubus*), the modern representative of which is now called ordinarily Bow Church. The modern church is on the south side of Cheapside, in the city of London, and stands on the site of a very ancient church, which was burnt down in the great fire of London in 1666, and which had a very fine arched crypt, whence it derived its name. The ecclesiastical tribunal, which has passed for a long time by the name of the Arches Court, is the court of appeal of the archbishop of Canterbury, as metropolitan of the province of Canterbury, and the proper designation of the judge is the Official Principal of the Arches Courts, but by custom he has come to be styled the Dean of the Arches, from the circumstance that the office of dean has been in modern times usually united in the same person with that of the official principal of the court of appeal. The office of the dean of the Arches may now be regarded as extinct, or at least as purely titular, like that of the dean of Bocking in Essex, inasmuch as the peculiar jurisdiction which he exercised as dean (*decanus*) over thirteen churches, locally situated within the diocese of London, but exempt from the bishop's jurisdiction, has been abolished, and the churches have been placed by statute under the ordinary jurisdiction of the bishop of London. It was, no doubt, owing to the circumstance that the Arches church was exempt from the bishop of London's jurisdiction that it was selected originally as the place of judicature for the archbishop's court. After the College of Advocates was incorporated and had established itself in Doctors' Commons, the archbishop's court of appeal, as well as his prerogative court, were usually held in the hall of the College of Advocates, but since the destruction of the buildings of the college, the court of appeal has had no settled place of judicature, and the official principal appoints from time to time its sittings, which have been held for the most part in Westminster Hall. The appeals from the decisions of the Court of Arches were formerly made to the king in Chancery, but they are now by statute addressed to the king in Council, and they are heard before the Judicial Committee of the Privy Council. By 23 Henry VIII. c. 9, the Arches Court is empowered to hear, in the first instance, such suits as are sent up to it by letters of request from the consistorial courts of the bishops of the province of Canterbury; and by the statute 3 and 4 Vict. c. 86 (the Church Discipline Act) this jurisdiction is continued to it, and it is further empowered to accept letters of request from the bishops of the province of Canterbury after they have issued commissions of inquiry under that statute, and the commissioners have made their report. The official principal of the Arches Court is the only ecclesiastical judge who is empowered to pass a sentence of deprivation against a clerk in holy orders. (T. T.)

ARCHIDONA, a town in the province of Malaga, in Spain, situated on the slope of a hill, about 10 miles W.N.W. of Loja. It seems to have been a flourishing place under the Romans, to judge by the statues, columns, and other remains which are found, but it is now, in the words of O'Shea, a "wretched village with nothing to visit." The inhabitants, about 7600 in number, are employed in fruit-growing, weaving, oil-pressing, and bacon-curing.

ARCHIL, or ORCHIL (*Orseille*, Fr.), a purple dye yielded by various species of lichens. The name is supposed to originate from the Portuguese *rocha*, a rock, in allusion to the source from which the raw material is derived. Archil can be extracted from many species of the genera *Roccella*, *Lecanora*, *Umbilicaria*, *Parmelia*, and others, but in practice two species of *Roccella*,—*R. tinctoria* and *R. fuciformis*, are almost exclusively used. These, under the name of "Orchella Weed," are imported from the Portuguese colony of Angola, on the west coast of Africa, where the most valuable kinds are gathered; from Cape de Verde Islands; from Lima, on the west coast of South America; and from the Malabar coast of India. They grow on maritime rocks and on trees along sea-coasts, and it will be seen that the species are very widely distributed. The colouring properties of the lichens do not exist in them ready formed, but are developed by the treatment they receive at the hands of manufacturers. Small proportions of a colourless, crystalline principle, termed orcine, is found in some, and in all a series of acid substances, which on treatment split up into orcine and other products. Orcine in presence of oxygen and ammonia takes up nitrogen and becomes changed into orceine, which is essentially the basis of all lichen dyes. Archil is prepared for the dyer's use in the form of a "liquor" and a "paste," and the latter when dried and finely powdered forms the "cudbear" of commerce, a dye formerly manufactured in Scotland from a native lichen, *Lecanora tartarea*. The manufacturing process consists in washing the weeds, which are then ground up with water to a thick paste. If archil paste is to be made this paste is mixed with a strong ammoniacal solution, and agitated in an iron cylinder heated by steam to about 140° Fahr. till the desired shade is developed—a process which occupies several days. In the preparation of archil liquor the principles which yield the dye are separated from the ligneous tissue of the lichens, agitated with a hot ammoniacal solution, and exposed to the action of air. When carbonate of potassium or sodium is added, a blue dye known as litmus, much used in chemical testing, is produced. French purple or lime lake is a lichen dye prepared by a modification of the archil process, and is a more brilliant and durable colour, than the other. The dyeing of worsted and home-spun cloth with lichen dyes was formerly a very common domestic employment in Scotland; and to this day, in some of the outer islands, worsted continues to be dyed with "crottle," the name given to the lichens employed. Stale urine is the form of ammoniacal liquor used in these localities, and that in early days was the recognised source of ammonia in the manufacture.

ARCHILOCHUS, one of the first Greek lyric poets, was born at Paros, one of the Cyclades. The date of his birth is uncertain, but he flourished between 720 and 680 B.C. His father, Telesicles, was of noble family, and had been selected to consult the Delphic oracle relative to sending out a colony from Paros. His mother, Enipo, was a slave. While still young, Archilochus gained a prize for a hymn to Demeter; he soon after left Paros and proceeded to Thasos, according to some authorities, as leader of a colony. But his chief reasons for leaving his native place seem to have been personal disappointment and disgust. Lycambes had promised him his daughter Neobule in marriage, and had afterwards withdrawn his consent. Archilochus, taking advantage of the licence allowed at the feasts of Ceres, poured out his wounded feelings in verses of unmerciful satire. Lycambes he accused of perjury, and his daughters of leading the most abandoned lives. Such was the effect produced by his verses, that Lycambes and his daughters are said to have hanged themselves. The satire was written in iambics, a measure introduced for the first time, and from its structure admirably adapted for light sarcastic poetry. At Thasos the poet passed some unhappy years, and incurred the great dishonour of throwing away his shield and fleeing from the field of battle. He does not seem to have felt the disgrace very keenly, for, like Alcæus and Horace, he commemorates the event in his verses. After leaving Thasos he is said to have visited Sparta, but to have been at once banished from that city on account of his cowardice. His works, owing to their licentious character, were also prohibited by the Spartans. He next visited Siris, in lower Italy, a city of which he speaks very favourably. He then returned to his native place, and was slain in a battle against the Naxians by one Calondas or Corax, who was cursed by the oracle for having slain a servant of the Muses.

The writings of Archilochus consisted of elegies, hymns, —one of which used to be sung by the victors in the Olympic games,—and of poems in the iambic and trochaic measures. To him certainly we owe the invention of iambic poetry and its application to the purposes of satire. The only previous measures in Greek poetry had been the epic hexameter, and its offshoot the elegiac metre; but the slow measured structure of hexameter verse was utterly unsuited to express the quick, light motions of satire. Archilochus made use of the iambus and the trochee, and organised them into the two forms of metre known as the iambic trimeter and the trochaic tetrameter. The trochaic metre he generally used for subjects of a serious nature; the iambic for satires. He was also the first to make use of the arrangement of verses called the epode. Horace in his metres to a great extent follows Archilochus. All ancient authorities unite in praising the poems of Archilochus, in terms which appear to be somewhat exaggerated. His verses seem certainly to have possessed strength, flexibility, nervous vigour, and, beyond everything else, impetuous vehemence and energy. Horace speaks of the "rage" of Archilochus, and Hadrian calls his verses "raging iambics." By his countrymen he was reverenced as the equal of Homer, and statues of these two poets were dedicated on the same day. The fragments of Archilochus are to be found in the collections of smaller Greek poets by Jacobs, Bergk, and Gaisford, and have been published separately by Liebel, *Archilochi Reliquiæ*, Leipsic, 1812, 1818.

ARCHIMANDRITE (from μάνδρα, a fold, cloister, or convent), is a title in the Greek Church applied to a superior abbot, who has the supervision of several abbots and cloisters. The name has sometimes been applied generally to superiors of large convents. In Russia the bishops are selected from among the archimandrites. Although the title is peculiar to the Greek Church, it has found its way into Western Europe. It is used in Sicily, Hungary, and Poland, and has even been applied to bishops of the Latin Church.

ARCHIMEDES, the greatest mathematician and the most inventive genius of antiquity, was born at Syracuse, in Sicily, about 287 B.C. In his youth he went to Alexandria, and completed his education there under Conon, at the royal school of the Ptolemies, of which Euclid had been the ornament some half a century before. On his return to his native city he devoted himself to geometrical investigations, and by his great energy and inventiveness carried the science far beyond the limits it had then attained. Combined with his remarkable faculty of analysis was a power of practical application which enabled him to establish the science of engineering upon a solid mathematical basis. Of the facts of his private life we have but a few disconnected notices. He was the devoted friend, and, according to some accounts, the relative of Hiero, king of Syracuse; and he was ever ready to exercise his ingenuity in the service of his admirer and patron. Popularly, Archimedes is best known as the inventor of ingenious contrivances, though many of the stories handed down about these are probably fabulous. He devised for Hiero engines of war, which almost terrified the Romans, and which protracted the siege of Syracuse for three years. There is a story that he constructed a burning mirror which set the Roman ships on fire when they were within a bow-shot of the wall. This has been discredited because neither Polybius, Livy, nor Plutarch mention it; mirrors may, however, as Buffon showed, be so arranged as to burn at a considerable distance, and it is probable that Archimedes had constructed some such burning instrument, though the connection of it with the destruction of the Roman fleet is more than doubtful. Among the most celebrated of his contributions to practical science are his discoveries in hydrostatics and hydraulics. The account usually given of one of these is remarkable. Hiero, it is said, had set him to discover whether or not the gold which he had given to an artist to work into a crown for him had been mixed with baser metal. Archimedes was puzzled till one day, as he was stepping into a bath and observed the water running over, it occurred to him that the excess of bulk occasioned by the introduction of alloy could be measured by putting the crown and an equal weight of gold separately into a vessel filled with water, and observing the difference of overflow. He was so overjoyed when this happy thought struck him that he ran home without his clothes, shouting, "εὕρηκα, εὕρηκα,"—I have found it, I have found it. It may have been this that led to his establishing the fundamental principle still known by his name, that a body immersed in a liquid sustains an upward pressure equal to the weight of the liquid displaced. Among a number of other mechanical inventions ascribed to him, the water-screw may be mentioned, which still bears his name. His estimate of the capabilities of the lever is expressed in the saying attributed to him, Δὸς ποῦ στῶ, καὶ τὴν γῆν κινήσω, "Give me a fulcrum on which to rest, and I will move the earth."

The life of this philosopher ends with the capture of Syracuse by Marcellus, 212 B.C. In the general massacre which followed the fall of the city, Archimedes, while engaged in drawing a mathematical figure on the sand, was run through the body by a Roman soldier. No blame attaches to the Roman general, Marcellus, since he had given orders to his men to spare the house and person of the sage; and in the midst of his triumph he lamented the death of so illustrious a person, directed an honourable burial to be given him, and befriended his surviving relatives. In accordance with the expressed desire of the philosopher, his tomb was marked by the figure of a sphere inscribed in a cylinder—the discovery of the relation between the volumes of a sphere and its circumscribing cylinder being regarded by him as his most valuable achievement. When Cicero was quæstor in Sicily (75 B.C.), he found the tomb of Archimedes, near the Agrigentine gate, overgrown with thorns and briers. "Thus," says Cicero (*Tusc. Disp.* v. 23), "would this most famous and once most learned city of Greece have remained a stranger to the tomb of one of its most ingenious citizens, had it not been discovered by a man of Arpinum." The range and importance of the scientific labours of Archimedes will be best understood from a brief account of those writings which have come down to us; and it may be remarked that though some useful and important works may have perished, it is probable that these are chiefly details of his mechanical inventions, and that all his most valuable mathematical discoveries have been preserved. The following treatises have escaped the ravages of time:—

(1.) *On the Sphere and Cylinder* (περὶ τῆς σφαίρας καὶ τοῦ κυλίνδρου). This treatise consists of two books, dedicated to Dositheus, and containing a number of propositions relative to the dimensions of spheres, cones, and cylinders, all demonstrated in a strictly geometrical method. The first book contains fifty propositions, the most important of which are:—Prop. XIV. on the measure of the curve surface of a cylinder; Props. XV. and XVI. on the surface of a cone; Prop XVII. of a frustrum of a cone; Prop. XXII. of a circle; Prop. XXXV. of the surface of a sphere; and Prop. XXXVII. of the relation between a sphere and its circumscribing cylinder. The second book contains ten propositions, which chiefly relate to plane spherical sections.

(2.) *The Measure of the Circle* (κύκλου μέτρησις) is a short book of three propositions. Prop. I. proves that the area of a circle is that of a triangle whose base is equal to its circumference, and height equal to its radius; Prop. II. shows that the circumference of a circle exceeds three times its diameter by a small fraction, which is less than $\frac{10}{70}$ and greater than $\frac{10}{71}$; and Prop. III. that a circle is to its circumscribing square nearly as 11 to 14. He arrived at these wonderfully accurate results by inscribing in and circumscribing about a circle two polygons, each of 96 sides; and, assuming that the perimeter of the circle lay between those of the polygons, he obtained by actual measurement the limits he has assigned.

(3.) *Conoids and Spheroids* (περὶ κωνοειδέων καὶ σφαιροειδέων) is a treatise in forty propositions, on the superficial and solid dimensions of the solids generated by the revolutions of the conic sections about their axes.

(4.) *On Spirals* (περὶ ἑλίκων), is a book, in twenty-eight propositions, upon the properties of the curve now known as the spiral of Archimedes, which is traced out by a radius vector, whose length is proportional to the angle through which it has turned from the initial position.

(5.) *Equiponderants and Centres of Gravity* (περὶ ἐπιπέδων ἰσορροπικῶν ἢ κέντρα βαρῶν ἐπιπέδων). This consists of two books, and may be called the foundation of theoretical mechanics, for the previous contributions of Aristotle were comparatively vague and unscientific. In the first book there are fifteen propositions, with eight postulates; and demonstrations are given, much the same as those still employed, of the centres of gravity—(1) of any two weights, (2) of any parallelogram, (3) of any triangle, (4) of any trapezoid. The second book is devoted to the finding the centres of gravity of parabolic segments.

(6.) *The Quadrature of the Parabola* (Τετραγωνισμὸς παραβολῆς) is a book in twenty-four propositions, demonstrating that the area of a parabola is $\frac{2}{3}$ of the triangle having its double ordinate for base and abscissa for height. His method of arriving at this result is most interesting, as being a sort of rude approximation to the modern process of area summation by integration. The expedients to which he resorted to avoid the idea of infinity are no less curious than they are admirable.

(7.) *On Bodies floating in Liquids* (Περὶ τῶν ὕδατι ἐφισταμένων), is a treatise in two books, on the principles of floating, and the positions of equilibrium of floating parabolic conoids.

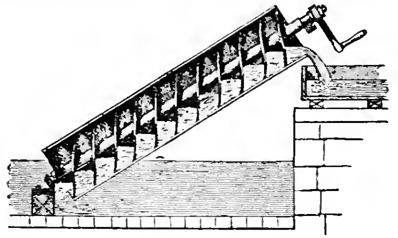
(8.) *The Psammites* (ὁ ψαμμίτης, Lat. *Arenarius*, or sand counter), a small treatise, dedicated to Gelo, the eldest son of Hiero, on arithmetical numeration, applied to reckoning grains of sand, is curious as containing the germ of the modern system of logarithms.

(9.) *A collection of Lemmas*, consisting of fifteen propositions in plane geometry. This has come down to us through a Latin version of an Arabic manuscript, and its authenticity has been questioned.

In the edition of Archimedes, published by Revault at Paris in 1615, the following works are said to be lost:—On the *Crown of Hiero*; on the *Cochleon, or Water-Screw*; on the *Helicon, or Endless Screw*; on the *Trispaston, or Combination of Wheels and Axles*; on the *Machines employed at the Siege of Syracuse*; on the *Burning Mirror*; on the *Machines moved by Air and Water*; and on the *Material Sphere*. We do not know, however, that he ever committed accounts of his mechanical inventions to writing.

The *Edito princeps* of the works of Archimedes, with the commentary of Eutocius, is that printed at Basil, in 1544, in Greek and Latin, by Hervagius. A Latin translation of them was published by Isaac Barrow in 1675 (London, 4to). Nicholas Tartalea (a celebrated algebraist), published in Greek and Latin the treatises on the *Centre of Gravity*, on the *Quadrature of the Parabola*, and on *Floating Bodies* (Venice, 1543). Frederic Commandine edited the beautiful Aldine edition of 1558, 4to, which contains *Circuli Dimensio, De Lineis Spiralibus, Quadratura Paraboles, &c., Conoidibus et Spheroidibus*, and *De numero Arenæ*; and in 1565 the same mathematician published the two books *De iis quæ vehuntur in Aquâ*. The most complete and magnificent edition of the works is that edited by Torelli, and published with the commentaries of Eutocius at Oxford, in 1792, folio. The most valuable edition of the *Arenarius*, which is also the first modern translation of any part of Archimedes, is that published in English by Anderson (London, 1784), with useful notes and illustrations. The first modern translation of the works is the French edition published by F. Peyrard (Paris, 1808, 2 vols. 8vo). A German translation, by Nizze, was published at Stralsund in 1824, and another by Gutenäcker, at Wurzburg, 1828, 8vo. See *Quart. Rev.*, vol. iii. p. 89; Plutarch's *Life of Marcellus*; Pope Blount's *Censura Celebrium Authorum* (London, 1690); the *Arenarius of Archimedes*, Oxford, 1837; *Ed. Rev.*, vol. xi. p. 185; Powell's *History of Natural Philosophy* (Lardner's Cycl.), p. 40.

ARCHIMEDES, Screw of, a machine for raising water, said to have been invented by Archimedes, for the purpose of removing water from the hold of a large ship that had been built by King Hiero. It consists of a water-tight cylinder, enclosing a chamber walled off by spiral divisions running from end to end, inclined to the horizon, with its lower open end placed in the water to be raised. A section of it is shown in the accompanying woodcut. The water, while occupying the lowest portion in each successive division of the spiral chamber, is lifted mechanically by the turning of the machine. Another form of the



Screw of Archimedes.

screw has the spiral revolving free in a fixed cylinder, but neither of the machines is now much used.

ARCHIPELAGO, a name which, though it is now applied to any island-studded sea, was formerly the distinctive designation of what, though still known as the Archipelago, is often distinguished as the Grecian Archipelago, namely, that part of the Mediterranean which lies between Greece and Thessaly on the W. and Asia Minor on the E.—the Ægean Sea (Αἰγαῖον Πέλαγος) of the ancients. Several etymologies of the name have been proposed, as—(1), It is a corruption of the ancient name; (2), it is from the modern Greek, Ἅγιο Πέλαγο, the Holy Sea; (3), it arose at the time of the Latin empire, and means the Sea of the Kingdom (*Arche*); (4), it is a translation of the Turkish name, Ak Degniz, *Argon Pelagos*, the White Sea; (5), it is simply *Archipelagus*, the Chief Sea.

The Grecian Archipelago abounds in islands, of which the following are the chief:—Thaso, near the Rumelian (*Thracian*) coast, opposite the mouth of the Karasu (*Nestus*); Samothraki, fronting the Gulf of Sares; Imbro and Lemnos, in prolongation of the peninsula of Gallipoli (*Chersonesus Thracica*); Skiathos, Skopelo, Celadroni, Peristeria, &c., running out from the southern extremity of the Thessalian coast; Negropont (*Eubœa*), the largest of all, along the east coast of Greece; Skyros, with its satellites, east of Negropont; Mitylene (*Lesbos*) and Chios, off Asia Minor; Samo and Nikari (*Icaria*), in prolongation from Cape St Maria (*Mycale Pr.*); Stancho (*Cos*, ἐσ-τὰν-Κῶ), in the Gulf of Cos, with Kalymno to the north; and finally, the great group of the Cyclades, of which the most important are Andros, Tenos, Myconos, and Delos, in prolongation of Eubœa, Zea (*Ceos*), and Cythnos, running out from the south of Attica, and Melos, Kimolos, Siphnos, Antiparos, Paros, Naxos, Amorgos, Astynactea, forming a curve, from west to east, with its convexity to the north, while to the south are a number of smaller islands. This profusion gives beauty and picturesqueness to the sea, but renders its navigation difficult and dangerous, notwithstanding the large number of safe and commodious gulfs and bays. Many of the islands are of volcanic formation; while others, as Paros, are mainly composed of pure white marble. The larger islands have some very fertile and well-watered valleys and plains. The chief productions are wheat, wine, oil, mastic, figs, raisins, honey, wax, cotton, and silk. The people are employed in fishing for coral and sponges, as well as for bream, mullet, and other fish. The men are hardy, well built, and handsome; and the women are noted for their beauty, the ancient Greek type being well preserved. The Cyclades belong to Greece; most of the other islands to Turkey.

The other Archipelagoes, portions of ocean with numerous islands in close contiguity, as the Indian, Caribbean, Patagonian, &c., will be described in their respective places.

ARCHITECTURE

ARCHITECTURE (Latin *architectura*, from the Greek ἀρχιτέκτων, a master-builder) is the art of building according to principles which are determined, not merely by the ends the edifice is intended to serve, but by considerations of beauty and harmony. It cannot be defined as the art of building simply, or even of building well. The end of building as such is convenience, use, irrespective of appearance; and the employment of materials to this end is regulated by the mechanical principles of the constructive art. The end of architecture as an art, on the other hand, is so to arrange the plan, masses, and enrichments of a structure as to impart to it interest, beauty, grandeur, unity, power. Architecture thus necessitates the possession by the builder of gifts of imagination as well as of technical skill, and in all works of architecture properly so called these elements must exist, and be harmoniously combined. The combination of technical with imaginative features removes architecture from the precise position occupied by painting, sculpture, and music, but does this more in appearance than in reality, since the greatest works of the architect must always be those in which the imagination of the artist is most plainly seen.

Like the other arts, architecture did not spring into existence at an early period of man's history. The ideas of symmetry and proportion which are afterwards embodied in material structures could not be evolved until at least a moderate degree of civilisation had been attained, while the efforts of primitive man in the construction of dwellings must have been at first determined solely by his physical wants. Only after these had been provided for, and materials amassed on which his imagination might exercise itself, would he begin to plan and erect structures, possessing not only utility, but also grandeur and beauty. Before proceeding to inquire into the history of architecture, it may be well to enumerate briefly the elements which in combination form the architectural perfection of a building. These elements have been very variously determined by different authorities. Vitruvius, the only ancient writer on the art whose works have come down to us, lays down three qualities as indispensable in a fine building, viz., *Firmitas, Utilitas, Venustas*, stability, utility, beauty. In an architectural point of view the last is the principal, though not the sole element; and, accordingly, the theory of architecture is occupied for the most part with æsthetic considerations, or the principles of beauty in designing. Of such principles or qualities the following appear to be the most important: size, proportion, harmony and symmetry, ornament, and colour. All other elements may be reduced under one or other of these heads.

Elements of architectural perfection.

Size.

With regard to the first quality, it is clear that, as the feeling of power is a source of the keenest pleasure, size, or vastness of proportion, will not only excite in the mind of man the feelings of awe with which he regards the sublime in nature, but will impress him with a deep sense of the majesty of human power. It is, therefore, a double source of pleasure. The feelings with which we regard the Pyramids of Egypt, the vast monoliths at Rome, the massive temples of Sicily and the Parthenon, and the huge structures of Stonehenge, sufficiently attest the truth of this principle.

The qualities in the general disposition of the parts of a building which are calculated to give pleasure to the beholder, are proportion, harmony, and symmetry. To obtain a clear idea of the general plan in order to appreciate these qualities, the best method is to contemplate the building under conditions that prevent the mind from being disturbed by the consideration of the details—at a distance, for instance, or by moonlight, when its outlines may be seen standing boldly out against the sky. Thus the mass of a Gothic cathedral, the proportion of its parts, the outline of tower, nave, choir, and lady-chapel, the deep shadows which show the projection or recess of its various parts, are in themselves beautiful even when there is not light enough to distinguish mouldings, carvings, or tracery.

Proportion.

Proportion itself depends essentially upon the employment of mathematical ratios in the dimensions of a building. It is a curious but significant fact that such proportions as those of an exact cube, or of two cubes placed side by side—dimensions increasing by one-half (*e.g.*, 20 feet high, 30 wide, and 45 long)—or the ratios of the base, perpendicular, and hypotenuse of a right-angled triangle (*e.g.*, 3, 4, 5, or their multiples)—please the eye more than dimensions taken at random. No defect is more glaring or more unpleasant than want of proportion. The Gothic architects appear to have been guided in their designs by proportions based on the equilateral triangle.

Harmony.

By harmony is meant the general balancing of the several parts of the design. It is proportion applied to the mutual relations of the details. Thus, supported parts should have an adequate ratio to their supports, and the same should be the case with solids and voids. Due attention to proportion and harmony gives the appearance of stability and repose, which is indispensable to a really fine building. Symmetry is uniformity in plan, and, when not carried to excess, is undoubtedly effective. But a building too rigorously symmetrical is apt to appear cold and tasteless. Such symmetry of general plan, with diversity of detail, as is presented to us in leaves, animals, and other natural objects, is probably the just medium between the excesses of two opposing schools.

Symmetry.

Ornament.

Next to general beauty or grandeur of form in a building comes architectural ornament. Ornament, of course, may be used to excess, and, as a general rule, it should be confined to the decoration of constructive parts of the fabric; but, on the other hand, a total absence or a paucity of ornament betokens an unpleasing poverty. Ornaments may be divided into two classes—mouldings and the sculptured representation of natural or fanciful objects. Mouldings, no doubt, originated, first, in simply taking off the edge of anything that might be in the way, as the edge of a square post, and then sinking the chamfer in hollows of various forms; and thence were developed the systems of mouldings we now find in all styles and periods. Each of these has its own system; and so well are their characteristics understood, that from an examination of them a skilful architect will not only tell the period in which any building has been erected, but will even give an estimate of its probable size, as professors of physiology will construct an animal from the examination of a single bone. Mouldings require to be carefully studied, for nothing offends an educated eye like a confusion of mouldings, such as Roman forms in Greek work, or Early English in that of the Tudor period. The same remark applies to sculptured ornaments. They should be neither too numerous nor too few, and, above all, they should be consistent. The carved ox skulls, for instance, which are appropriate in a temple of Vesta or of Fortune, would be very incongruous on a Christian church.

Colour.

Colour must be regarded as a subsidiary element in architecture, and although it seems almost indispensable and has always been extensively employed in interiors, it is doubtful how far external colouring is desirable. Some contend that only local colouring, *i.e.*, the colour of the materials, should be admitted; but there seems no reason why any colour should not be used, provided it be employed with discretion and kept subordinate to the form or outline. This subject is of too much importance to be dismissed summarily here, and will be treated in a supplementary notice at the end of this article.

Rise and progress of the art. As has been already pointed out, the origin of the art is to be found in the endeavours of man to provide for his physical wants. A picturesque account of the early stages in its progress is given by Vitruvius. According to him, man in his primitive savage state began to imitate the nests of birds and the lairs of beasts, and constructed arbours with twigs of trees. To these arbours succeeded huts with walls composed of dried turf, strengthened with reeds and branches. From huts to houses the progress is gradual and easy. Other writers have endeavoured to trace three orders of primitive dwellings—the cave, the hut, and the tent—constructed severally by the tribes who devoted themselves to hunting and fishing, to agriculture, and to a pastoral and nomadic life. There can be no doubt that climate and surrounding circumstances affected not only the form of the primitive, buildings but also the materials employed. Thus, where trees abounded, stone was probably a material seldom used, as it entailed a much greater amount of labour than timber; but as stone would neither burn nor rot, it was preferred for all durable purposes. Where wood was plentiful, as in Greece and in Lycia, stone architecture exhibits traces of an original timber construction. The columns were originally posts, and the architraves and triglyphs beams resting on each other. The Lycian tomb in the British Museum furnishes a strong proof that there the art of the carpenter preceded that of the mason, and suggested forms, which became conventional, and from which the latter could not venture to depart. On the other hand, in the plains of Egypt, where building timber is scarce, and where there is abundance of large stone in the mountains, the mason element seems to have prevailed. In such plains as those of Nineveh and Babylon artificial stone was made from lumps of dried or burnt clay. Finally, in vast sandy deserts, where there are neither trees nor stones, the skins of beasts, sewed together and supported by sticks, formed the earliest shelter. This soon grew into the tent, and its form still influences the architecture of the Chinese and the Tartars. Much ingenuity has been expended in the inquiry whether it was timber or stone that first gave birth to the art of *architecture;* the probability is, that the hut, the cairn, and the tent, all contributed their share in different countries.

No traces remain of the steps by which the beautiful temples of Egypt or the magnificent halls of Persia and Assyria were developed from these rude beginnings. The earliest known structures of those countries belong to an age already considerably advanced in civilisation and in the art of construction. And the history of architecture from its earliest specimens in Egypt is not one continuous line of progress. We can indeed show how from these early structures sprang the art of Greece; how that was modified by the Romans; and finally, how the Pointed architecture of the 13th century arose. But the development is not gradual; it proceeds by a series of steps, and one style does not shade imperceptibly into another. No doubt the architects of each country borrowed somewhat (in detail more especially) from the designs of the adjacent countries; but, nevertheless, each country originated forms peculiar to itself, and in all its artistic efforts continued to repeat and elaborate them. So definite are the characteristics of the styles of different nations, that from the mere form, carving, or decoration of any structure, its age and its architects can, usually, be fairly determined.

PREHISTORIC STRUCTURES.

The numerous relics of structures left by primeval man have generally little or no architectural value. The only interesting problem regarding them, the determination of their date and purpose, and of the degree of civilisation which they manifest, falls within the province of archæology.

The principal specimens of such prehistoric erections may be classified thus—

(1.) *Monoliths* (*Maenhir*, from *Maen*, a stone, *hir*, high), or single upright stones (fig. 1). The best example is at Carnac, in Brittany. This huge stone, when perfect, was 63 feet high, and 14 feet in diameter at its widest part. It is rudely shaped to a circular form, and weighs about 260 tons.

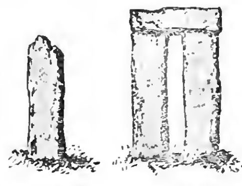


FIG. 1.—Maenhir and Trilithon.

(2.) *Cromlechs*, table-stones, generally consisting of one large flat stone supported by others which are upright (fig. 2). The cromlech is also named *Dolmen*, from *Taal*, or *Daul*, a table, and *Maen*, a stone. A good example of the cromlech is the structure known as "Kit's Coity House," near Maidstone. Other examples occur in different parts of Great Britain and Ireland, and numerous specimens are found in Algeria, in India, in the country east of the Jordan, in Guernsey, and near Saumur, on the Loire.

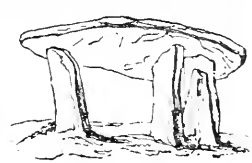


FIG. 2.—Dolmen.

(3.) *Circles of Stone.*—The most important specimen of these in Britain is Stonehenge (fig. 3). Others are found at Avebury, in Wiltshire (fig. 4); at Stanton Drew, in Somersetshire; at Stennis, in Orkney; and at Callernish, in Lewis; and several have been discovered in the districts around Mount Sinai and Aden. In some circles, as at

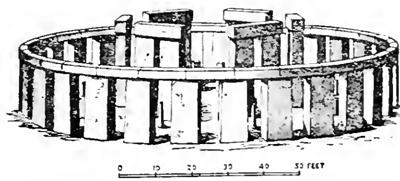


FIG. 3.—Stonehenge (restored, after Inigo Jones).

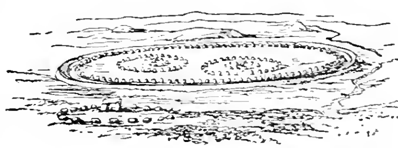


FIG. 4.—Circles of Avebury (restored). From Waring's *Stone Monuments*.

Stonehenge, as well as separately, are found trilithons (fig. 1), which appear to be a modification of the dolmen.

(4.) *Tumuli.*—These include the *beehive huts*, so called from their shape, found scattered throughout Cornwall, Wales, and Scotland (fig. 5). Similar, but superior, edifices are to be met with in Ireland; and of these, New Grange, near Drogheda, apparently a burial mound, is the finest specimen (fig. 6). The design of the

FIG. 5.—Beehive Hut, Lewis. From Waring.

FIG. 6.—Section of chambered Burial Mound, New Grange, Ireland. From Waring.

FIG. 7 —"Nurhag," near Isili, Sardinia. From Waring.

"nurhags" (fig. 7), which are found in great numbers in the island of Sardinia, has greatly puzzled archæologists. It has been conjectured that they were sepulchres, the dead

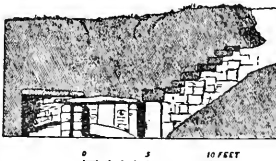


FIG. 8.—Section of Pict's House, Pierowall, Orkney. From *Archæologia*, vol. xxxiv. pl. 17.

being exposed on their summits. Of the so-called "Picts' houses" of the Orkney Islands, some are chambered tumuli, while others may be more properly described as underground dwellings (fig. 8).

(5.) *Wooden huts*, the submerged remains of which have been recently discovered in the lakes of Switzerland, as well as in Sweden, in Italy, and in Ireland. These erections, which rose on piles just above the surface of the water, present no features of architectural interest.

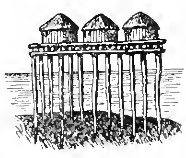


FIG. 9.—Lake Dwellings, or Crannoges, Lake Ardakillin, Roscommon. From Troyon's *Hab. Lacustres*, 1860.

A specimen of prehistoric sculpture, on stone, taken

FIG. 10.—Ancient Swiss Lake Dwellings. From Troyon's *Hab. Lacustres*, 1860.

from ruins in the island of Gozo, in the Mediterranean, is given in fig. 11.

Prehistoric remains are separated by a wide gulf from those which now fall to be noticed, inasmuch as, whether or not they led, by improvement in their forms, to anything really architectural, no evidence remains of such progress, and they must therefore be regarded as practically dissociated from anything that we have now to describe.

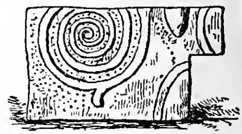


FIG. 11.—Ornaments on stone, Gozo. From Waring.

EGYPTIAN ARCHITECTURE.

For the beginnings of the art—its earliest efforts, grand even in their infancy—we must turn to Egypt.

A short description of the general configuration of the country may be useful here. Its habitable land is a narrow strip a few miles wide, extending from the Nile, on one or both its banks, to the rocks or desert. About 100 miles up the river is Cairo, and close to it Memphis, the old capital of Lower Egypt, Heliopolis, and the great pyramids of Ghizeh, Abooseer, Sakkara, and Dashour; 450 miles higher up the river is the site of the great Thebes, with Karnak and Luxor on the right or eastern bank, and Medinet Haboo on the west. Beyond this in succession are Esne, Edfoo, Elephantina, Syene, and Philæ, close to the first cataract. Higher up (in Nubia) are the great caves of Aboosimbel, and at a still greater distance the pyramids of Meroë, or Dankelah. The rock is generally limestone up to Thebes, sandstone and breccia to Syene, where the well-known variety of granite, with hornblende, is found; these with the addition of unburnt brick, are the chief materials used in the construction of the Egyptian architectural monuments. The granite was principally supplied by the quarries at Elephantina and Syene, for which the Nile offered a ready mode of conveyance, although it appears that the obelisks and other enormous blocks were sent by land. Some species were brought down the river from Ethiopia, but we do not find that the materials were brought from any other foreign country. It may be remarked, too, that in the earliest structures the common *grès* or sandstone is principally employed. Excepting the obelisks and some few of the propylæa, all the temples at Thebes are of that material. In Lower Egypt, on the contrary, and in the works of later date generally, almost everything is constructed of granite.

It seems quite certain that Egyptian art is original and not derived from that of India; and it may be concluded with great probability that the structures of Egypt are the oldest specimens of architecture in the world. The origin of the structures themselves has been matter of some discussion. By several writers it has been thought that the rock-cut caves of Upper Egypt were the earliest efforts of architectural design, and furnished models for the enormous piles raised along the banks of the Nile. An examination of these caves, however, will show clearly that the very reverse is the case, and that the carvings of the excavations are imitated from the above-ground buildings.

The oldest works of the Egyptians, according to Herodotus, were the embankment of the Nile by Menes, the foundation of the city of Memphis, and the commencement of a temple to Vulcan. Next we learn from Manetho, as cited by Eusebius, that Venephes, the fourth king of the first dynasty, built some pyramids at a place called Cochomen, but this is all we know of them. Eusebius further records that Tosorthus, or Sosorthus, the second king of the third dynasty, found out how to build with polished or smooth stone (*καὶ τὴν διὰ ξεστῶν λίθων οἰκοδομὴν εὕρετο*).

Great Pyramid.

The next structure of which we have notice is the Great Pyramid, the most gigantic work in the world—one which never has been, and perhaps never will be surpassed. At this time the Egyptians must have reached a proficiency in the mechanical arts of which we can form no conception. They seem to have been able to quarry rocks of the hardest stone, even granite—to transport them to great distances—to raise huge blocks, vast monolith obelisks, that would puzzle our engineers with their best tackle—and, more wonderful still, they appear to have had the power not only of polishing granite, but of carving on that most stubborn material with the utmost facility, large surfaces and even huge statues being covered with hieroglyphics of the most minute kind and of the highest finish. It is impossible to discover how this was done, for though Herodotus (ii. 124, 125) tells us they had iron tools, it was long before the conversion of that metal into steel had been found out; and with all the best modern tools of steel, it is difficult and costly to carve even plain letters in granite. According to the account of Herodotus, the occasion of the erection of this great work was the caprice of a king, Cheops, who is supposed to be the Suphis of Syncellus, and the Chembes of Diodorus. This king was a tyrant of the very worst kind; he closed all the temples throughout Egypt, forbade every sort of religious observance, and forced all his subjects to labour for him as he pleased. Among other whims, he determined to build this pyramid as a tomb for himself. The stones were quarried in the Arabian mountains, and none were less than 30 feet long. They were then conveyed by the Nile to a newly-constructed road, three-quarters of a mile long, 60 feet broad, and in a cutting of 48 feet. This road, of polished stone, and carved with figures, took ten years to complete. Twenty years were spent in building the pyramid itself.

The site of this extraordinary structure is at Ghizeh, in the neighbourhood of Cairo. The base was, Herodotus tells us, 8 plethra (about 808 English feet) square, and the height the same. This, however, is not the case, the Greek author having probably measured the sloping edge. The dimensions are variously given by the various persons who have measured it. M. Nouet, who was of the French commission in Egypt, and had perhaps the best means of ascertaining the truth, states its base to be a square whose side is 716 French or 768 English feet, and gives the height as 421 French or 452 English feet. The dimensions of the pyramid in its original state, as given by Colonel Vyse, are 764 feet length of base, 720 feet slant side, and 480 feet high. According to Sir Henry James (*Notes on the Great Pyramid*, 1869), the side of the base is 760 feet; while Professor Piazzi Smyth gives this as 763·81, and the height as 486·2567. The pyramid thus covers upwards of 13 acres, and is about 150 feet higher than St Paul's cathedral. As compared with the largest building in the world, St Peter's, Rome, the Great Pyramid covers an area which is as 58 to 22, or nearly three times as much, and is 50 feet higher. Like almost all the other pyramids, its sides face the cardinal points, and it is entered from the north by a descending passage, which leads to a few small chambers or cells, the largest of which is but 17·7 feet wide. In one of these a solitary sarcophagus was found. The pyramid appears to be a solid mass of stone, and is built in regular courses or layers, which vary in thickness from 2 to 5 feet, each receding from the one below it to the number of 202; though even this is variously stated from that number to 260, as indeed the height is given by various modern travellers at from 444 to 625 feet. And the ancient writers differ as widely both among themselves and from the moderns. On the top course the area is about 10 English feet square, though it is believed to have been originally two courses higher, which would bring it to the smallest that in regular gradations it could be. This vast erection, on which the labours of 100,000 men were bestowed for twenty years, and which contains 85 millions of cubic feet of stone, must have cost (reckoning quarrying, transport—twice by land and once by river—squaring, hoisting, and setting at 2s. per foot) something like $8\frac{1}{2}$ millions of English money.

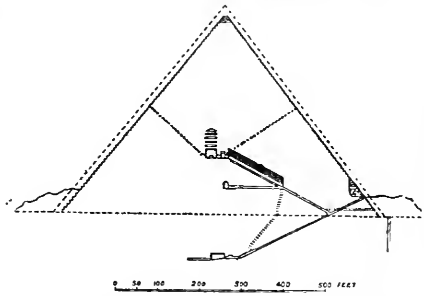


FIG. 12.—Section of Great Pyramid. From Vyse's *Pyramids of Ghizeh.*

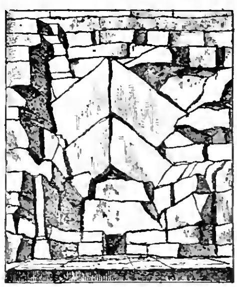


FIG. 13.—Entrance to Great Pyramid of Gizeh.

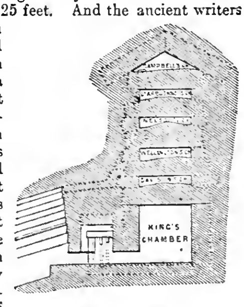


FIG. 14.—Part Section of Great Pyramid. From Vyse.

Other pyramids. A second pyramid, close to the first, was built by the successor of Cheops, whom Herodotus calls Chephren; the inscriptions on the stones, however, give the name Shafra. The side of its base is about 60 feet less than that of the former. About forty years later, Mycerinus, or Mencheres, built a third; but the side of the base is only about 364 feet, or less than half that of the Great Pyramid. It was, however, entirely faced with polished granite, while the others were of limestone. A statue of King Chephren has recently been found in a temple close adjacent to the pyramids, and now forms one of the most remarkable objects in the museum at Cairo. Canina (*Architectura Antica*, part i.) has described altogether twenty large and twenty-seven small pyramids, some not more than 30 feet square. But the researches of Lepsius and others prove that the number is much greater than this, and on the range of cliffs overlooking the Nile, from Aboorwash in the north to Illahoon in the south, the number is probably not under 100.

Design and construction of the pyramids. A great deal of trouble has been taken to discover the principles on which the Egyptians planned these erections. The most reasonable theory is that each side was meant for an equilateral triangle, four of which, laid sloping and brought to a point, would compose the pyramid; but neither the dimensions nor the angles agree with this. It is true that the sides of the three great pyramids have an angle with the horizon of from 51½° to 52½° or thereabouts; but those at Abooseer and at Sakkara, as given by Canina, measure 55°, while at Barkal, near Meroë, the angle is no less than 72°. At Dashour the pyramid has a slope about half way up of 53°, which afterwards is flattened to 44°. At Meydoum there is a pyramid in three great steps. If,

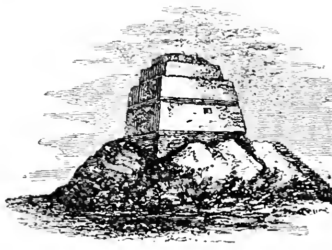


FIG. 15.—Pyramid of Meydoum. From Vyse.

therefore, the Egyptians had begun to work on the above theory, they departed from it in many notable instances.

The following seems to have been the manner in which the pyramids were generally constructed. A level platform was cut in the rock, a portion of which was, however, left in the centre above the general level to serve as a sort of core to the pyramid. A deep chamber was then sunk in the rock, with a passage leading from it always on the north side, and usually at an angle of 26° to 28°, to the surface of the ground. It is curious that these passages were almost always of one dimension, viz., 3 ft. 5 in. wide, and 3 ft. 11 in. high. Over the chamber was built a mass of masonry, which was gradually added to at the side and top, according to the power, or the wealth, or the length of life of the founder. Finally, the angles of the stones were cut off to the proper slope, or a casing added, and the pyramid thus completed from the top. Some of the casings were highly finished. Those of the first and second pyramid were of polished stone; that of the third was of polished granite. Occasionally, as in the Great Pyramid, and in the southern one at Dashour, there was a chamber built above the one which was cut in the rock. Their entrances were carefully concealed, and even the doors of the chamber defended by gigantic portcullises of granite, some 8 to 10 feet square, weighing 50 to 60 tons, so as to render the security of the chambers as great as possible. Yet every chamber in the chief pyramids, at least, except perhaps "the false one" at Meydoum, has been rifled ages ago, and so the great purpose of their erection utterly set at nought. Most of the sarcophagi which they once contained have also been carried away. One, that of Mycerinus, was lost in its passage to England; but the mummy-case and mummy which it contained are now in the British Museum. The sarcophagus of the Great Pyramid still rests in its chamber. An extra interest belongs to the third pyramid (of Mycerinus) owing to its chamber being ceiled with a pointed arch. But it is not a true arch, the stones being merely strutted against each other, as over the entrance to the Great Pyramid (see fig. 13 *supra*), and the underside cut to the above form. The chamber of a pyramid at Sakkara was lined with blue and white tiles like the Dutch style; and at the false one at Meydoum there is, about two-thirds up, a band about 12 feet wide, left rough all round, and it has been supposed that this may have been left as a ground for decoration. But there is nothing to prove this. Herodotus, however, expressly says that the exterior was richly sculptured, and a model of a pyramid that is to be seen at the Museum of Cairo bears out his statement. The construction of pyramids seems to have ended in Lower Egypt at a very early date, with the old dynasty of Memphis. But some of crude brick, and containing arched chambers, are found at Thebes, and are supposed to be of date about 1200 B.C. Many similar structures, but on a very much smaller scale, were erected in Ethiopia and Meroë down to about 700 B.C.

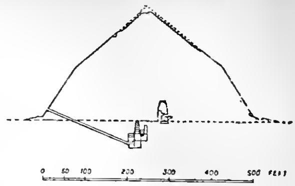


FIG. 16.—Section (facing east) of South Stone Pyramid at Dashour. From Vyse.

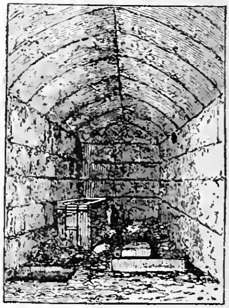


FIG. 17.—Sepulchral Chamber, Third Pyramid. From Vyse.

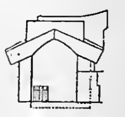


FIG. 18.—Section of Sepulchral Chamber, Third Pyramid. From Vyse.

Many theories have been stated as to the purposes for which these gigantic monuments were erected, but the opinion of M. Mariette, the latest, as well as one of the most learned writers, may be taken as correct, viz., that every pyramid was a tomb and the gigantic enclosure of a mummy. It is certain that every pyramid is on the western bank of the Nile, the region of the setting sun, and thus associated by the Egyptians with the regions of death, and that each group of pyramids is the centre of a necropolis

Next to the pyramids in massive grandeur comes the Great Sphinx, and an additional interest has lately been associated with this statue, from the finding of an inscription, which seems to prove that it was sculptured before the time of the builder of the first pyramid. The Egyptian sphinx was quite different from the Greek, which usually had a female head on the body of a winged lion, whereas the Egyptian was wingless, and had usually the head of a man, bearded and capped, and thus represents strength and wisdom. Those with the head of a ram, or crio-sphinxes, are supposed to be dedicated to Ammon (Jupiter Ammon); those with the head of a hawk are called hieraco-sphinxes, and are sacred to Ra, or the sun. The

FIG. 19.—Figures at Thebes.

Great Sphinx at Ghizeh has the body of a lion crouching close to the ground; the height from the floor, or platform on which it lies, to the top of the head is 100 feet: the total length is 146 feet; across the shoulders it measures 34 feet. The head, from the top to the chin, is 28 feet 6 inches, and is calculated to be 40,000 times the bulk of an ordinary human head. A small temple or sanctuary was built between its paws. With the exception of this, and the paws themselves, which are of masonry, the whole appears to be carved out of the solid rock. Indeed, it may safely be assumed to be solid; for Colonel Vyse drilled a hole 27 feet deep into the shoulder, and found that, so far at least, it was so.

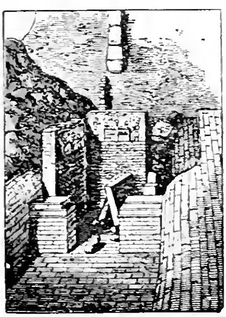


FIG. 20.—Temple between paws of Great Sphinx. From Vyse.

Serapeum.

Another grand memorial of the old dynasty must be mentioned, viz., the Serapeum, near the pyramid of Sakkara, discovered in 1851 by M. Mariette, and excavated 30 feet deep in the solid rock. It contains the mummies of the sacred bulls, placed in gigantic sarcophagi, 11 feet high, 7 to 8 feet wide, and 13 to 18 feet long, each of which is placed in a chamber. The chambers, forty in number, are excavated on each side of galleries about 12 feet wide, the ceilings being *cut* (not *built*) to the form of an arch.

No great distance beyond Sakkara, in the district called the Fayoom, was the famous Labyrinth, an immense mass of buildings mentioned by Herodotus as the palaces built for the twelve kings. From his description of it this appears to have been as great a work and as great a wonder as the pyramids themselves. It was close to Lake Mœris, and contained in the time he wrote 3000 chambers, half above and half below ground, besides immense halls, corridors, courts, gardens, &c. The roofs were wholly of stone, and the walls covered with sculpture. On one side stood a pyramid 40 orgyiæ, or about 243 feet high. It appears from the ruins that huge masses of buildings once occupied three sides of an open quadrangle, about 200 yards square in the inside—the two wings being about 300 yards long, and the third side about 400, measured on the outside. The pyramid, as stated by the various authorities, occupied the greater part of the fourth side, and measured about 348 feet square. There are a multitude of small chambers in two stories, as described by Herodotus, and Canina supposes there was a third story above these supported on columns—a sort of open gallery.

Tombs.

TOMBS.—The great reverence paid by the Egyptians to the bodies of their ancestors, and their careful preservation of them by embalmment, necessitated a great number and vast extent of tombs. Some of these, erected long after the building of pyramids had ceased, are built up above ground; others are caves cut in the sides of rocks; others are passages tunnelled under ground to a great extent. The tombs above ground have been for the most part destroyed. But some very interesting ones are found near the Great Pyramid. They are of well-squared stone, in the form of truncated pyramids; the tops are level, and they show no appearance of anything having been built above them. But there must have been a covering of some kind, as pits, leading to sepulchral chambers beneath, are cut down directly from the surface level. The most curious tomb at Ghizeh is known as Campbell's, of the supposed date of about 660 B.C. It is an open excavation, 53 ft. 6 in. deep, 30 ft. by 26 ft. 3 in. on plan, with niches, &c., leading out of it. In these were found four sarcophagi, one of which, of basalt, is in the British Museum. This excavation is supposed, from some indications left of a springing stone, to have been covered by an arch. If so, this would be the oldest known stone arch of a large size. In fact, it is difficult to imagine any other way in which this large excavation could have been covered. But the special object actually found was a tomb built up in the centre of the excavation, of good masonry,

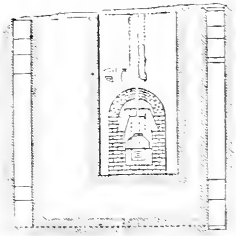


FIG. 21.—Campbell's Tomb; section looking west. From Vyse.

covered by three stones as struts, over which was a perfectly formed voussoired arch. This arch was destroyed not long ago by the Egyptian Government, in order to build a mill. Outside the whole excavation was a deep trench 5 ft. 4 in. wide, and 73 feet deep, from which branch out a number of chambers. This excavation was probably finished above with some such truncated pyramid as we have already described.

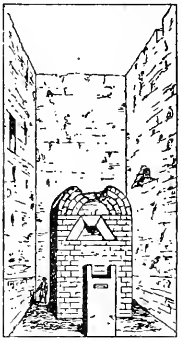


Fig. 22. Building in Campbell's Tomb. From Vyse.

Even more interesting are the tombs at Beni Hassan and Thebes. There is little attempt at architectural decoration in these, except the facade and some columns cut in the rock inside; but they are filled with the most interesting paintings, representing even the minutest incidents of private life. A model of one was exhibited in London by Belzoni; and there is a valuable series built up, and painted in fac-simile, in the Vatican at Rome. It appears that as soon as a king succeeded to the throne, the excavation of his tomb commenced, and proceeded year by year till his death. Canina has given plans and sections of several of the royal tombs, extending from 250 to 400 feet direct into the solid rock. Several of these tombs at Beni Hassan have external facades high up in the cliffs, consisting each of two columns *in antis*, to which we shall have again to refer when treating of the origin of the Grecian Doric. Others, as at Ghizeh and Sakkara, have their entrances level with or below the ground, and without external decoration; whilst others, as at Thebes, have their entrances high up in the face of the cliffs, and not only without ornament of any kind, but closed up as if for purposes of concealment. But each, no matter of what size or description, had one or more chambers or corridors, in the floor of some one or other of which was sunk a deep pit. Leading out of this pit, again, were other chambers, in one of which was deposited the sarcophagus. When this was done the pit was filled up so as to render the concealment of the place of sepulture as complete as possible. One of the grandest at Thebes is that of a priest, otherwise unknown to fame, which comprises a series of halls, passages, and chambers, at various levels, branching off in one place three different ways. In all, it is 862 feet long, and the part actually excavated occupies an area of 23,000 feet.

Many of the paintings already alluded to are often simply executed in colour, but others are emphasised by being sculptured also in slight intaglio. This came into use, it would seem, about the 14th century B.C., the earlier work being in relief. The stone was usually prepared for painting by being covered with a very thin fine stucco. Even the fine granites were so covered sometimes, and the woodwork also. Imitations of costly woods, &c., are to be found even at this early time.

Temples.

TEMPLES.—The Egyptian temples range from the time that Thebes became the capital (about 2000 B.C.) down to the time of the Cæsars.

Of all the temples, the most remarkable is perhaps the rock-cut one of Aboosimbel, in Nubia, supposed to have been excavated in the 14th century B.C. The façade was cut in the steep face of a rock, the entrance doorway being flanked by two gigantic statues (66 feet high) on each side. The main feature internally was a grand hall supported by two rows of detached piers, in front of each of which is a statue 17 ft. 8 in. high. Another remarkable temple exists at Ghizeh, built up within a great excavation in the rock; here was found the statue of Chephren before mentioned. The temple is lined with immense blocks of polished granite, as are also the piers, each of these being of one stone about 15 feet high, 5 feet wide, and 3·2 thick. Over this structure there was clearly another, above ground, as extensive remains of fine stone-walling still exist. This singular edifice is without inscription of any kind, and evidently was connected in some way with sepulture, as tomb-chambers lead out of it. The apparently great antiquity of these and other excavations lent countenance to the theory to which we have before alluded, viz., that the origin of Egyptian art is to be found in them. But the evidence before us distinctly shows that all the forms used in the great excavations at Aboosimbel, Thebes, Beni Hassan, and other places, are clearly copied from built buildings. Thus, we have the ceilings arched out of the solid rock, or formed with clear imitations of beams, squared or round, also cut out of the rock, just as square beams or round logs were used in ordinary buildings; and so with the other parts of the excavations.

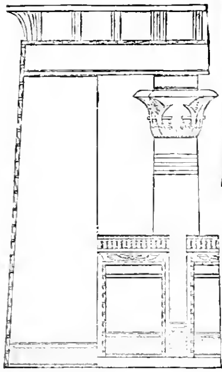
The grandest architectural efforts of the Egyptians are shown in their built temples, whose construction ranges from the time at which Thebes became the chief capital (about 2000 B.C.) down to so late even as the time of the Cæsars. Sir Gardner Wilkinson, in his *Architecture of Ancient Egypt*, gives a very full account of these edifices, and classifies them thus:—1. *Sanctuary Temples*, or those with only one single chamber. 2. *Peripteral Temples*, or the like, but surrounded with columns. 3. *Temples in Antis*, with a portico of two or four columns in front. 4. Those with porticos of *many* columns, as Esne, Dendera, &c., and many inner chambers. 5. Those with large *courts*, and with *pyramidal towers* or propylons in front. The earliest temples were small, consisting of a simple chamber to hold the statue of the deity, with one opening or doorway in front, through which the votary might look, and with an altar for sacrifice. They were sanctuaries into which only priests might enter. The building was surrounded with a wall of brick forming a court or temenos, which was entered by a tall stone gateway or propylon, and was often planted with trees. In process of time these temples were enlarged, and there were added chambers for the priests, and large doorways flanked by towers with sloping sides (Plate VII. fig. 5), and sometimes by a portico or pronaos (fig. 2) supported by columns. The vestibule, or court-yard, was surrounded by a colonnade (fig. 4); the propylon was of gigantic proportions, and full of chambers (figs. 1, 4). The sanctuary, *adytum*, or σηκος (fig. 4), still contained the idol and its altar. Across the court, and, in fact, sometimes for an immense distance outside, there was a δρόμος, or avenue of sphinxes, through which processions defiled. At the commencement of this avenue there was frequently an open or hypæthral building, or peristyle of columns, where it is supposed the processions assembled and were marshalled. This building is called a canopy by Sir Gardner Wilkinson.

The pyramidal form of the propylæa, peculiar to Egyptian temples, may have been suggested by the pyramids, as neither that form nor those adjuncts to a temple appear to have been used before the period at which it is supposed the former were constructed. The grandeur and dignity inherent in that form would indeed hardly be suspected till its appearance in the pyramids themselves; and certainly the impression of its effect must have been strong, to induce men to seek it in a truncated pyramid under a very acute angle, as in the propylæa, relying on the effect of

EGYPTIAN.

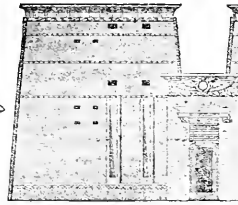
Plan, Section and Elevations of the Temple of Apollinopolis Magna at Edfou.

Fig. 5.



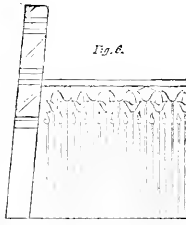
Part of Elevation of Pronaos on an enlarged scale.

Fig. 1.



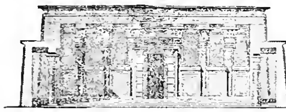
Elevation of Propylon.

Fig. 6.



[illegible] of Fig. 1. on an enlarged scale.

Fig. 2.



Elevation of Pronaos. (Section on the line B.B. of Plan.)

Fig. 7.

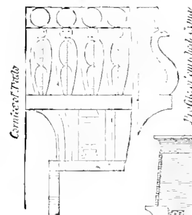
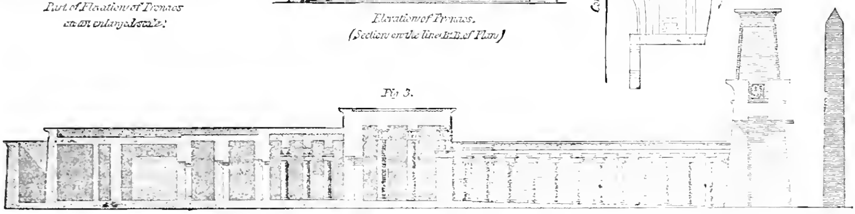
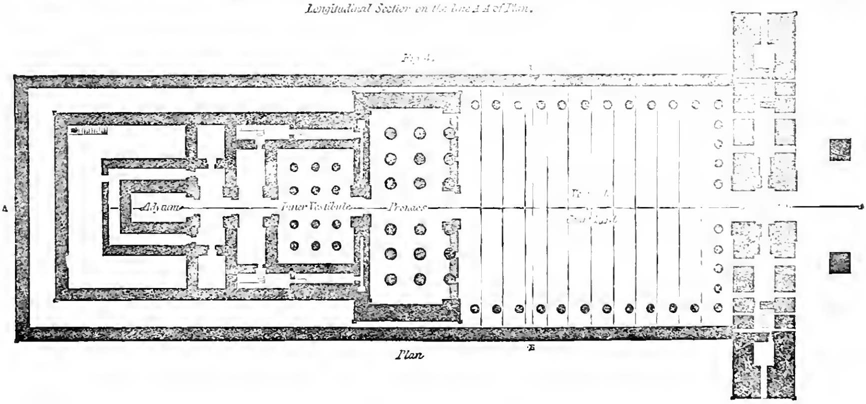


Fig. 3.



Longitudinal Section on the line A A of Plan.

Fig. 4.



Plan

its outline alone. It was gradually, too, that this tendency was generally applied, for in the earliest Pharaonic structures the vertical outline is most common, except in the propylæa, where they exist; and in the structures of the Ptolemies the inclined outline pervades everything. The larger and more perfect structures do not externally present the appearance of being columned, a boundary wall or peribolus girding the whole, and preventing the view of any part of the interior,—except perhaps the towering magnificence of some inner pylones; of the lofty tops of an extraordinary avenue of columns, with their superimposed terrace; of the tapering obelisks which occupy, at times, some of the courts; or of a dense mass of structure, which is the body of the temple itself, enclosing the thickly columned halls. The immense magnitude of these edifices may perhaps have made them, in their perfect state, independent of considerations which have weight in architectural composition at the present time, and on which indeed its harmony depends. The various portions of the same temple differ in size and proportion; whence it happens that the cornices of the lower parts abut indefinitely against the walls of the higher, while the latter are not at all in accordance among themselves.

Temple of Edfoo. Plate VII. The structure selected here to exemplify Egyptian architecture, and figured in elevation, plan, and details in Plate VII., though not ranked among the Pharaonic monuments, is perfectly characteristic of the style and arrangement of Egyptian temples, and is a more regular specimen than any other possessing the national peculiarities. It is known as the temple of Apollinopolis Magna, or of Edfoo, in Upper Egypt, on the banks of the Nile, between Thebes and the first cataract. It has recently been cleared out, and its magnificent ruins now stand forth grandly and clearly.

The plan of the enclosure behind the propylæa is a long parallelogram, the moles or propylæa themselves forming another across one of its ends. The grand entrance to the great court of the temple is by a doorway between the moles, to which there may have been folding gates, for the notches, as for their hinges, are still to be seen. Small chambers, right and left of the entrance, and in the core of the propylæa, were probably for the porters or guards of the temple: a staircase remains on each side, which leads to other chambers at different heights. To furnish these with light and air, loop-holes have been cut through the external walls, disfiguring the front of the structure. The grand doorway (fig. 4) is about 50 feet high, and is flanked by two massive towers 110 feet high. The whole facade measures about 250 feet, or about 70 feet longer than that of St Paul's. The propylon is covered with numerous figures, all of colossal proportions, and some as high as 40 feet. The court is 160 feet by 140, and is surrounded on three sides by columns 32 feet high, forming a covered gallery. The pronaos, or covered portico, measures 110 feet by 44, and consists of three rows of six columns, each 34 feet high, parallel and equidistant, except in the middle, where the intercolumniation is greater, because of the passage through. The front row of columns is closed by a sort of breastwork or dado, extending to nearly half their height, in which moreover they are half-imbedded; and in the central opening a peculiar doorway is formed, consisting of piers, with the lintel and cornice over them cut through, as exhibited in the elevation of the portico. From the pronaos another doorway leads to an atrium or inner vestibule, consisting of three rows of smaller columns, with four in each, distributed as those of the pronaos are. Beyond this vestibule there are sundry close rooms and cells, with passages and staircases which were probably used for storing the sacred utensils. The insulated chamber within the sixth door was most probably the adytum, or shrine of the deity or deities to whom the temple was dedicated. It measures only about 33 feet by 17 feet, while the whole edifice within the walls covers about as much ground as St Paul's, London.

The longitudinal section of the edifice (fig. 3) shows the relative heights of the various parts, and the mode of constructing the soffits or ceilings, which are of the same material as the walls and columnar ordinances; that is, in some cases granite, and in others freestone. The elevation of the pronaos (fig. 2) shows also a transverse section of the colonnades and peribolus. It displays most of the general features of Egyptian columnar architecture; the unbroken continuity of outline, the pyramidal tendency of the composition, and the boldness and breadth of every part. The good taste with which the interspaces of the columns are covered, may be remarked. Panels standing between the columns would have had a very ill effect, both internally and externally; and if a continued screen had been made, the effect would be still worse, as the columns must then have appeared from the outside absurdly short; but as it is, their height is perfectly obvious, and their form is rendered clear by the contrast of light and shade occasioned by the projection of the panels, which would not exist if they had been detailed between the columns. The lotus ornament at the foot of the panels is particularly simple and elegant; and nothing can be more graceful and effective than the cyma above their cornice, which is singularly enriched with ibis mummy-cases (figs. 6 and 7). The jambs forming a false doorway in the central interspace are a blemish in the composition; they injure it very much by the abruptness of their form, and their want of harmony with anything else in it. The front elevation of the moles or propylæa (fig. 1) with the grand entrance between them, is peculiarly Egyptian; and very little variety is discoverable between the earliest and latest specimens of this species of structure. It is an object that must be seen to be appreciated; simplicity and an inherent impressiveness in the pyramidal tendency are all on which it has to depend for effect, with the exception of its magnitude. The projecting fillet and coving which form a cornice to the structures, though large and bold, appear small and inefficient when compared with the bulk they crown; and there is nothing particularly striking in the torus which marks the lateral outline and separates the straight line of the front from the circular of the cornice. Neither are they dependent for their effect on the sculpture, for their appearance is as impressive at a distance, which makes the latter indistinct, as when they are seen near at hand.

A portion of the portico is given on a larger scale (fig. 5), to show more clearly the forms and arrangement of Egyptian columnar composition. The shaft of the column in this example is perfectly cylindrical. It rests on a square step, or continued stylobate, without the intervention of a plinth or base of any kind; and it has no regular vertical channelling or enrichment, such as fluting, but is marked horizontally with series of grooves, and inscribed with hieroglyphics. The capitals are of different sizes and forms in the same ordinance. In this example the capital, exclusive of its receding abacus, is about one diameter of the column in height. Its outline is that of the cyma, with a reversed ovolo fillet above, and its enrichment consists principally of lotus flowers. The capital of the column next to this (fig. 2), in the front line, is much taller, differently formed, and ornamented with palm leaves; the third is of the same size and outline as the first, but differently ornamented; and the corresponding columns on the other side of the centre have capitals corresponding with these, each to its fellow, in the arrangement. Above the capital there is a square block or receding abacus, which has the effect of a deepening of the entablature, instead of a covering of the columns, when the capitals spread, as in this case. In the earlier Egyptian examples, however, in which the columns are swollen, and diminished in two unequal lengths, the result is different, and the form and size of the abacus appear perfectly consistent. The height of this column and its capital, without the abacus, is six diameters. The entablature consists of an architrave and cornice, there being no equivalent for the frieze of a Greek entablature, unless the coving be so considered, in which case the cornice becomes a mere shelf. The architrave, including the torus, is about three-quarters of a diameter in height, which is half that of the whole entablature. The architrave itself is in this example sculptured in low relief, but otherwise plain. The torus, which returns and runs down the angles of the building, is gracefully banded, something like the manner in which the fasces are represented in Roman works. The coving is divided into compartments by vertical flutes, which have been thought to be the origin of triglyphs in a Doric frieze; but these are arranged without reference to the columns, and are in other respects so totally different from them as to give but little probability to the suggestion. The compartments are beautifully enriched with hieroglyphics, except in the centre, where a winged globe is sculptured, surmounting another on the architrave, as shown in the elevation of the pronaos. The crowning tablet or fillet is quite plain and unornamented. Angular roofs are unknown in ancient Egyptian buildings, and consequently pediments are unknown in its architecture.

Temple at Karnak. The temple at Edfoo, though its dimensions are considerable, is small when compared with that at Karnak. This covers about 420,000 feet, or five times as much as St Paul's, London, and more than twice as much as St Peter's at Rome. The propylon is 370 feet long, or twice as much as that of St Paul's. The hypostyle hall,[1] a parallelogram of about 342 feet long, and 170 feet wide, is the most wonderful apartment in the world. It has fourteen rows of columns, nine in each row, and 43 feet high; and two rows, six in each, of the enormous height of 62 ft., 11 ft. 6 in. in diameter, and carrying capitals which measure 22 feet across. This hall (with the two gigantic pylones) is said to cover 4000 superficial feet more than St Paul's. Beyond it is the adytum or shrine, a small apartment, measuring only 26 feet by 16 feet.

In many cases the temples want the peribolus and propylæa, the edifice consisting of no more than the pronaos and the parts beyond it. In others, particularly in those of Thebes, this arrangement is doubled, and there are two pairs of the colossal moles, and another open court or second vestibule intervening between them and the portico. The central line across the courts is formed by a covered avenue of columns, of much larger size than ordinary; and the galleries around are of double rows of columns instead of one row with the walls. The obelisks indicated in the plan and section of Edfoo (Plate VII.), before the propylæa, occupy the situation in which they are generally found, though in this case there are none. Colossal seated figures are sometimes found before the piers of the gateway; and from them, as a base, a long avenue of sphinxes is frequently found ranged like an alley or avenue of trees from a mansion to the park gate, straight or winding, as the case may require.

Statues. STATUES.—Connected with the temples, and forming an important part of their decorative features, were gigantic statues and obelisks. The statues are of enormous proportions. The sitting figure of Memnon is about 53 feet without the pedestal; and that in the sepulchre of Osymandyas (the Memnonium) is nearly 60 feet high. The face of Memnon is 7 feet high, and the ear 3 feet 6 inches long, and the shoulders measure nearly 26 feet across.

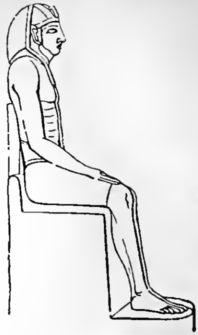


FIG 23.—Sitting Figure of Memnon.

Obelisks. OBELISKS.—The obelisks of Egypt are generally huge monoliths of red granite or syenite. Their use originated, no doubt, in the custom of setting up stones to commemorate particular events. The Egyptians embellished these stones, first, by working them to a fine face, and afterwards by covering them with carvings. They stand frequently in pairs before the propylon of the temples, as at Karnak and at Philæ. After the conquest of Egypt the emperors transported many of these monuments to Rome. At the time the celebrated *Regionaries* (accounts of each of the wards or *Regiones* of Rome) were written, there were six great obelisks, and forty-two small ones at Rome. Of these twelve only are now left, varying in height from over 100 feet to $8\frac{1}{2}$ feet. The first, which now stands close to the church of St John Lateran, is 148 Roman palms in height, or a little over 108 English feet, is about 8 feet square at the base, and weighs, as is estimated, nearly 450 tons. It is covered with hieroglyphics, from which we gather it was erected in honour of Thothmes IV. It stood originally before the temple of Amen Ra, and was brought over by Caligula. Each obelisk diminishes equally towards the top—that near the Lateran, ·253 part of the base; that at St Peter's, ·261; two at Thebes, ·3; and the one near S. Maria Maggiore, ·307, or nearly one-third. The diminution from the base may therefore be estimated roughly at from one-quarter to one-third.

The Barberini obelisk is about $7\frac{3}{4}$ times as high as the diameter of the base, Cleopatra's needle, $8\frac{1}{2}$; the one at St Peter's 9 times, at Luxor 10 times, at the Lateran 11 times; while two at Thebes, and one in the Piazza Navona at Rome, have an altitude of no less than 12 times the diameter of the base.

The obelisks have no entasis or swell from top to bottom like a column, but in almost all cases there is a slight convexity on the horizontal section of each face. The one in the Place de la Concorde at Paris has the peculiarity of being convex on one side, and slightly concave on another.

In all ancient examples, the small pyramid which covers the obelisk is at least $1\frac{1}{2}$ times as high as the diameter of the top of the obelisk in which it is placed. In modern examples the pyramidion is almost always too flat, which gives a bad effect. Obelisks appear to have been used in contrast with the long horizontal lines of the temples; so that we are unable to judge of the effect produced by these gigantic monoliths, when placed in their original positions, for the few examples in Rome, Paris, &c., are isolated and have nothing near them to contrast them with. The enormous labour and care expended upon the Egyptian obelisks may be judged from the fact, that the largest one at Karnak, which weighs 297 tons, must have been lifted out of the quarry, lowered into a ship, raised out of this into a carriage, transported more than a hundred miles on land, and

[1] So called by Diodorus Siculus, because the middle ranges of columns, with the roof, &c., are higher than the side parts, and admit light by a range of windows opening over the side roofs, something like the clerestories of our cathedrals.

then raised upright, and to a considerable height, to its pedestal.

Columns.

COLUMNS.—In the rock-cut tombs and temples we come to the earliest forms of columnar architecture now existing; and Sir Gardner Wilkinson considers that he can trace the process by which the plain, square, uncarved pier was gradually developed into the ornamental column of the complete Egyptian style. Thus in the case of a plain pier, the first thing was to cut off the angles, making it an octagon; a second cutting produced a 16-sided column. The sides slightly curved formed flutes, and a large slab on the top brought the whole to much the appearance of a rude Doric column.

Suppose, however, that the pier was painted on each side with the stem and bud or flower of a plant, *e.g.*, the lotus. The figure would be cut in intaglio; the plain spaces between being then cut away, the column would represent 4 or 8 stalks, supporting buds in flower conjoined. These would be united together by sculptured bands, and the whole would form one column of 4 or 8 stalks, supporting a capital.

Sir G. Wilkinson has classed Egyptian columns into eight orders. *First*, The *square pillar*, or post of stone. This often has a line of hieroglyphics running down it vertically. *Second*, The *polygonal* column, plain or fluted. This is sometimes painted, or otherwise ornamented with devices. *Third*, The *bud* capital, or one formed like the bud of the papyrus. Of this there are three varieties. The oldest, from Beni Hassan, is composed of four plants bound together by a sort of necking of fine bands under the buds, the columns coming down straight to the plinth. Then there are columns of eight similar shafts, and these generally turn in at the bottom. After the reign of Amenoph III. simple round shafts came into use. The second variety is composed of similar shafts, capitals, and neckings; but there are similar bands or necking on the bud itself, and a sort of short rods or reeds, descending vertically from the neckings on the sides of the column. The third variety has a single circular shaft, without any indication of the united water plants, but still with bands round the necking, and the capital itself. In these two last varieties the lower part of the shaft is generally ornamented with a sort of sheath or spathe, resembling the lower part of a water plant.

In the *fourth* order the capital is like an *inverted bell.* It formerly was called the lotus capital, but in reality it has no resemblance to that flower. The capital is so much undercut that the ornaments on its edge are not visible, except to a spectator who is immediately beneath them.

The *fifth* order is the *palm tree* column, and resembles the head of that tree, with the lower or drooping boughs cut off. The neckings are composed of five bands, but have the peculiarity of a piece hanging down like a knot at the end. These columns are found as early as the time of Amenoph III. In the time of the Ptolemies the shafts came straight down to the plinths, and were not drawn in at the bottom as in the earlier periods.

The *sixth* order is called the *Isis-headed order*, the capital being formed of one or more heads of that deity, surrounded by a representation of a doorway, or small shrine with an image, and sometimes a votary worshipping placed over it. At Dendera the faces, exclusive of the head-dress, are five feet across. Sometimes the Isis head is formed on a square or polygonal column. Sometimes the head is that of Athor, the Venus of the Egyptians. In this order also are included the capitals at the tomb of Rhamses III. at Thebes. These are the heads of cows painted blue and red, and with long reverted horns.

The *seventh* is called the *composite order*. The shafts are generally round, and the capitals, as the name imports, are a mixture of styles. The bell and palms, or the palm and the Isis head, are frequently found in combination. A most curious instance is ranked under this style, of columns of the third order with inverted shafts, and also inverted capitals, taken from Karnak, the work of Thothmes III.

The *eighth* order is called the *Osiride*, from containing statues of the deity Osiris. This order is something like the Persian, or the Caryatides of the Greeks and Romans; but it differs, inasmuch as the figure does not support the entablature, but stands in front of a square pier which discharges that duty. This order is sometimes used in the courts and sometimes in the halls. Grotesque figures of Typhon are found in a building called the Typhonium at Barkal. These, however, partly support the entablature with their odd-shaped caps.

The following list of heights, diameters, and distances between the columns, selected from those given by Canina and Sir G. Wilkinson, shows at one view the peculiarities of the various styles:—

	Height.		Diameter.		Inter-columniation.	
	ft.	in.	ft.	in.	ft.	in.
Beni Hassan, square, ...	18	4	3	8	6	1
Do., polygonal, ...	16	8	3	7½	10	5
Do., four reeds, ...	15		2	4	7	2
Karnak, bud capital, ..	18	11	3	8	6	6
Do., side colonnades, do.,	39		9	6	9	4
Do., central, fourth order,	60	3	11	8	12	6
Memnonium, do., do., ...	29	4	7	2	7	2
Do., side do., do., ..	22	10	5	8½	8	7
Dendera, sixth order, ...	43	2	8		8	5
Esne, seventh order, ...	29	11	5	9	8	
Edfoo, do., ...	43	2	8		8	5

PILASTERS.—These are employed in all ages, though they do not always accord with the order of the columns. For instance, at Thebes the pilasters of the Temple *in antis* of Dayr el Medeeneh are of the sixth or Isis-headed order, while the columns between are of the seventh or composite order. They are generally square, and without diminution.

Pilasters.

ENTABLATURES.—These are nearly alike in all orders, and may be described as a cornice and architrave without a frieze. The former consists of a fillet or regula, beneath which is what is generally called a large hollow or cavetto; but in reality the upper half is a quarter round, and the lower nearly straight. Under this moulding is a bold torus which separates the cornice from the architraves, and runs down the sloping sides of the angle of the building to the ground. The cornice is generally ornamented with divisional vertical lines, like triglyphs. Between these the cartouches or ovals of the reigning monarch, or other devices, are carved. The centre is generally occupied by the winged globe, or emblem of the Good Dæmon. The torus is often ornamented as if strings were bound round a bundle of sticks, like the *fasces* of a Roman lictor. On the upper part of the smaller cornices there is often a row like the antefixæ of a Greek temple, but their form is peculiar, and is supposed to represent the pots in which the mummies of the sacred cats and ibis were preserved. The architraves are plain, without being broken into fasciæ, and are generally covered with hieroglyphics.

Entablatures.

FORTIFICATIONS.—Next to the temples, the grandest buildings were perhaps the fortifications. We know that the temples themselves were often used as citadels, few of the towns being fortified. Even Thebes seems not to have been so. Of the actual citadels we have a few remains, as at Dakkeh. But several are shown on the drawings, and bear a curious resemblance to mediæval works, the ramparts of the walls and towers having battle-

Fortifications.

ments which overhang like our machicolations, while, in the centre of the enclosure formed by the walls, was generally a high square tower or keep. Of the further details we know little.

Private Dwellings. PRIVATE DWELLINGS.—Of these little is known, except from paintings found in the tombs. One noted ruin at Medinet Haboo has, indeed, been supposed to be that of a palace; but one of the latest authorities, M. Mariette, throws doubt on this, considering that it was erected partly for defence and partly as a triumphal monument. The ordinary dwellings seem, like the houses in the Labyrinth, to have been in two stories, with an open gallery at the top, supported by columns probably of wood. The larger houses consisted of rooms ranged round three sides, and sometimes four, of a large court-yard planted with trees, and with a tank, and perhaps a fountain, in the middle. There was an entrance porch, on which are hieroglyphics, being, as Sir G. Wilkinson supposes, the name of the inhabitant. Larger houses are supposed to have had two courts—the outer, in which to receive vistors, the inner for the females of the family. Smaller houses, particularly in the country, had a similar court, with granaries and store-rooms below, and living apartments above, like those of the modern Fellah in Egypt, or the small *vigna* houses in Italy. The roofs seem to have been flat, like those of the modern Egyptians; and the houses appear, from a painting found at Thebes, to have been ventilated in the same way as at present, by the contrivance called a *mulkuf*, or wind-shaft, over which are two screens, like large square fans back to back, bending forward each way to catch any air that may chance to be stirring, and direct it down the shaft into the house.

Résumé. Although we have only ruins to guide us (for no man living has seen an Egyptian temple as it appeared to the old Egyptians), yet we can gather that to the Egyptians we owe the earliest examples of columnar architecture, and at the same time that they had not got beyond the rudiments of it. The stable effect of their massive columns disappears when we notice that scarcely any, except those of very recent date, have the wide-spreading base which we know so well in every other style; that the massiveness of the column is in fact wasted, as the lower part is rounded off and cut away so as to render $\frac{1}{4}$th of it simply useless; and that the bold projecting capital carries no weight, and adds nothing to the strength of the stone beam above it, for that beam rests on a small block of stone *above* the capital, borrowing no strength whatever from it. It will also have been noticed, that nearly every Egyptian work is rectangular in plan, and that in exceptional cases, as, *e.g.*, the buildings at Philæ, Kalabsche, and Luxor, no attempt has been made to soften down the harshness of the lines. With the elevation it was the same. The square was never changed into the circle or the octagon. Nearly every form is bounded by the rectangle, and the only varieties found in the grandest of the buildings in Egypt are the slope of the massive pylon and the tapering obelisk. The minaret and the dome, which give such charming variety of outline, and the varied mouldings, without which it now seems to us that no building could be perfect, were unknown to the Egyptians.[1] But of all things, the neglect of the arch is the most curious. Crude brick arches are found at least as early as the 16th century B.C., and others have been found of the same date, it is thought, as the pyramids. Yet the Egyptians of later times systematically employed enormous stones for their coverings and lintels, and left the arch unused. We must remember, in justice to the Egyptians, that their efforts in art were fettered, to an extent which we are perhaps unable to appreciate, by the restrictions imposed upon them by conventionalities connected with their religion. That they were so fettered in sculpture at least is abundantly clear from many examples. The freedom which characterises one of their earliest statues, that of King Chephren, the exquisitely bold yet delicately graceful sculptures in the Serapeum and in the tomb of Tih at Sakkara, and other examples, show clearly that the Egyptians had a power for design and execution which only such a cause as that referred to above could have suppressed.

[1] One example, apparently, of a cupola occurs in a painting at Bayr el Bahree (Thebes), but no trace of an actually built cupola exists.

JEWISH ARCHITECTURE.

The long sojourn of the Jews in Egypt, and the fact that their chief employment there seems to have been the manufacture of bricks, must have made them acquainted with the architecture of that country. On the conquest of Canaan, the Israelites seem to have taken possession of the dwellings of the vanquished people; and we have no record of any important building constructed by the Jews till the days of Solomon. The piety of this prince seems to have induced him to carry out his father's wishes with regard to the temple, but at so low an ebb was the art of building that the Jews did not even know how to hew timber properly (1 Kings v. 6). The king therefore applied to Hiram, king of Tyre, with whom he was on friendly terms, and that monarch sent an architect and staff of skilled workmen. Materials were collected for the building, and careful accounts of the whole work are given in the books of Kings and of Chronicles. Solomon's temple.

The early temple is described (1 Kings vi. vii.) as a building of stone, roofed and floored with cedar. It appears to have been rectangular, with a single roof, and divided into two parts by a wall. It was 60 cubits[2] long, 20 wide, and 30 in height, or about 110 feet by 36 feet, and 55 feet high. In front was a porch the same width as the temple (20 cubits), but only 10 cubits in depth.

Round the house—which, of course, must mean on three sides only, as the porch occupied the front—were the priests' chambers, in three stories, one over the other, the lowest 5 cubits broad, the middle 6, and the upper 7,—a passage which has puzzled most commentators, but which will be considered presently. On the right side was a winding-stair leading to the upper stories of chambers. The walls of the house, as well as the ceiling, were lined with boards of cedar. The joists of the floor seem also to have been of cedar; but the floor itself was of planks of fir. The cedar was carved with "knops" and open flowers.

The house was, as has been said above, divided crossways into two parts—the outer temple and the oracle, or Holy of Holies. The one was 40 cubits long, by 20 broad; the other was 20 cubits square. The oracle had doors and door-posts of olive-wood. The temple door-frames were of olive, and the doors of fir, all being hung folding. Both doors were carved with cherubim, palm trees, and open flowers. The entire fabric, even the floors, were gilt —"overlaid with gold." The account in the Second Book of Chronicles (ch. iii. iv. &c.) is substantially the same, except (a difference easily to be accounted for) that it describes the greater house, *i.e.*, the outer temple, as ceiled with fir tree; and we gather also from the description, that the whole was roofed with tiles of gold: the nails were also of gold, and weighed 50 shekels. At the door of the porch were two columns of bronze, or "pillars of brass," each 18

[2] Canina makes the sacred cubit = ·554 of a French metre, *i.e.*, 21·81 English inches, or not quite 1 foot 10 inches.

cubits, or 33 feet high, and 12 cubits round, or about 7 feet in diameter. They had capitals (chapiters) also of molten brass, five cubits high, decorated with lily work, chain work, and pomegranates. In front of the porch was the altar, surmounted by a low wall three courses of stones in height. The whole building was enclosed by a walled court, called the inner court, or that of the priests. In front of this was another, called the lower court; and the whole of this area was enclosed by a circumscribed court going round the whole of the other courts and buildings; and this was called the outer court, or that of the Gentiles. It will be noted that in the careful description of the pillars, &c., no mention is made either of base or of moulded cornice.

Canina (*Tempio di Gerusalemme*, Rome, fo.) conceives the style of the building to have been Egyptian; that the temple was lighted like the hypostyle halls, by a range of windows over the roofs of the cells or priests' chambers; that these windows were like those of the clerestory of a church splayed at the bottom and sides; that the walls of the temple itself sloped towards the top on the outside, or, to use the technical language, were built "battering," while the walls of the priests' chambers were built perpendicular, and for this reason each story measured a cubit more than the room below. He also supposed that the capitals of the columns, which are described as of lily work, were in fact the lotus (water lily) capital of Egypt. The porch itself he considers to have been like the propylon, containing other chambers like those of Egypt.

Mr Fergusson's restoration, as given both in his *History of Architecture* and more at length in Smith's *Dictionary of the Bible*, is different. He assumes that the plan was somewhat analogous to that of the still existing building known as the palace or temple of Darius at Persepolis, which has a range of chambers on each side. The difficulty as to the upper chamber being wider than the lower he solves in a very satisfactory way, by supposing that there was a set-off in each story on which the flooring just rested, so as not to cut into the walls of temple.

In the prophecy of Ezekiel (ch. xl. *sqq.*) we have a very full and interesting account of what the temple was in his time. The house itself and the oracle do not appear to have been altered, but the old courts seem to have been swept away and succeeded by vast atria, and a mass of halls and chambers.

Temple of Herod.

In the time of Cyrus the temple was rebuilt, but this second temple was demolished by Herod, who constructed a new one of the same dimensions as that of Solomon. The outer house was 40 cubits long, and the Holy of Holies 20 cubits; but it was nearly double the height of the first temple. The porch also, instead of being the width of the house, 20 cubits, was 100 cubits long and 100 high, crossing the temple in the form of a T, and forming a magnificent façade much longer than that of St Paul's in London. Round the house were three stories of priests' chambers. The court had three entrances on each side, which were called respectively the water-gates, the fire-gates, and the oblation-gates. But the peculiar difference between Herod's temple and the earlier building was that there was, in front of the court last described, another of about the same size, surrounded by a colonnade and chambers, which was the place set apart for the women. These courts were surrounded by an outer court, having a species of cloister on the north, east, and west sides, composed of a double row of columns. On the south side was a similar construction a furlong in length. It consisted of three rows of columns, forming with the outer wall, three aisles—the two outer being 30 feet wide and 50 feet high; the centre being 45 feet wide and 100 feet high—no doubt with a species of clerestory. These columns are described to have been so large that it took three men with extended arms to span their circumference. The outer court was elevated six steps above the basement level; the inner courts stood on a sort of plateau, with retaining walls and parapets round it, which was ascended by fourteen steps; this was on the level of the women's court. Between this and the inner court was a gate called that of Nicanor, in front of which was a semicircular flight of fifteen steps. The temple itself was entered by a flight of twelve steps, so that its floor must have been between 20 and 30 feet above the ground-level of the surrounding city. The whole was built of the most beautiful white marble.

House of the forest of Lebanon.

We read in the First Book of Kings (vii. 2, 8), that Solomon built "the house of the forest of Lebanon," "his house where he dwelt," and "a house for Pharaoh's daughter." Some have supposed these to have been three distinct palaces, but Canina considers them as all connected, and as three parts of one large structure. The house of the forest of Lebanon—so called, in all probability, from the cedar of which it was constructed—is described as being 100 cubits long, 50 wide, and 30 high (180 feet by 90 by 54). Its horizontal area was thus very nearly equal to that of Westminster Hall. It had four rows of cedar pillars, or, as the Vulgate more correctly renders it, four corridors (*deambulacra*) formed by three rows of cedar columns, fifteen in each, or forty-five in all, with cedar architraves, and covered with cedar. This Canina restores as an Egyptian hall, lighted, as described by Vitruvius, with a portico in front, of 50 cubits by 30. The great hall, he supposes, led on one side to the palace occupied by the king, in which was the hall of judgment and the throne, and on the other side, to the queen's palace and the women's apartments, or, as it has been called in later times, the harem. The porticoes and hall seem to have been of cedar, but the houses were "of costly stones" (1 Kings vii. 9).

The excavations recently made, at the expense of the Palestine Exploration Fund, have disclosed considerable remains of the massive ancient masonry, and of the cisterns, conduits, &c. But, with these exceptions, no part of old Jerusalem appears to be extant. There are, however, some objects, formerly considered to belong to Jewish times, that should be mentioned. There are, first, what are called the tombs of the kings of Judah. These are a number of sepulchral chambers hewn out of the solid rock, and containing sarcophagi. They vary from 10 to 20 feet square, and are entered, exactly like the tombs of Beni Hassan, by a portico *in antis*, about 40 feet wide. There are two columns and two pilasters in front, of Greek Doric character, about 13 feet high. The most curious feature of these is, that a broad band, about 3 feet wide, richly sculptured with foliages, runs down on each side 4 or 5 feet and over the columns horizontally. Above this last, quite independent of the lower construction is a regular Doric architrave and frieze, of a character between Grecian and Roman; this is ornamented with triglyphs, pateræ, and foliage. In front of the portico is a large court-yard, about 100 feet square.

Tombs of the Kings

In the Valley of Jehoshaphat, near Jerusalem, are three extremely curious relics; two stand alone, on platforms excavated from the rock, and the third is scarped into the rock itself. The first is called the tomb of Absalom. It is a square building with a solid wall, in which are engaged Ionic columns, about 13 feet high; over this is a Doric entablature with triglyphs, and an altar, surmounted by a very curious sort of hollow-sided cupola of trumpet-mouth section, and a terminal. The whole, including the flight of steps, is about 60 feet high.

Another similar building, of about the same size, is commonly called the tomb of the prophet Zechariah. This is surmounted by a simple pyramidal roof. Beneath it is a handsome doorway leading to a sepulchral chamber. Over the ordinary classic entablature is the regular Egyptian cornice or torus, surmounted by a bold quarter hollow and fillet exactly like those on the propylons of Egypt, which have been already described.

The third building is entirely rock-cut, and consists of a large façade, about 90 feet wide and 100 feet high. This is reported to be the place to which the apostles retired before the siege of Jerusalem. Below is a plain face, about 45 feet high, on each side of which are wings with two pilasters, both running up to the top of the building. Between these is a species of portico, about 40 feet wide, with columns and pilasters, of nearly pure Grecian Doric. There are also several other rock-cut tombs or sepulchres scattered about in the neighbourhood of Jerusalem, but none of them possess much architectural interest. One is called the sepulchre of Jehoshaphat.

From the character of the architecture it is incredible that these buildings can have anything like the age ascribed to them. The Ionic capitals are evidently Roman, and therefore cannot date earlier than the conquests by that people; probably they are of the time of Herod; while the Egyptian cornices show that the traditional ornaments of that people had not been entirely forgotten. Besides this, the general plan of a temple, *in antis*, scarped into a rock, so entirely resembles the work at Beni Hassan, that it is impossible to deny that these very interesting remains strongly corroborate the views of Canina, that the architecture of the early temples was at least based on the architecture of the Egyptians.

Indian Architecture.

Considerable light has been recently thrown upon the history of architecture in the East. The traditions as to the extremely remote antiquity of the rock-cut temples, the caves of Ellora, and the wonderful pagodas, have disappeared before the searching eye of critical investigation. In the time of Herodotus the Persians had no temples; and even in that of Tacitus, the great Indo-Germanic races "would not confine their gods within walls." The early religion, which appears in the Vedas, was Brahminism, but in the 6th century B.C., the first of the Buddhas seems to have commenced a perversion of the ancient faith. The struggle appears to have gone on for years, till three-quarters of a century after the time of Alexander the Great, about 250 years before the Christian era, when a powerful ruler named Asoka, a grandson of Chandragupta, who is supposed to be the Sandracottus of the Greek writers, abjured Brahminism, and made Buddhism the religion of the state. Certain *Lats*, or pillars, erected by him, and inscribed with his edicts, are the earliest extant architectural remains of India.

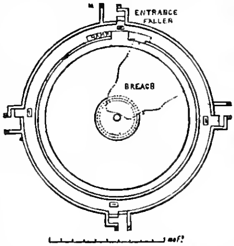


Fig. 24.—Plan of Tope at Sanchi.[1]

Topes. The Buddhist topes are supposed to have been erected at first to commemorate some event, or to show that the spot was sacred; but after a time they were employed to contain relics, such as the tooth or collar-bone of one of the Buddhas. The relics seem in some cases to have been preserved in a sort of box or case at the top of the tope, called a *tee;* in others, in regular relic chambers. Where there were relics, the place was called *dagoba*, or relic shrine, of which, perhaps, our term pagoda is a corruption. A great number of these topes were built in the form of large towers, others in the form of hemispheres. One of these, the Sanchi tope, is described and figured by Mr Fergusson. The diameter is 106 feet. It has a curious species of gate entrance, and is surrounded by a stone fence. Others are partly cylindrical, and are finished with either a flat circle, or pointed terminals like a dome at the top. A fine example has recently been discovered at Bharhut by General Cunningham.

Of the next two classes of Buddhist architecture, the temples (Chaityas) and monasteries (Viharas), no *built* examples exist in India. They are, in fact, rock-cut caves. At least one thousand temples are known—one-tenth probably Brahminical or Jain, the rest Buddhist. They are Rock-cut temples.

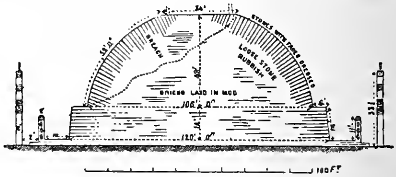


Fig. 25.—Section of Tope at Sanchi.

said to form an uninterrupted series, from the first, in Behar, by the grandson of Asoka, 200 years before Christ, to those at Ellora, which, instead of being of an almost diluvian antiquity, as has generally been reported, have been proved to date from the 7th or 8th century of our era, while the most recent is the work of Indra-dyumna, as late as the 12th century. One of these cave-temples at Karli,

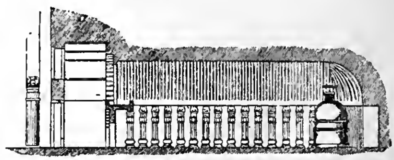


Fig. 26.—Cave at Karli: section.

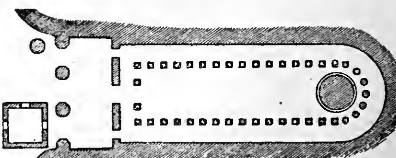


Fig. 27.—Cave at Karli; plan.

near Bombay, presents exactly the features of a Roman basilica, or early Christian church. It has a circular end or apse, and is divided into three aisles by two rows of columns. Others are simple square buildings, with a circular or oval chamber at the end entered by a small door. The monasteries, which exceed the temples in number, seem generally to have been square caves supported

[1] Figs. 24 to 38 are taken from Fergusson's *History of Architecture*, by the kind permission of the author.

by pillars of the natural rock left in their places, and surrounded by a number of small sleeping-places or cells.

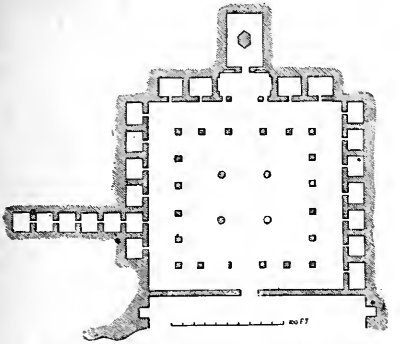


FIG. 28.—Cave at Baugh, on the Nerbudda ; plan.

Ellora caves. The most wonderful excavations are those at Ellora, near Aurangabad. These are a series of hypogea or caves sunk in the solid rock, extending a distance of 3 or 4 miles. Canina has given plans and interior views of six of them. Those called Parasova Rama and Diajannata are simply halls supported on massive piers with level architraves. The piers are richly carved with figures and friezes, and have a sort of cushion capitals, and square abaci, and stand round, forming a kind of atrium. That called Indra has a court open to the sky, in which is a small shrine or temple. In the solid rock are two halls similar to those above described, a larger and smaller. The piers of the Tin Tal are quite plain. In the Viswakarma is a quadrangle, open to the sky and surrounded by pillars. This leads into an atrium with three aisles and an apse, and exactly like a basilican church.

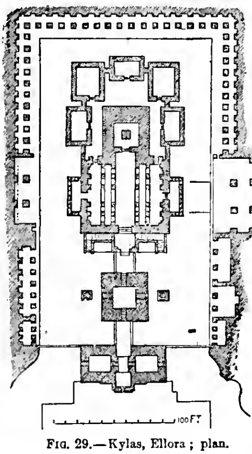


FIG. 29.—Kylas, Ellora ; plan.

Kylas. The most magnificent of the Ellora caves, and indeed of the native Hindu works, are the chambers and halls called the Kylas, or Kailasa. These are sunk into the rock, and occupy a space of 270 feet deep and 150 feet wide. The roofs are solid rock, supported by pillars, or rest on the walls, or on the divisions of the assemblage of chambers. There is a porch, on each side of which are two columns. This conducts into a hall, supported on 16 such columns, and leading into a sort of adytum. Round this is passage space and five chambers. The whole forms a temple, with its usual appendages, just such a one as would be built on the ground, and round this a wide open space, with a colonnade or cloister encircling the whole. Great part is open to the sky, for the sake of light and air, but the work is entirely cut out of the solid rock.

FIG. 30.—Kylas, Ellora.

The date of the construction of the Kylas is about 1000 A.D.

Jain work. The earliest existing work of the Jains seems to be of the 10th century. They were a sect which arose in the endeavour to re-establish Brahminism, and which first seems to have acquired importance about 450 A.D. This sect rejects the doctrines of Buddhism, as also the practice of monasticism. The famous temple at Somnauth belongs to them. Mr Fergusson has given a description of that built by Vimala Sah, on Mount Abu, as a type of the ordinary Jain temple. In the centre is a cell in which is a cross-legged figure of one of the twenty-four saints worshipped by this sect; in this case it is that of Parswanath. The cell is always terminated by a pyramidal roof. In front of this is a portico of 48 pillars, disposed much like a cruciform church with a dome at the intersection of the transepts. The whole is surrounded by a species of cloister formed by double rows of columns, and a series of small chambers like the cells of a *vihara*. But as the sect abjure monasticism, each cell is used not as a dwelling, but as a kind of small chapel, and contains one of their cross-legged deities. One of the peculiarities of this style is that richly-carved brackets spring from the pillars at about two-thirds of their height, and extend to the architraves, forming a sort of diagonal strut to strengthen and support them.

The Jains probably adopted the dome at a very early period, and it is doubtful whether the Buddhists ever used this species of construction. "No tope," Mr Fergusson observes, "has the smallest trace of such a structure, though of domical shape outside, and the design of the rock-cut temples, with the upright supports, the raking struts, and the level architraves, has manifestly been deduced from timber construction." The Indian dome has no voussoirs radiating from the centre, as in European architecture. The courses are all horizontal; and the domes are therefore necessarily pointed in section, for they would not stand if circular. The Indian dome, however, has this merit, it requires no abutments, and has no lateral thrust. The pressure is entirely vertical; and if the foundation be sound, and the pillars stout enough, there can be no failure.

The leading idea of the plan of the Jain temple is that of a number of columns arranged in squares. Wherever it was intended to have a dome, pillars were omitted, so as to leave spaces in the form of octagons. By corbelling over the pendentives in level courses the dome was gradually formed. The plan and view of the temple at Sadree exhibit a building as large as most cathedrals. It has the great number of 20 domes, varying from 36 feet to 24 feet in diameter, and supported by 420 columns.

Like most architectural peoples, the Jains were also fond of tower-building. The *Jaya Sthamba*, a tower of victory erected by Khumbo Rana, to commemorate the defeat of Mohammed of Malwa, in 1439, is nine stories high, the two topmost stories being open. The general outline is not unlike that of an Italian campanile, with pilasters at the angles, and an overhanging corbelled top. It is richly ornamented from bottom to apex, and affords a very favourable idea of Indian art.

Hindu architecture has been divided into that of the Aryan or Sanscrit races of North India, that of the South or of the Tamul races, and that prevalent in the Panjab and Cashmere. Of the first and last we have comparatively little knowledge, but South Hindu work is treated of at great length by Rám Ráz,[1] a native author. The accompanying view of the temple at Tiravalur (fig. 31), which measures 945 by 700 feet, is from his work on Hindu Architecture. The remains of the buildings are numerous, as the Tamul races were perhaps the greatest temple builders in the world; and the whole subject has been so well elucidated by the author last referred to, that its principles may be considered to be clearly ascertained and settled. The great pagoda at Tanjore (fig. 32), by far the grandest temple in India, resting on a base 83 feet square, rises in fourteen stories to a height of nearly 200 feet. The interior represented in fig. 33—a hall in the palace at Madura—illustrates a comparatively recent style.

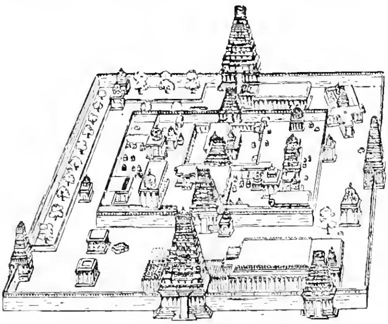


FIG. 31.—Temple at Tiravalur, near Tanjore.

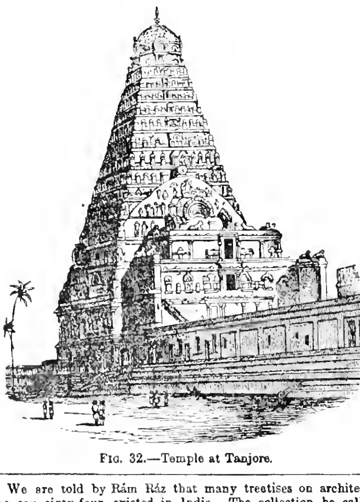


FIG. 32.—Temple at Tanjore.

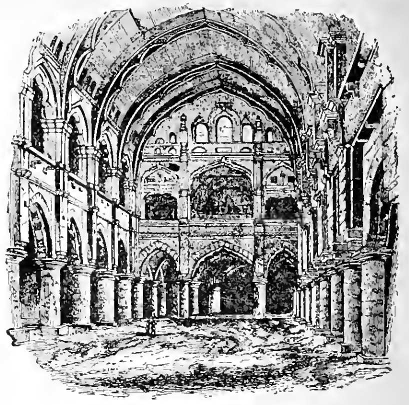


FIG. 33.—Hall in Palace, Madura.

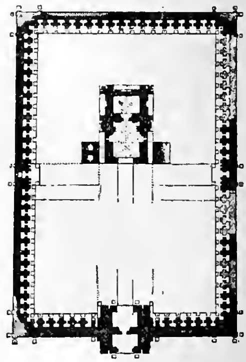


FIG. 34.—Temple of Martund; plan.

The architecture of the north-east is known chiefly from the drawings in Vigne's *Travels in Cashmere*, and in General Cunningham's *Memoir to the Asiatic Society of Bengal*. The temple of Martund (fig. 34), reduced from the latter work by Mr Fergusson, shows a cloistered court surrounded by pillars and cells, and entered by a porch. In the middle of this is a temple with a species of *naos* and *pronaos*. But the most curious feature is a series of doors with acute pediments over them shaped very much like Gothic gablets, and containing trefoil arches. A similar feature occurs (fig. 35) at Pandrethan, in a temple built about 1000 A.D., or 250 years later than Martund. It seems by no means improbable that these pointed domes,

[1] We are told by Rám Ráz that many treatises on architecture, some say sixty-four, existed in India. The collection he calls the *Silpa Sástra* Of these he mentions that the most perfect is the *Mánasára*, of which forty-one chapters were in his possession He also cites several others, one of which he calls *Casyápa*. In an epitome of the *Mánasára* he states that the first chapter treats of the various measures in use in the country; the second describes the *sthapati*, or architect—the *sútragráhi*, or measurer, probably the surveyor or clerk of works, and then the various builders; while others treat of pillars, bases and pedestals, halls, and the Vimana or temple itself.

gablets, and trefoiled arches may have strongly affected the architecture of the Saracens.

Of the style of North India Mr Fergusson gives remarkable, and by no means elegant, examples; as the Black Pagoda at Kannaruc, and temples at Barolli and at Benares. The chief features are a sort of entrance porch, sometimes walled and sometimes carried on pillars, called the nuptial hall, leading into a great pagoda, square in plan, and finishing with a sort of tub-shaped dome. The ornamentation is profuse, so much so as to detract from the greatness of the design. There are no buildings in this style anterior to the Mahometan conquest The date assigned to the temple of Jugernath is 1198, and to the Black Pagoda, 1241 A.D. The ghâts, or landing-places (fig. 36), that line the banks of the rivers of Northern India, are often of great architectural merit.

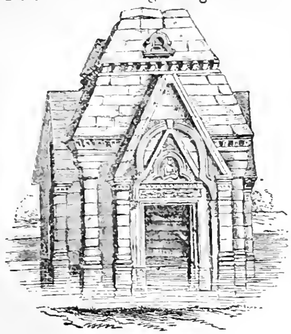


FIG. 35.—Temple at Pandrethan.

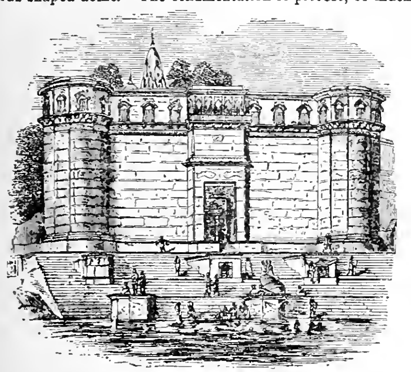


FIG. 36.—Ghoosla Ghât, Benares.

FIG. 37.—Shoemadoo Pagoda, Pegu.

The pagoda forms a very prominent feature in the architecture of Further India. A specimen of the Burmese style of temples is presented in the Shoëmadoo (*i.e.*, "golden great god") Pagoda of Pegu (figs. 37, 38).

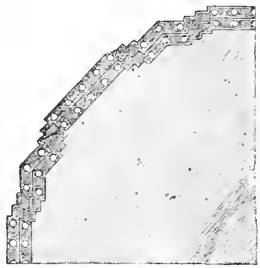


FIG. 38.—Shoemadoo Pagoda, Pegu; quarter of plan.

ASSYRIAN ARCHITECTURE.

Assyria and Babylonia or Chaldea may be shortly defined as the countries watered by the Euphrates and Tigris, lying between Armenia and the Arabian desert, and reaching down to the Persian Gulf.

The capital, Ninus or Nineveh, was taken by the Medes under Cyaxares, and some 200 years after Xenophon passed over its site, then mere mounds of earth. It remained buried until 1845, when Botta and Layard discovered the ruins of the Assyrian cities. The principal remains are those of Khorsabad, 10 miles N.E. of Mosul; of Nimroud, supposed to be the ancient Calah; and of Kouyunjik, in all probability the ancient Nineveh. In these cities are found fragments of several great buildings which seem to have been palace-temples. They were constructed chiefly of sun-dried bricks, and all that remains of them is the lower part of the walls, decorated with sculpture and paintings, portions of the pavements, a few indications of the elevation, and some interesting works connected with the drainage, &c.

The structures were built usually on artificial mounds, and approached, it is supposed, by great flights of steps (of which remains composed of black basalt have been found at Khorsabad). They consist of series of halls and chambers of no great size, the largest hall in Sennacherib's palace at Kouyunjik being only 200 feet by 45 feet, whereas Westminster Hall is 268 feet by 68 feet. In their proportions they are utterly unlike Egyptian structures, and they display the striking peculiarity of being elongated beyond anything known in other styles of architecture; *e.g.*, one of the Kouyunjik halls is 122 feet long by 27 wide, another is 218 feet long by 25 wide. The great hall at Nimroud, though 162 feet by 62, was divided lengthwise in the centre by a wall 12 feet thick, leaving each side only 25 feet wide. Another peculiarity of these structures is the immense thickness of the walls. Those of the Kouyunjik hall (27 feet wide) were 15 feet thick, and those of Nimroud (32 feet wide) were 26 feet thick. It has, indeed, been reckoned by Mr Fergusson, that in some of the palaces the area of the walls is as great as that of the chambers. The reason he suggests for this is that these thick walls supported a double row of columns as a clerestory under the roof, so arranged as to give light and air, while excluding the rays of the sun. He covers the halls with flat roofs, supported on columns, which being of wood have rotted or been burnt. An entirely different theory is that of M. Flandin, who studied the subject on the spot. He believes that the halls were vaulted and had small windows at the springing. M. Victor Place has found at Khorsabad several vaults, and also terra cotta tubes, through which he believes that the vaults were lighted, just as domes were in Persia in later times. But no vault has been found large enough to span any of the wide Assyrian halls. Of their elevations there are few traces remaining. At Nimroud, what is supposed to be the tomb of Sardanapalus has its lower part, which is about 20 feet high, of solid masonry, and the rest of burnt bricks. It has slightly projecting piers, but no ornaments or mouldings. At Khorsabad and the S.E. palace of Nimroud there is some attempt at decoration, by rude semi-columns, without capitals or bases, arranged in clusters of seven, side by side, the groups being separated by recesses. A few detached pieces of moulding have been found at Khorsabad, but of the very simplest kind, and we have no vestiges of capital or entablature. Were our knowledge limited to these and a few similar remains, we should have to form but a poor idea of Assyrian art. But the sculptures have revealed to us a degree of refinement which had been previously looked for only in Greece. These sculptures lined the sides of the halls to a height of 10 feet. In them we see columns with both base and capital, and surmounted by entablatures. Sometimes the columns are combined with pilasters, as in the Greek porticos *in antis*. In one specimen the columns were carried on the backs of bulls, as is shown by one of the bas-reliefs, and, more conclusively still, by the beautiful small model of a winged bull brought to England by Mr George Smith, which has carved upon its back a base, just as is shown on the slabs.

In these bas-reliefs we have further—1. The facade of a palace, having at top a grand row of window openings divided by Ionic columns; 2. A small building on the banks of a river, having two columns with bases and a kind of Ionic capital, between two plain pilasters, and with rude indications of a cornise; 3. Another façade of two columns, with bases, and Corinthian capitals, between two pilasters, likewise with capitals. Over these is an entablature, somewhat rudely worked, but clearly showing architrave, frieze, and cornice, and antefixæ over. The latest of these slabs must have been carved many years before the earliest date assigned to any known Greek work. In view of these and similar remains the following words of Niebuhr are memorable:—"There is a want in Grecian art which no man living can supply. There is not enough in Egypt to account for the peculiar art and mythology of Greece. But those who live after me will see on the banks of the Tigris and Euphrates the origin of Grecian mythology and art."

The plans of all the Assyrian buildings are rectangular, and we know that long ago, as now, the Eastern architects used this outline almost invariably, and upon it reared some of the most lovely and varied forms ever devised. They gather over the angles by graceful curves, and on the basis of an ordinary square hall carry up a minaret or a dome, an octagon or a circle. That this was sometimes done in Assyria is shown by the sculptures. Slabs from Kouyunjik show domes of varied form, and tower-like structures, each rising from a square base. The resemblance between the ancient form of the dome and those still used in the Assyrian villages is very striking. Whether sloping roofs were used is uncertain. Mr Bonomi believes that they were, and a few sculptures seem to support his view. Of the private houses nothing, of course, remains; but they are represented on the slabs as being of several stories in height, the ground floor as usual having only a door and no windows. All have flat roofs, and we gather from one of the bas-reliefs, which represents a town on fire, that these roofs were made, just as they now are, with thick layers of earth on strong beams. These roofs are well-nigh fire proof, and the flames are represented as stopped by them, and coming out of the windows. No remains of a window, or, so far as we are aware, of an internal staircase, have been found.

Of the fortifications we know much more. In the north wall of Nimroud fifty-eight towers have been traced, and at Kouyunjik there are large remains of three walls, the lower part being of stone, and the upper of sun-dried bricks. At Khorsabad there are the remains of a wall, still 40 feet high, built of blocks of stone 3 to 4 feet thick, and the evidences wanting as to the finishing of these is completely supplied by the sculptures, which show an extraordinary resemblance to mediæval works of the same class. Tier upon tier of walls are represented, enclosing a great tower or keep in the centre. The entrances are great arched gateways flanked by square towers. These and the other towers have overhanging parapets just like the mediæval machicolations, and are finished at top with battlements, remains of which have been found at Nimroud and Kouyunjik, and at Kaleh Shergat, the supposed capital of Assyria before Nineveh.

Of temples distinct from the palace we have a few supposed remains, but little is absolutely known as to their general form.

But in Chaldea there are some enormous masses of ruins, evidently remains of the vast mounds which formed the substructure of their temples. The grandest of all these and the most interesting is the Birs Nimroud, near Babylon, which has been identified as the temple of the Seven Spheres at Borsippa. This was reconstructed by Nebuchadnezzar, as appears by a well-known inscription. Another example is at Mugeyer, which was 198 feet by 133 feet at the base, and is even now 70 feet high, and it is clear that both it and the Birs were built with diminishing stages, presenting a series of grand platforms, decreasing in length as they ascended, and leaving a comparatively small one at top for the temple cell. This has been found, it is supposed, at the Birs Nimroud, of vitrified brick.

The most interesting parts of the Assyrian edifices are the finishings. The pavements were sometimes of sun-dried bricks, at other times of baked bricks, or of alabaster slabs laid in bitumen. At Khorsabad there was one in a single block 13 feet square, and 3 ft. 11 in. thick, and at the Nimroud temple there were two slabs, one 19 ft. 6 in. by 12 feet, and the other 21 feet by 16 feet, and 1 ft. 1 in. thick, both sides covered with inscriptions. Of ornamental pavements there are admirable examples from Kouyunjik at the British Museum, and from Khorsabad at the Louvre, both covered with delicate carving in alabaster of nearly the same pattern. It is difficult to conceive how such delicate work could have been used as paving, and still retain its beautiful sharpness; for it was not filled in to protect the pattern. Directly above the pavement came the sculptured slabs, which are so numerous that at Kouyunjik alone there are some 2 miles in length of them. They are generally about 10 feet high from the ground, and are carved in alabaster. Many of them show traces of having been decorated with colours. Connected with these sculptures were the great winged animals which stand one on each side of the portals of the palaces. Some of the grandest have the body and legs of a bull, with an enormous pair of wings projecting from the shoulders, high over their backs, and covering the breast. They have human heads, bull's ears with large ear-rings, and horns, winding from the brows upwards, and encircling a coronet of leaves, bound by a fillet of roses. They stood in pairs on each side of the palace doorways, and it is thought by some that generally there were no doors or lintels, all being open to the roof and enclosed with curtains. But doors were sometimes used, as the places or stages, from the early structures of wood, and thus originated a style, grand, picturesque, and in its ruins beautiful, but well-nigh isolated in the history of art, there being nothing from which it was quite copied, and nothing which seems quite to have sprung from it.

The few remains which exist of a later date are separated from the above as widely in architectural forms as in chronology. Neither the Greek Seleucidæ nor the Parthian Arsacidæ have left any buildings (of importance at least) which can be identified; and the well-known edifices at Serbistan, Firouzabad, and Ctesiphon, are late in the time of the Sassanidæ. The two former edifices have domes rising from square bases and lighted by small apertures, as Victor Place suggests was the case at Khorsabad, and each is approached, as was the Khorsabad palace, through a deep vaulted entrance. At Ctesiphon this vault is 115 feet deep, 72 wide, and 85 high. Of the famous palace at Dastageod (Artemita), 60 miles north of Ctesiphon, described by the Byzantine writer, Theophanes, no remains are known to exist; but Dr Tristram has discovered at Mashita, in the land of Moab, a palace with its enclosing walls, richly decorated with carving, &c., which Mr Ferguson considers to have been built by Chosroes shortly before the Arab invasion. The edifice is minutely described and illustrated in Tristram's *Land of Moab*.

Architecture of Asia Minor.

Little was known of the antiquities of Asia Minor until, in 1838 and 1840, Sir C. Fellows discovered in its north-western corner eleven ruined and deserted cities. It was reasonable to think that in these we should have the missing link between Assyrian and Greek art. But although a few of the sculptures show traces of Assyrian influence, and though the later structures are very similar to those of Greece, the productions of native art seem quite isolated and peculiar. The most ancient remains are considerably later than such masterpieces of skill as the tomb of Agamemnon at Mycenæ, and the great works of later times were erected long after the Parthenon.

The earliest works remaining are singularly like the Etruscan graves so often found in Italy. Perhaps the first of these is the tomb at Tantalais near Smyrna, which has simply a square chamber, ceiled with a pointed arch, formed with oversailing courses, and all covered with a tumulus. Like to it is the tomb of Alyattes, king of Lydia, on the bank of the Hermus, near Sardis. It has also one chamber, 11 feet by 8, and 7 feet high, in the centre of a circular pyramid, not sloping directly from the ground, as in Egypt, but having a high moulded stereobate, at the starting, some ¾ mile round. This structure would create no surprise if found in Tuscany; and still more to increase the resemblance to Etruscan work, it appears to have been surmounted by five stone pillars. Of the tombs which belong to the races between the above and the time when Greek art was introduced or was invented, the rudest are perhaps, to be found in Caria. They are sarcophagi, and those at Olinda, *e.g.*, are of enormous size, ranged on each side of the street leading to the city. In the simplest form a cavity was made in a great stone for the body, and a heavy lid put over it, coped, or rising as a pediment in centre. Generally they were plain and oblong in shape. In Lycia, chiefly on the banks of the Xanthus, are found other sepulchres of remarkably singular form. We look in vain for their prototypes, or anything copied from them. The most simple are cut in the steep rocks which invariably overhang the cities, and are often curiously like Elizabethan windows, with mullions and panels. Some have a Gothic shaped top, which is also peculiar to Lycia [illegible] the kind [illegible]mission of Messrs Nisbet [illegible] pediment [illegible] them show evident traces of having been copied in stone from wooden originals. For they are shown with joints put together with dovetails and pins, and with cornices like the ends of round trees; not actually so constructed, but all carved out of one solid mass. The designs of these rock-cut tombs were then still further elaborated in the detached monuments. The earlier ones, indeed, are much more simple, and are known as the obelisk tombs, being merely great high blocks of stone or marble, standing on a square base and surmounted by a cornice. They have not the real obelisk form, and have got the name merely on account of their height. In the grander works, the obelisk is surmounted by a sarcophagus of great size, coped with the pointed arch, with mullions and panels as above detailed, and all bearing signs of a wooden origin. Some are of enormous size, the stones weighing 50 to 80 tons. The different parts of the edifice were hollowed out for coffins, a plan of sepulture little known elsewhere.[1] These singular tombs are found all through Lycia, but a beautiful variety of them, found only at Xanthus, has the ridge stone grooved to receive an ornamental crest, sometimes richly sculptured. These singular structures are separated by a wide interval from the forms of Greek art; but that their design was, to some extent, adopted and used by the Greeks, we have various signal proofs. The Harpy tomb, whose sculptures are in the British Museum, is supposed to have been erected so late even as after the capture of Xanthus by the Persians in 547. It has the chief Lycian peculiarities, a base 6 feet high, carrying a square shaft 17 feet high in one block, weighing some 80 tons, and surmounted by a cap stone of 15 tons weight. Near the top, on each face, was carved the famous Harpy frieze. Near this was another, known as the Chimæra tomb, having the Gothic headed sarcophagus, and with a sculptured crest. And near to this again, was another of a similar kind, called the Winged Horse tomb. Doubtless these and other works, both in Lycia and Caria, were wrought by Lycian workmen under Greek guidance, but they seem to have made no lasting impression upon the architecture of the Greeks.

Grecian Architecture.

Hitherto, we have found that, in each country, the artistic forms used in the earliest periods descended to later times, which embodied to some extent the traditionary forms bequeathed to them. Even the Egyptian pyramids, unarchitectural as they are, were copied down to the 7th or 8th century in Nubia, and the earliest columnar architecture clearly shows itself as simply the beginning of a series of works extending from 2000 B.C. even to the Cæsars. But in Greece the earliest works are entirely separated from the later by an absolute break both in architectural forms and construction. In various parts of Greece and of Italy, specimens of rude walling are found of such remote antiquity, that they are, as by common consent, referred to the fabulous ages, and, for want of a more distinctive term, are called Cyclopean. Now it appears, from the concurring evidence, in the opinion of most antiquaries, that a people who have been called Pelasgi, or sailors, migrated from Asia Minor, or the coast of Syria, at a very early period, and possessed themselves of various countries, some of which were unoccupied, and [illegible] pro-

[1] The following inscription, though belonging to Greek times, shows how this was done:—"In the sarcophagus I buried Barilla my wife; and I wish myself to be put into the sarcophagus, and nobody else [illegible] In the first compartment lying under it I wish my second wife [illegible] Polychromas my [illegible] to be buried; in the other are to be put [illegible] other children [illegible] nobody else is to be put either into the sarco[illegible] [illegible] the [illegible] employment of glazed coloured bricks.

others inhabited by Celtic tribes. Professor Heeren, who affixes dates to the various migrations, expressly says that the Pelasgi were of Asiatic origin. "Their first arrival in the Peloponnesus was under Inachus, about 1800 B.C., and according to their own traditions," he says, "they made their first appearance in this quarter as uncultivated savages. They must, however, at an early period have made some progress towards civilisation, since the most ancient states, Argos and Sicyon, owed their origin to them; and to them, perhaps with great probability, are attributed the remains of those most ancient monuments generally termed Cyclopic." He adds, that the Hellenes, a people of Asiatic origin also, expelled the Pelasgi from almost every part of Greece, about 300 years after their first occupation of it; the latter keeping their footing only in Arcadia and in the land of Dodona, whilst some of them migrated to Italy, and others to Crete and various islands. The arrival of the Egyptian and Phœnician colonies in Greece, Professor Heeren thinks, was between 1600 and 1400 B.C. The most ancient specimen of Cyclopic walling is found at Tiryns, near Mycenæ. It is composed of huge masses of rock roughly hewn and piled up together, with the interstices at the angles filled up by small stones, but without mortar or cement of any kind. The next species is in stones of various sizes also, shaped polygonally, and fitted with nicety one to another, but not laid in courses. Specimens of this are found at Iulis and Delphi, as well as at the places already mentioned, in Greece, and in various parts of Italy, particularly at Cossa, a town of the Volsci. This also was constructed without mortar. The mode of building walls, which took the place of that, is not called Cyclopean; it is in parallel courses of rectangular stones, of unequal size, but of the same height. This was, however, often used in combination with the polygonal, as in one very beautiful specimen at Rhamnus. The parallel masonry is common in the Phocian cities, and in some parts of Bœotia and Argolis. To that succeeded the mode most common in, and which was chiefly confined to, Attica. It consists of horizontal courses of masonry, not always of the same height, but composed of rectangular stones.

FIG. 42.—Wall at Tiryns, Greece; from Waring's *Stone Monuments.*

The oldest existing structure in Greece of regular form is of far superior construction to the Cyclopean walling, and must be referred to early colonists. It is at Mycenæ, and consists of two subterranean chambers, one much larger than the other. The outer and larger one is circular, and entered by a huge d[illegible]ay at the end of a long avenue [illegible]lossal walls, buil[illegible] nearly parallel [illegible]ses of rect- [illegible] roofs were made, just as they now are, with thick without mortar. Its external effect is that of an excavation, though the structure of the front is evident; and internally it assumes the form of an immense lime-kiln; its vertical section being of a conical form, with nearly parabolic curves, like a pointed arch. The construction of this edifice was thought to afford clear evidence that the Greeks were acquainted with the properties of the arch; but in the most material point this was destroyed on finding that it consisted of parallel projecting courses of stone in horizontal layers, in the manner called by our workmen battering, or perhaps more correctly, corbelling. It proves, however, that its architect understood the principle of the arch in its horizontal position; for Mr Cockerell discovered, by excavations above it, that the diminishing rings of which the dome is composed were complete in themselves for withstanding outward pressure; the joints of the stones being partly wrought radiating, and partly rendered so by wedges of small stones driven tightly into them behind. The apex is formed, not by a key-stone, for the construction does not admit of that, but by a covering stone, which is merely laid on the course immediately below it. It may be added, that internally the lower projecting angles of the stones are worked off to follow the general outline. Though this is the largest and most perfect, its internal diameter at the base being 48 ft. 6 in., and its height from the floor to the covering stone 45 feet, yet edifices exhibiting similar structure are found in many other places in Greece itself, in Egypt, in Sicily, and in Italy. They all, however, tend to prove, that the principle of the construction of the vertical arch was unknown at the time of their erection in all those countries; and their erection is evidently of the most remote antiquity. But neither could the mechanical powers have been unknown to their constructors. In the edifice which we have described, and which is thought by some to be the treasury of Atreus, or the tomb of his son Agamemnon, mentioned by Pausanias as existing among the ruins of Mycenæ in his time, the inner lintel of the doorway is 27 feet in length, 16 feet deep, and nearly 4 feet thick, weighing, it is computed, upwards of 130 tons; and the lintel of the Gate of the Lions in the Acropolis of the same city, is, from its immense magnitude, also strongly illustrative of the great mechanical skill of the people of those times.

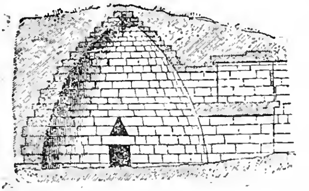


FIG. 43.—Treasury of Atreus, Mycenæ; section. From Waring's *Stone Monuments*

As no nation has ever equalled the Egyptians in the extent and magnitude of their architectural monuments, neither have the Greeks been surpassed in the exquisite beauty of form and proportion, in the extreme simplicity and perfect harmony, which pervade every part of their structures. Unfortunately these monuments are known to us only by their ruins, for there is not a Grecian building remaining in a perfect state. In Greece proper, at least, this was not so until a comparatively recent date, viz., that of the war between the Venetians and Turks. The Parthenon itself was nearly perfect until that time, when it was shattered by an explosion of gunpowder (1687).

First in importance in Grecian architecture is the use of the three orders, Doric, Ionic, and Corinthian, with the peculiar mouldings, &c., connected with each. The Doric and Ionic columns, rudely drawn, appear on the early Etruscan or Greek vases. They are very slender, with large projecting capitals and with entablatures, which indicate pretty clearly copies from a construction of wood. Buildings, much as these, and all of wood, are described by Sir C. Fellows as still being constructed in Lycia. That columns of wood were used in the ancient temples of Greece we know from such notices as we have, *e.g.*, of an old wooden column which was preserved in the temple of Juno at Olympia, as h[illegible]ing been [illegible] of those of a form[illegible] [illegible]. By [illegible] doubt sometimes used, as the place at in, recesses for the bolts, hinges, pins, or sockets have been found; and Mr Smith has discovered a doorway with its actual lintel, now in the British Museum.

Above the sculptured slabs decorations have been found of various kinds. The most lasting seem to have been of baked bricks richly coloured and glazed. At the city gate of Khorsabad blue glazed tiles with yellow reliefs have been found. Victor Place found also that the lower part of the walls near the gate were faced with coloured enamelled bricks, having human figures, lions, &c., within an ornamental border. The arch over the gateway was also richly decorated with glazed tiles. Large remains of coloured decoration in plaster have also been found at Nimroud, &c. They were of figures outlined in black on a blue ground, and below the outer coat of plaster more extensive decorations have been found on an earlier coat. They were of various colours on a pale yellow ground. In other cases they had merely a black outline and were uncoloured. Now the difference of age between the several structures is some centuries, and it is curious to find that the earliest art works, viz., those in the N.W. palace, are the best in point of variety of detail and ornament, in severity of style and purity of outline. The later have extreme delicacy and minuteness, truth to nature and vigour of treatment, particularly in the animals, but they want, in the opinion of Mr Layard, the vigour of the old decorations. Of external decorations we have a striking account in the inscription relating to the Birs Nimroud, in which the several stages are described as being coloured as follows:—the lowest, black; the others in succession, orange, red, yellow, green, and blue. This vivid colouring may be explained by a discovery made by Mr Loftus at Warka of a wall which

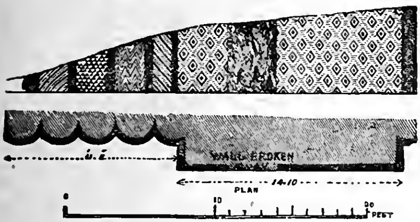


Fig. 39.—Elevation and Plan of Terra-Cotta Cone wall, Warka.[1]

was richly decorated in geometrical patterns by means of small earthenware cones, the wide ends outwards and en-

Fig. 40.—Terra-Cotta Cone, reduced by one-seventh.

amelled in different colours; also by Victor Place's discovery at Khorsabad of four stages of a temple coloured in succession white, black, red, and blue.

In the Assyrian and Chaldean buildings little use was made of marble, granite, or stone, the greater part of the edifices being built with bricks,—the lower parts with burnt bricks put together with bitumen, and the rest with crude bricks and slime. Sometimes the walls were faced with burnt bricks. One wall has been found with 10 feet in thickness of burnt brick facing, and 28 feet of crude bricking.

In Assyrian art generally there is little analogy to that of Egypt. There is some slight resemblance in the mouldings and in a few of the ornaments, but in Assyria there are no forests of columns, no grand pylons, no enormous cloistered court, and nothing to equal the gigantic pyramids or tombs of Egypt. The sphinx is superseded by the winged bull, and the slightly cut intaglio by the magnificently sculptured slab. In these early Assyrian structures there is art at a high stage of perfection, but we have no means of discovering the steps by which it was attained.

[1] Figs. 39, 40, and 41 are from Loftus's *Chaldæa and Susiana*, by the kind permission of Messrs Nisbet, the publishers.

Persian Architecture.

Persia was one of the greatest of ancient nations. At one time it embraced all Upper Asia, and Asia Minor, Phœnicia, Egypt, Thrace, and Macedonia, and though the greatness of its glory has departed, it was still a great living nation even in the 18th century when its king Nadir Shah invaded India. Compared thus with Egypt, Assyria, and Babylonia, long since extinct, it has had a wonderful existence, reaching down from Cyrus to our own time.

We know little of its early history. It cannot be doubted, that long before the rise of the Persian power, mighty kingdoms existed in these regions, and particularly in the eastern part of Bactria, yet of those kingdoms we have by no means a consistent or chronological history—nothing but a few fragments. It is probable that from dynasties which ruled in Media properly so called, immediately previous to the Persians, the style of architecture may have been in some measure derived, though indeed we know of no remains of earlier date than those which are properly called Persian.

Of the early times of the empire no authentic remains exist, except those of the tomb of its founder, Cyrus, at Murgab or Pasargadæ (east of the head of the Persian Gulf), and some of the walls, &c., of the ancient capital, Ecbatana, in North Media. The former is still in a wonderful state of preservation, but it can scarcely be reckoned amongst Persian edifices, as it is clearly a work designed by some architect from a Greek colony of Asia Minor. The tomb stands on seven bold steps of white marble, the lowest being 43 feet by 37 feet. The tomb itself is 21 feet by 16 ft. 5 in. outside, with bold mouldings to the door; it has a sloping roof of marble, with a pediment at each end, enriched with mouldings. The chamber itself is only 7 feet by 10, the walls being built up with thick blocks of marble. Near the tomb was the famous inscription, "I am Cyrus the king, the Achæmenian," and though this is now wanting, recent discoveries seem to have disinterred the stone which had borne it, and which had been torn away. Round the tomb outside had evidently been a colonnade of 24 columns, fragments of which, with the bases, alone remain. They resemble those commonly used by the Greeks. This singular structure seems to have been unique in Persia. It is evidently the work of a foreigner, although the outline may represent, as is supposed, a temple. The famous walls of Ecbatana, the ancient capital, are said to have been 75 feet broad and 105 high, its stones 9 feet by 4 ft. 6 in., and its gateways 100 feet high and 60 wide. The remains, however, show walls only 12 feet wide, stones only 2 feet by 1 ft. 2 in., and a gateway only 12 feet high and 10 feet wide. They deserve particular mention on account of their being among the earliest examples of constructive colouring on a grand scale. The walls are said to have been seven in number, one over the other on the sides of a conical hill, and coloured in succession, white, black, scarlet, blue, orange, silver, and the innermost gilt. From what has been discovered at Warka (see above), it is possible that this gorgeous description may have been founded on fact; and we know that the Easterns in early times were profuse in their employment of glazed coloured bricks.

Of the domestic structures of the same early time we have no remains, but it would appear that the grander buildings had courts, surrounded by colonnades, somewhat in the Egyptian style, the columns and beams being of wood, coloured, and sometimes gilt, or coated with metal. Above was a sloping roof. We learn particularly from this that the Persian or Median architects were thoroughly well used to a wooden construction.

Some 50 years after Cyrus, the chief buildings at Persepolis and Susa were constructed; large portions still remain, and form some of the grandest ruins in existence. Of these we have measured drawings worked out by Messrs Texier and Flandin, from which we derive the chief part of our knowledge, although we have very interesting accounts by Sir R. K. Porter, Mr Rich, Mr Morier, Mr Loftus, &c. The existing buildings at Persepolis occupy a remarkable position on an elevated platform (partly, it would seem, artificial) at the foot of a steep rock in the face of which were cut out the tomb chambers of the Persian kings. The platform was 1425 feet on the west side, and 926 feet on the north, about the size of the Horticultural Gardens in London, including the arcades and conservatory. It was raised about 40 feet above the level of the adjoining country, and faced with a wall, built with stones of an immense size. The platform was approached by the grandest flight of steps in the world, each step being 22 feet long. Having scaled these, the stranger would pass through the first building, viz., the Propylæum of Xerxes, a building whose remains have given rise to several theories as to its original plan and purpose. There remain two grand gateways 24 feet apart, with portions, more or less perfect, between these, of four columns 45 feet high. The gateways had openings of 13 feet, and each of their piers was partly composed of bulls, admirably executed, and strikingly like the Assyrian sculptures at the Louvre from Khorsabad. The human heads of these animals are crowned with coronets of leaves, and from the top of the coronets to the hoofs, the animal measures 19 feet. Nothing further has been discovered which would throw light on the general plan of the building. Mr Fergusson believes that it was enclosed and roofed, and served as a justice hall, or place of assembly at the entrance of the palace. M. Flandin's idea is, that the structure was a mere open portico roofed, but without walls, except perhaps for a few feet in height. Through this structure was the entrance to the grand palace, the Chehil Minar, *i.e.*, hall of 40 columns, an Eastern mode of expressing a great many, as there were really 72. It was approached by a magnificent staircase, each step of which served as a pedestal to a figure (1 ft. 9 in. high) in bas-relief, the whole representing a procession, and of great value as giving the varied costumes, &c., of the period. The columns of the palace are arranged in four divisions, viz., one of 36 columns in the centre, and three each of 12 columns in two rows, divided from the centre by a space of about 60 feet. Of all these only 10 are standing, but the bases of most remain, and the whole ground is covered with the ruins of the columns that have fallen. Their height varied from 60 feet (including capital and base) in the front division, to 67 ft. 4 in. in the centre one. In these columns there is an advance upon the architecture of Egypt, for they have bases, richly carved, and capitals of a form unknown to our art, before or since. The typical form is that of the double-headed bull with a deep cavity between the heads, evidently intended to hold a beam. There is a quaint grandeur about these columns, from their design and their gigantic size. The capitals of one division, the western, are 7 feet high, and 12 ft. 2 in. wide, whilst the shafts, 54 ft. 10 in. high, are each composed of only four great marble blocks. Unfortunately we have only fragments of these buildings, with no history or tradition to guide us as to their perfect forms. There are no walls, no doorways, and no roofs. Mr Fergusson in his restoration places walls between the several divisions, and thus forms them into one grand, enclosed structure, with a mass of columns in the centre, and three porticoes at the sides. He also believes that there was an upper story, to which, indeed, some Persian writers have alluded. Sir R. K. Porter's restoration, with that of Messrs Flandin, Coste, and Texier, is quite different. They believe that the four groups of columns were isolated and had no enclosing walls, but were simply screened by curtains; that the centre division had a flat roof with an opening in the centre, protected by an awning, for light and ventilation; that the roof, cornices, and superstructure of all kinds, were of wood, as no fragment of a stone cornice, lintel, or tile has been found.

Now it so happens that at Susa there was another great palace, similar, or nearly so, in size and plan to that at Persepolis, and with an inscription showing it to have been built by Artaxerxes Mnemon, son of Xerxes. The height of the columns is unknown, but the capitals and bases correspond closely with those at Persepolis. The capitals have singular volutes under the double bull's heads, the whole being 28 feet high, the capitals alone being thus as high as the columns and bases together of St Martin's, London. Mr Loftus examined this structure carefully, and satisfied himself that no walls had ever existed. In addition to this an ancient drain has been found at Persepolis, in the very line which one of the main walls must have occupied. Mr Loftus therefore agrees with Sir R. K. Porter and the others in their restoration. The description in Esther i. 6, has been supposed to refer to this palace. Two other structures at Persepolis were really enclosed—viz., the palaces of Darius and Xerxes. Each has the four divisions of columns, as at the Chehil Minar and Susa; but the jambs to the doors and other portions of the enclosure still remain. These were clearly places for habitation. A still larger enclosed building, the hall of 100 columns, has also left gigantic fragments. The size and arrangement are unknown; but it must have been about 225 feet square, and enclosed by walls, some of the doorways and blank windows of which remain. The excavated tombs of the kings, high up in the face of the mountain, just as described by Diodorus, are the only other important remains of ancient Persia. Remains at Susa.

FIG. 41. — Compound Capital and Base of Column at Susa.

To sum up as to our knowledge of Persian art, the greater part of the remains are columnar, not an edifice is built on the Assyrian plan, and there is little to remind us of Assyria except the human headed bull. The doors and windows somewhat resemble those of Egypt. They have the same plain architrave, the large roll, cavetto, and fillet at top. But the sides of the portals are straight; there are no massive pylons, and the whole character of the columns, bases, and capitals is utterly unlike any known remains of Egyptian or Assyrian art. By what stages the Persian architects arrived at the singular work at Persepolis and Susa we cannot now judge. All we know is that Persian art was developed contemporaneously with that of Greece, though with utterly different results. The elegant form of the Greek temples, the curve of the Assyrian arch, would seem to have been unknown to the Persians, who, it appears likely, worked out their latest forms by gradual

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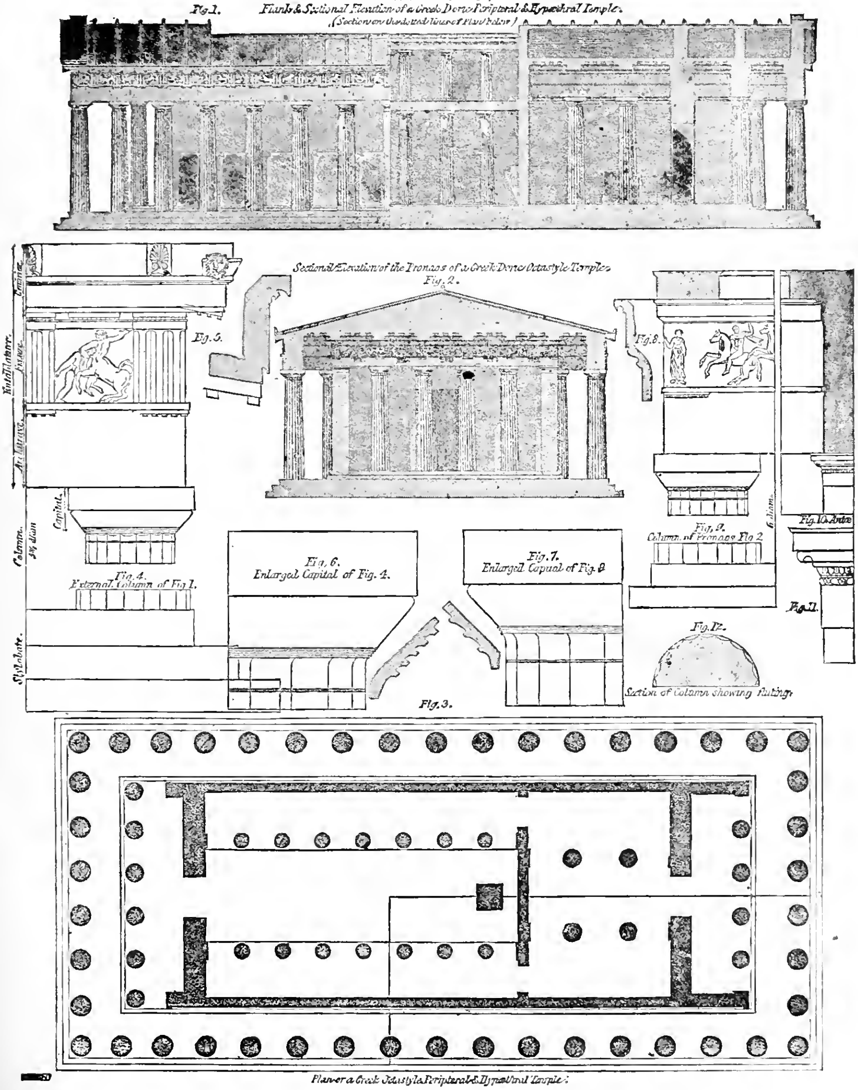

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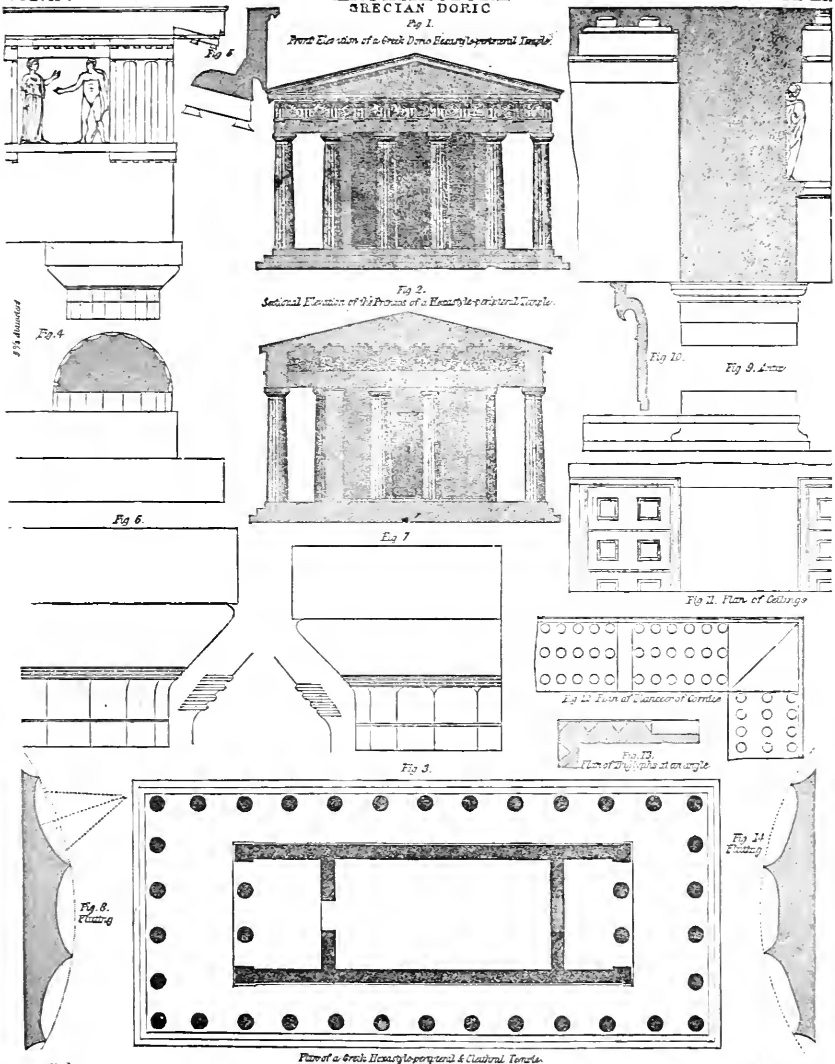
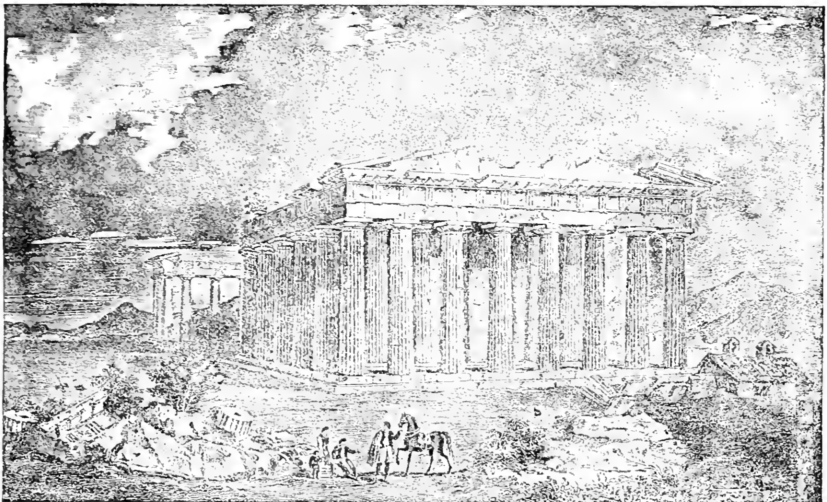


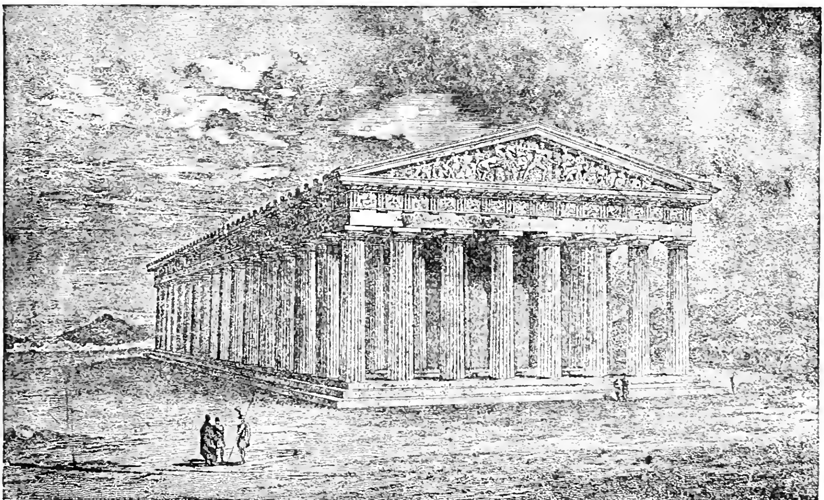
Plan of a Greek Hexastyle-peripteral & Clathral Temple.

R.K. del

The Temple of Minerva Parthenon at Athens. (North-west view)



In its present state.



Restored.

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these light wooden structures we see the origin of the orders, by the earliest stone columns known being the most massive and if we turn to Egypt, the mother of the arts and sciences, we shall find many things in some of the most ancient structures which may have furnished an idea of the Doric arrangements to the fertile imagination of the Greek. Allusion has already been made to the well-known façade at Beni Hassan, on the Nile, as giving us a very likely prototype of the Grecian Doric column.

Of the triglyph, the most distinguishing part of the Doric entablature, there are many indications in the early works of Upper Egypt; and in the structures of the Ptolemies they are still more evident, though it may be objected that in them the indications were borrowed from the Greeks after the Macedonian conquest. But it must be borne in mind that the Egyptian nation did not change its character, religion, or usages by the change of its governors; and the Egyptians were, through the whole period of their existence as a nation, an originating and not an imitative people; whereas the Greeks seized on a beauty wherever they found one, and made it their own by improving it. To the question, why the Greeks cannot be allowed to have originated that beautiful style of architecture which they brought to the perfection it displays in their works, it may be sufficient to answer, that it would be against the common course of events if it were so. It is remarkable that, in Greece, the earliest specimen of columnar architecture that presents itself displays the chief characteristics which are found in works of periods when learning and civilisation were at their acme in that country

It will be convenient to give here at the outset a list of the principal Greek buildings.

Tabular List of Principal Greek Temples, &c.[1]

Site of Temple, &c.	Date. B.C.		Cols. Front.	Cols. Flank.	Order.	
Assos			8	13	Doric	Peripteral
Corinth					Do.	
Selinos (3d Temple)			6	14	Do.	Peripteral
Do.		T. of Jupiter	8	16	Do.	Dipteral
Segesta	c.600 to 500	Minerva	6	14	Do.	Peripteral
Syracuse		Do.	6	14	Do.	Do.
Ægina		Jupiter	6	12	Do.	Do.
Pæstum (Hypæthral)			6	14	Do.	Do
Do.			9	18	Do.	Pseudodipteral
Do.			6	13	Do.	Peripteral
Agrigentum		Juno	6	13	Do.	Do.
Do.		Concord	6	13	Do.	Do.
Do.	480 400	Jupiter	7	14	Do.	Engaged
Athens	480	On the Ilissus	4	...	Ionic	Amphiprostyle
Do.	470	Victory	4	...	Do.	Do.
Do.	460	Theseum	6	13	Doric	Peripteral
Do. (finished)	438	Parthenon	8	17	Do.	Do.
Do.	435	Propylæum	...	...	Do.	Do.
Olympia	finis. c.436	Jupiter	6	...	Do.	Do.
Bassæ (Phigelia)	420	Apollo	6	15	Do.	Do.
Branchidæ, Ionia	...	Do.	10	21	Ionic	Dipteral
Erechtheum (Athens)	410	...	...	...	Do.	Irregular
Priene	336	Minerva	6	...	...	
Ephesus	336	Diana	8	20	Ionic	Dipteral
Halicarnassus	353	Mausoleum	...	...	Do.	
C. of Lysicrates, Athens	835	...	...	...	Corinthian	

The Grecian Doric (Plates VIII., IX., X.)

Vitruvius gives several accounts of the origin of the Greek Doric order. He states first that "Dorus (the son of Hellenus and of the nymph Orseis), king of Achaia and of all the Peloponnesus, having formerly built a temple to Juno in the ancient city of Argos, this temple was found by chance to be in that manner which we call Doric." In another place he deduces the arrangements of the order from those of a primitive log hut, settling with the utmost precision what, in the latter, suggested the various parts in the former. But he also tells us that the Doric column was modelled by the Grecian colonists in Asia Minor in the proportions of a human figure, and was made six diameters in height, because a man was found to be 6 times the length of his foot. But this story, even supposing it to be rational, does not coincide with the Greek Doric at all, but, if with anything, with the Roman.

In the Greek examples, this order may be divided into three parts, stylobate, column, and entablature (Plate VIII. fig. 4). The stylobate is from two-thirds to a whole diameter of the column in height, in three equal courses, which recede gradually the one above from the one below it, and on the floor or upper step the column rests. That graduation, it may be remarked, does not appear to have been made by the ancients to facilitate the access to the floor of the stoa or portico, but on the principle of the spreading footings of a wall, to give both real and apparent firmness to the structure, both of which it does in an eminent degree.

The column varies in height in different examples, from four diameters, as at Corinth, to six diameters, as at Sunium. Of this the capital, including the necking, is rather less than half a diameter: in those cases in which a necking does not exist, the capital itself occupies nearly the same proportion (Plate VIII. figs. 4 and 9; Plate IX. fig. 4). The shaft diminishes in a slightly curved line, called an entasis, from its base or inferior diameter upwards to the hypotrachelium, where the diameter is from two-thirds to four-fifths of that at the base. It is the inferior diameter that is always intended when the term is used as a measure of proportion. The capital consists of a necking, an echinus or ovolo, and an abacus; the necking is about one-fifth of the height of the capital, and the other two members equally divide the remaining four-fifths; when there is no necking, the ovolo occupies the greater proportion of the whole height. The abacus is a square tablet, whose sides are rather more than the inferior diameter of the column. The corbelling of the ovolo adapts it to both the diminished head of the shaft and the extended abacus, flowing into the one, and forming a bed for the other by means of a graceful cyma-reversa; but its lower part is encircled by three or four rings or annulets, which are variously formed in different examples, and which give the echinus form to the great moulding, although it is, as we have said, part of a cyma-reversa. (Figs. 6 and 7 of Plates VIII. and IX.) The shaft is divided generally into twenty flutes; but there are several examples with sixteen, and there is one with twenty-four. The flutes are sometimes segments of circles, sometimes semi-ellipses, and sometimes eccentric curves (Plate VIII. fig. 12; Plate IX. figs. 8, 14.) They always meet in an arris or edge, and follow the entasis and diminution of the column up through the hypotrachelium to the annulets, under which they finish, sometimes with a straight and sometimes with a curved head. At the base they detail on the pavement or floor of the stylobate. In one example at Segesta the columns are not fluted at all, and in two others, at Cnidus and Delos, the flutes are marked at top and bottom only, but in these examples the columns were possibly not finished.

The third part of the order, the entablature, ranges in various examples from one diameter and three-quarters to rather more than two diameters in height, of which about four-fifths is nearly equally divided between the architrave and frieze, while the cornice occupies the remaining one-fifth: this is in some cases exactly the distribution of the entablature. (See Plate VIII. fig. 5; Plate IX. fig. 5.)

[1] The angle columns are counted each way.

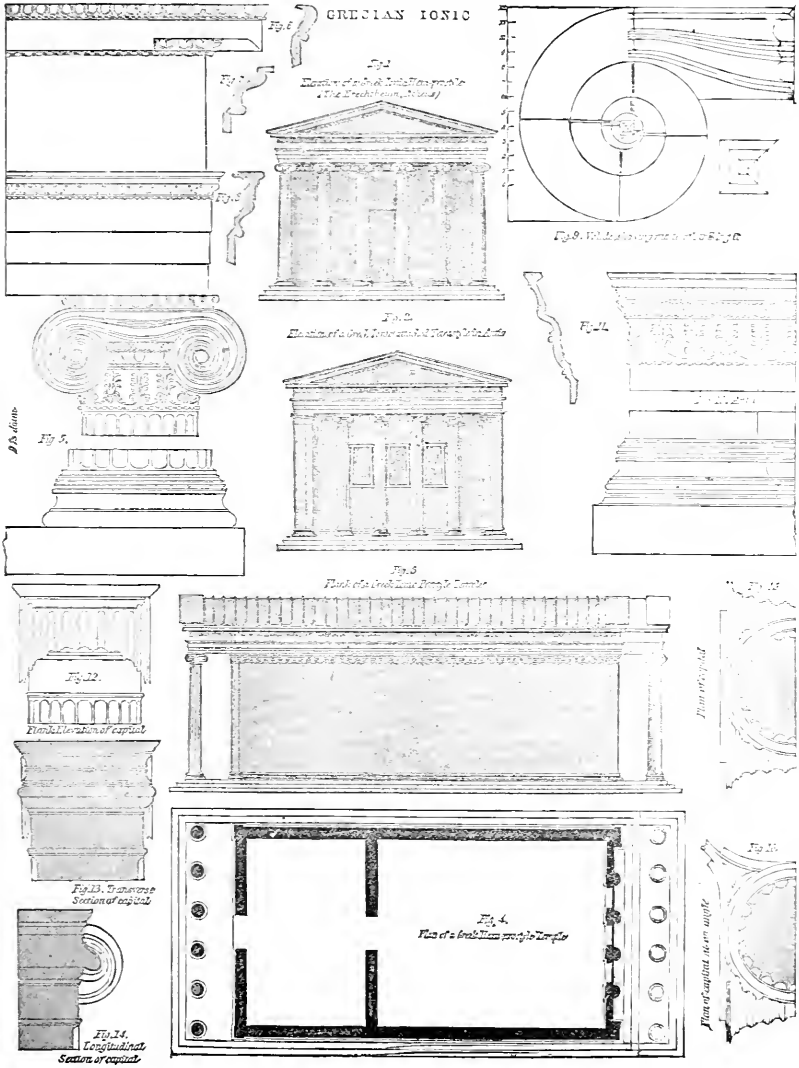
The architrave is in one broad face, four-fifths, and sometimes five-sixths of its whole height; and the remaining fifth or sixth is given to a projecting continuous fillet called the tænia, which occupies one-half the space, and a regula or small lintel attached to it, in lengths equal to the breadth of the triglyphs above in the frieze. From the regulæ six small cylindrical drops, called guttæ, depend. There are examples to the contrary, but it may be taken as a general rule, that the architrave is not in the same vertical line with the upper face of the shaft, or its circumferential line, at the superior diameter, but is projected nearly so much as to impend the line or face of the column at the base. In one example only is the architrave known to be sculptured, viz., at Assos, where it has bas-reliefs of bulls fighting. The frieze, vertically, is plain about six-sevenths of its whole height, and is bounded above by a fascia, slightly projecting from it, which occupies the remaining seventh. Horizontally, however, it is divided into triglyphs and metopes, which regulate the intercolumniations; the former being nearly a semidiameter in width, and the latter (the space interposed between two triglyphs) generally an exact square, its breadth being equal to the whole height of the frieze, including the fascia. This latter breaks round the triglyphs horizontally, and is a little increased in depth on them. These metopes are shown on the vases to be holes between the ends of beams, and that the metopes were, at one time, open, seems to be proved by a passage in Euripides, who lived during the construction of the Parthenon. No example, however, early or late, remains to support this view. Each glyph, of which there are two whole ones and two halves to every tablet, is one-fifth of the width of the whole, and the interglyphs are each one-seventh of the whole tablet or triglyph. The glyphs detail on the tænia of the architrave, but are variously finished above. In some examples they are nearly square-headed, with the angles rounded off; in others the heads are regular curves, from a flat segment to a semi-ellipse. The semiglyphs are finished above in a manner peculiar to themselves, with a turn or drop; but hardly two examples correspond in that particular. The tablets in which the glyphs are cut are vertical to the face of the architrave, the metopes recede from them like sunk panels; these are often charged with sculptures, and indeed almost appear contrived to receive them. The third and crowning part of the entablature, the cornice, in what may be considered the best examples, projects from the face of the triglyphs and architrave about its own height. Vertically, it is divided into four equal parts, one of which is given to a square projecting fillet at the top, with a small congeries of mouldings, different, and differently proportioned to each other, in various examples. Two other parts are given to the corona, and the remaining fourth to a narrow sunk face below it, with the mutules and their guttæ. These latter form the soffit or planceer of the cornice, which is not horizontal or at right angles to the vertical face of the entablature generally, but is cut up inwards at an angle of about 80°. The width of the mutules themselves is regulated by that of the triglyphs over which they are placed, to which it is exactly equal. They are ornamented each with three rows of six small cylinders, similar to those which depend from the regulæ under the triglyphs and on the architrave. There is twice the number of mutules that there is of triglyphs, one of the former being placed over every metope also in the manner the examples indicate.

This completes the Greek Doric order according to the generally received sense of the term; but there are other parts necessary to it. In the front or on the ends of a temple, or over a portico, a pediment is placed (Plate IX. fig. 1). Its intention is to enclose the ends of the roof, but it forms no less a part of the architectural composition. In reason, it should be raised as much as the roof required; but when the span is great that would be unsightly; and reference appears to have been made to the common standard of proportion, as the pediments of most Doric temples are found to be about one diameter and a half in height at the apex of the tympanum, which in a hexastyle arrangement makes an angle at the base of about 14°, and in an octastyle about $12\frac{1}{2}$°. The pediment is covered by the cornice, without its mutules, rising from the point of its crowning fillet, so that no part of it is repeated in profile. Another moulding, however, is superimposed: sometimes this is an ovolo with a fillet over it, and sometimes a cymatium. It varies much in its proportion to the cornice, but in the best examples it is about one-half the depth of the latter without its mutules. Ornaments of various kinds, statues or foliage, are believed to have been placed on the apices and at the feet of pediments as acroteria. Of these, however, we have the remains of one only (a very beautiful one), viz., at Ægina; but indications of the plinths or blocks which may have received them exist, and such things appear represented on ancient coins and medallions. The tympana of pediments are well known as receptacles of ornamental sculpture. On the flank of a Doric temple, the cornice supported a row of ornamented tiles called antefixæ. These formed a rich and appropriate ornament, but they rather belonged to the roof than to the columnar arrangement or order. The antefixæ covered the ends of the joint-tiles as the pediments did those of the roofs; and corresponding ornaments called stelai rose out of the apices of the joint-tiles, forming a highly enriched ridge (see Plate VIII. fig. 1).

A secondary Doric order arises in the disposition of a Grecian temple, from the columns of the pronaos and the inner part of the external entablature continued and repeated. Of this the frieze is generally without triglyphs, though there may be regulæ and guttæ on the architrave. The fascia of the frieze is either moulded or enriched on the face; and, instead of a cornice, the beams of the ceiling are laid at equal intervals to support sunk panels or coffers, in which there may be flowers or other enrichments (Plate VIII. fig. 8).

Propriety in the composition and arrangement of antæ is as necessary to the perfection of the Doric order as to that of the columnar ordinance itself, especially if the latter be *in antis*. Slight projections are made on the end and side faces of a wall, so as to form a species of pilaster, whose front shall be nearly equal to the diameter of the columns to which it is attached, exactly equal indeed to the soffit of the entablature, whose faces have been described as impending the circumferential line of the column at a little above its base. This rests on the stylobate in the same manner as the columns do, with sometimes a small continuous moulding as a base; and its capital is a congeries of mouldings, about the depth of the abacus, with a plain fascia corresponding to the ovolo of the columnar capital. The entablature of the order to which it is attached rests on it, and, continuing along the flank of the building, is received by a similar combination at the other end. These, it may be remarked, were seldom diminished or fluted, an example at Pæstum being about the only exception. Being projections from and upon the ends and faces of walls, they could not be diminished without involving an absurdity, and fluting on a straight surface must be productive of monotony, as the flutes can only project a series of equal and parallel shadows. Not so, however, with columns, on whose rotund surface fluting produces a beautiful variety of light and shade in all their gradations, which it could not possess without that enrichment; for on a plain

GRECIAN IONIC



column neither are the lights so bright nor the shadows so dark as in the former case, nor are they so finely diffused over the whole surface in the one as in the other.

In the Parthenon the antæ, as well as the columns, are without bases. In all other examples the base line of the antæ is marked by a few small mouldings. In the only example which occurs in the ancient architectural remains of attached Doric columns—that of the pseudo-peripteral temple of Jupiter Olympius at Agrigentum—the stylobate is peculiarly arranged. The upper gradus is grooved, and detailed round the columns and along the walls between them; and a congeries of vertically arranged mouldings and fillets rests on it, and receives the base of the column.

As before stated, the earliest examples of columns are the heaviest; they are also the most tapering, and there are some other details which help us in identifying the date of a Doric edifice in Greece proper. The hypotrachelium in early examples, as at Corinth, has three grooves; in later, as the Parthenon, only one. The contour also of the chief member, the echinus, varied at different dates. In the earliest it was full and round, as at Corinth, and at Assos (the latter having the greatest curve of any known example); sometimes possibly, as at Segesta, struck with the compass, but almost always part of a conic section (parabola). In later times it became less curved, and in the finest examples almost flat, as in the Propylæum and Parthenon, but still forming part of a very delicate curve (hyperbola). In one case, at Selinus, where, to an inexperienced eye, the whole temple would appear to be of the same date, the differences alluded to contrast very strongly with each other. In the very late times of Greek work, when art became debased, the coarse round form of earlier work is exhibited, as in the Agora. The width of the abacus in early examples, as Corinth, is as much as two-sevenths the height of the shaft and cap. In later examples it diminishes to one-fifth. And as the column, so the entablature was more massive in the early examples, except in the colonies, where the old proportions continued to a late period. At Pæstum the proportion of entablature to column is as 1 to 2·4; Ægina, 1 to 2·53; Theseum, 1 to 3 nearly.

Such are the materials of which the Greeks composed those beautiful temples, whose peculiar effect and character arise from their simplicity and harmony. These qualities are visible in the long unbroken lines which bound their forms, and the breadth, boldness, and fitness of every part. The entablature, though massive, is fully upborne by the columns, whose spreading abaci receive it, and transmit the weight downwards by the shafts, which rest on a horizontal and spreading basement,—the magnitude of every part, as before remarked, being determined by the capacity of the sustaining power. Besides graceful and elegant outline, and simple and harmonious forms, these structures exhibit a wonderful variety of light and shade, arising from the judicious contour and arrangement of mouldings, every one of which is rendered expressive. The effect is heightened by the fluting of the columns and the peculiar form of the columnar capital, with its broad square abacus, which projects a deep shadow on the bold ovolo. The play of light and shade about the insulated columns is strongly modified by the deep shadows on the walls behind them; and in front, where the inner columns appear, the effect is enchanting. For all the higher effects which architecture is capable of producing, a Greek peripteral temple of the Doric order is perhaps unrivalled.

The Grecian Ionic (Plate XI.)

Of this beautiful and graceful order it is as difficult to determine the origin as of the Doric. The explanation of Vitruvius is that the Ionian colonists, on building a temple to Diana, wished to find some new manner that was beautiful. Following the method which they had pursued with the Doric (proportioning the column according to the dimensions of a man), they imparted to this the delicacy of the female figure—in the first place, by making the diameter of the column one-eighth of its height, then by putting a base to it in twisted cords, like the sandals of a woman, and forming the capital with volutes, like the hair which hangs on both sides of her face. To crown all, he says that they chanuelled or fluted the column to resemble the folds of female garments, by which it would appear that Vitruvius did not know that the Greeks never executed the Doric order without fluting the columns. "Thus," he goes on to say, "they invented these two species of columns, imitating in the one the naked simplicity and dignity of a man, and in the other the delicacy and the ornaments of a woman."

From the recent discoveries in Assyria, however, there can be no reasonable doubt that the Greek colonists of Ionia at least obtained their idea of the Ionic capital from Nineveh. As to its earliest forms great differences of opinion exist. An extremely plausible theory, originated and ably worked out by Mr Skidmore, suggests that the delicate Ionic curls were copied from the curved ornamental wire-work of the goldsmiths. On the other hand, a recent French author has found in Sicily a rudely carved capital which is little more than a block of stone with the ends rounded off, the curve being continued, and thus forming a volute; and it is very possible that a crude idea like this might have been worked out, with some help from Assyria, into one of the many forms of the Ionic capitals.

Of this graceful and elegant style we take the proportions and peculiarities from the perfect examples of the Athenian Acropolis. This order may also be considered in three similar parts, stylobate, column, and entablature.[1] The stylobate is in three receding equal courses or steps, whose united height is from four-fifths to one diameter. The column, consisting of base, shaft, and capital, is rather more than nine diameters in height; of which the base is two-fifths of a diameter, and the capital, including the hypotrachelium, is in one case three-fourths, and in the other seven-eighths of a diameter high. As shown in the vases, it is invariably very long and slender, and without bases; but no actual example remains to us without a base. The base consists of a congeries of mouldings extending gradually from a diameter and a third to a diameter and a half, and its height is in three nearly equal parts, two equal fillets separating them. The lowest, a torus, rests on the top of the stylobate or floor of the portico, a fillet divides that from the scotia, a second fillet intervenes between the scotia and a second torus, and a third fillet bases the apophyge or escape of the shaft. The upper torus of the base is, in one example, fillet-fluted horizontally; and in the other, the same member is enriched with the guillochos. The shaft diminishes with entasis from its lower or whole diameter to above five-sixths of it immediately under the hypotrachelium. It is fluted with twenty-four flutes and alternating fillets, which follow the diminution and entasis of the column. The flutes in plan are nearly semi-ellipses, and they finish at both ends with the same curve; a fillet is in thickness nearly one-fourth the width of a flute. The difference in the height of the capital is in the length of the necking, which in one case is separated from the head of the shaft by a carved bead, and in the other by a plain fillet. Above the necking, a height of about one-third of a diameter is occupied by a congeries of three spreading or corbelling mouldings—a bead, an

[1] For explanation of terms see Plate IX figs. 5 to 8, and glossary.

ovolo, and a torus—which are all appropriately carved. On these rests the parallelogramic block, on whose faces are the volutes, and whose ends are concaved into what is technically termed a bolster to connect them. This part is about one-third of a diameter in height, and includes a rectilinear abacus, whose edges are moulded to an ovolo and carved with the egg and tongue ornament. The volutes are three-fifths of a diameter in depth, and extend in front to one diameter and a half; and they are nearly a semi-diameter apart. The volutes and the flowing lines which connect them are represented in figs. 5 and 9, Plate XI. The bolsters are fluted vertically with alternate fillets, on which are carved beads. An ornament composed of the honeysuckle with tendrils encircles the necking of the column. It must be remarked, that as the capitals are parallelogramic, and present but two similar fronts, to preserve the appearance of volutes externally on all sides, the capitals of the columns at the external angles of porticoes are differently arranged (compare figs. 15 and 16). The outer volute is bent out at an angle of 45°, and volutes are put on the end or side-front of the capital also, the outer one being the other side of the angular volute of the front. To suit the angle internally, the two volutes of the inner face are placed at right angles to each other: this is, however, at best but an awkward expedient, and need not be employed when a portico projects only one intercolumniation. All the Greek volutes are flat on the surface, except at Bassæ, where the volutes are curved.

The entablature, which is rather more than two diameters in height, is also divided into three parts,—architrave, frieze, and cornice,—which may be proportioned by dividing the whole height into five parts, four of which, as in the Doric, may be again equally divided between the architrave and frieze. The cornice, however, in the example referred to, does not occupy one-fifth of the entablature; but if it had a fillet over the upper moulding, which it appears to want, that would be just its proportion. If the architrave (fig. 8) be divided into nine parts, seven of them may be given to three equal fascias, which slightly project the one before the other, the first or lowest, which is vertical to the circumferential line of the inferior diameter, being covered by the second, and the second by the third. The remaining two-ninths form a band of mouldings corbelling a broad fillet, which separates the architrave from the frieze, these mouldings are enriched. The frieze (fig. 7), which does not project quite so much as the lowest fascia of the architrave, is, in the Athenian examples, quite plain; but it may be enriched with foliage, or made the receptacle of sculpture in low relief. In two examples (one at Selinus, and another at Agrigentum) the frieze has the Doric triglyph. The cornice (fig. 6) projects from the face of the frieze rather more than as much as its whole height, and is composed of bed-mouldings, a corona, and crown-mouldings. The first are a carved bead and carved cyma-reversa, the former of which only occupies a portion of the height of the cornice, as the planceer is cut up inwards, in the manner represented by dotted lines in the figure, to a sufficient depth for it; the crown mouldings, which consist of a carved ovolo above a carved bead, are rather more than one-fourth of the whole cornice; and the corona occupies the rest of its height, except that small portion given to the bead of the bed-mould. A fillet above the crown-mouldings, as already intimated, is certainly necessary to complete the order and receive the antefixæ, as described in the Doric, for the flank of a temple.

The pediments in the examples of Ionic are flatter than in those of the Doric, the angle made by the covering cornice with the base being, in a hexastyle, less than 14°. A vertical fillet, with a small moulding, equal in depth to the two crown-mouldings of the cornice, covers them in the pediment, in the place of the cyma-recta or ovolo used in the Doric order. The intercolumniation differs in these examples, in the one it is two diameters, and in the other three diameters and one-sixth.

A much greater variety is found in the composition of the Ionic than of the Doric order. Indeed, the examples of the Athenian Acropolis alone have neckings.[1] In all the others the shaft runs up to the corbelled mouldings which bed the block of the volutes, and the flutes finish under them. Neither have they a torus in that congeries, but a bead and ovolo alone, the latter projecting inconveniently under the pendent lines that connect the volutes, and thus the capital is not more than half a diameter in height.

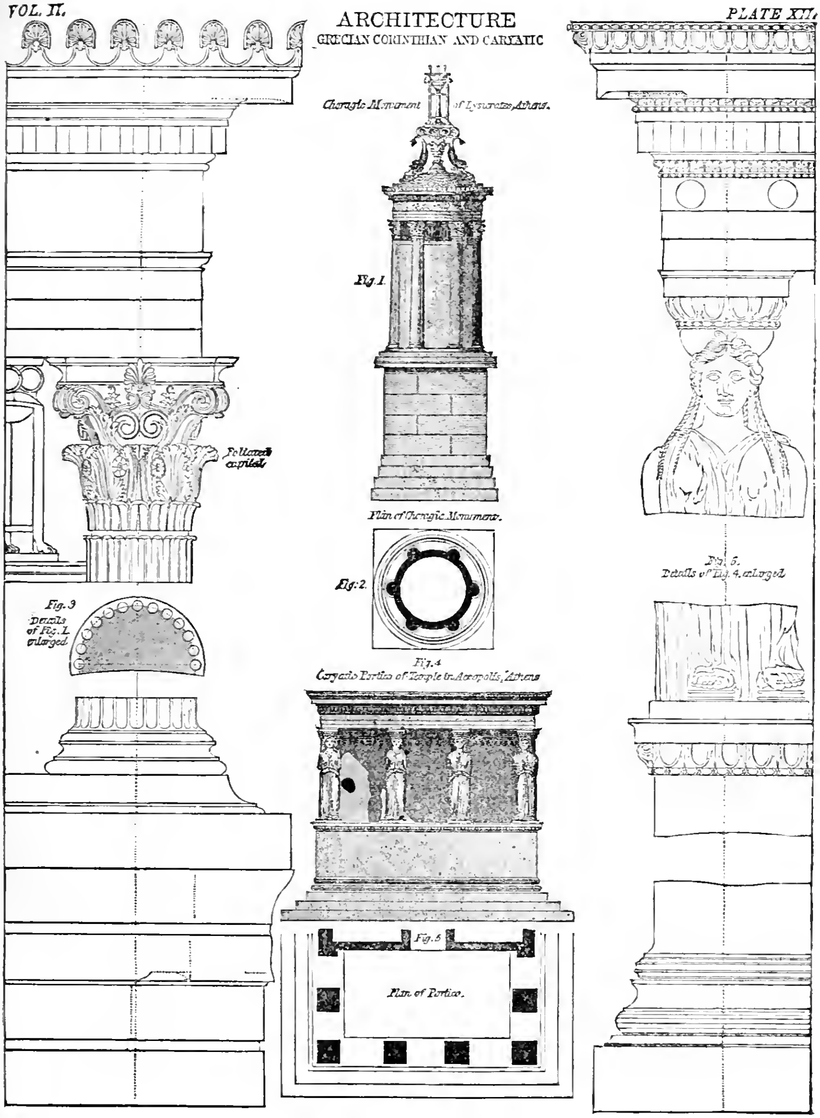
The Asiatic or the truly Ionian examples of this order are far inferior to those above referred to. Their bases are differently, and certainly less elegantly composed. They are without hypotrachelia, as may have been inferred; they want the torus in the capital; and, in most cases, instead of flowing, pendent lines, they have straight lines connecting the volutes. Their entablatures are not so finely proportioned, nor so delicately executed. The coronas want breadth, and the bed-moulds of the cornice are as much too heavy as those of Athens are perhaps too light. Indeed, upon the whole, they have more of the grossness of Roman architecture than of the delicacy and elegance of Grecian, though the Ionian examples are supposed to be the models of those of Athens. In the celebrated temple of Diana at Ephesus the columns present an almost unique example of the lower parts being sculptured. Fine specimens of these are now in the British Museum. The only instance known of sculptured columns is at Narga in Nubia.

The width of the antæ of the Ionic order is determined, as in the Doric, by the soffit of the entablature; and it will, of course, be exactly the same as, or rather less than, the inferior diameter of the column. It is slightly raised, too, from the face of the wall at the ends of which it stands. The base of the antæ is, in one of the two examples of the Acropolis, a little deeper than that of the column, having a small projecting moulding between the lower torus and the floor; and the lower torus itself is reeded. In the other example there is no difference in the form and proportion of the antæ and columnar bases, but both the tori are fluted horizontally, with beaded fillets between the flutes. The antæ cap consists of a congeries of corbelling mouldings, nearly one-third of a diameter in height. It is divided into three nearly equal parts, the lowest of which is composed of a bead and an ovolo; the second of another bead and a cyma-reversa, all carved; and the third of a plain flat cavetto, with a narrow fillet and small crowning cyma-reversa, forming an abacus (fig. 11.) The necking is like that of the capital, and is enriched in the same manner. The cap or cornice thus formed breaks round the projection of the antæ, and is continued along the wall under the entablature the whole length of the building, or till it is impeded by some other construction; and the base is continued in like manner. Attached columns have the voluted capital, but their base is that of the antæ; and it is detailed round them and along the wall to which they belong, as with the antæ. It must be remembered, however, that the attached columns in the triple temple are about one-ninth less in diameter than those which are insulated, though they are similar in other respects, and have the same entablature.

[1] A curious example of the use of the beautiful necking ornament (as at the Erechtheum) occurs in the gigantic monument in Algeria, called the tomb of the Christian Lady, whose date is supposed to be the 1st century B.C. It is evidently a rude copy of some such original as the above.

ARCHITECTURE

GRECIAN CORINTHIAN AND CARYATIC



The back of the triple temple, between the attached columns, presents one of the only two examples in Greek architecture of windows, the other being that of the temple of the Giants at Agrigentum. These are rather more than twice their width in height, and are narrower at the top than at the bottom. They rest on a broad, bold sill, which is equal in depth to two-sixths of the opening, and are surrounded externally by a congeries of mouldings, which, with a plain fascia, constitute an architrave. This architrave is one-fourth the opening in width; it diminishes with the window, and in the same proportion; and is returned above in two knees, which are made vertical to its extreme point at the base.

The Grecian Corinthian (Plate XII.)

The traditionary tale Vitruvius relates regarding the invention of the Corinthian capital (about Callimachus and the basket on the grave of the Corinthian virgin), is the only reason for the name it bears. His account of the origin of this third species of columnar composition is even more absurd than what he gives of the other orders. He says that it was arranged "to represent the delicacy of a young girl whose age renders her figure more pleasing and more susceptible of ornaments which may enhance her natural beauty." With much more reason might the Doric be called the Corinthian order; for, as previously stated, the oldest existing example of that style is at Corinth; whereas there is nothing, either in ruins or authentic records, to prove that the latter was ever known in that city. Columns with foliated capitals are not of very early date in Greece; earlier examples exist in Asia Minor, and foliage adorns the capitals of columns in some of the Pharaonic monuments of Egypt. In the Assyrian sculptures, however, the Corinthian capital is clearly shown. The interior of the temple of Apollo Didymæus, at Miletus in Ionia, exhibits the earliest example of the acanthus leaf arranged round the drum of a capital in a single row, surmounted by the favourite honeysuckle; but that edifice was constructed about a century before Callimachus is understood to have lived. The only perfect columnar example in Greece itself of this species of foliated capital is of later date than, and is a great improvement on, that of Miletus; it is the beautiful little structure called the choragic monument of Lysicrates at Athens. (Plate XII. figs. 1, 2, 3.) Specimens of square or antæ capitals enriched with foliage are less uncommon in Greece than of circular or columnar capitals; but they are almost invariably found to have belonged to the interior of buildings, and not to have been used externally. In considering Greek architecture, it is necessary to bear in mind that it ceases almost immediately after the subjection of Greece to the Roman power; for though there are many edifices in that country in the style of columnar arrangement of which we are now speaking besides those referred to, they belong to Roman, not to Greek architecture. The earliest of them, perhaps, and certainly the least influenced by Roman taste, is the structure called the tower of the Winds, or of Andronicus Cyrrhestes, at Athens. The Agora, or Doric portico, as it is sometimes designated, in the same city, is a spurious example of Greek Doric, evidently executed under the Roman domination.

The importance which the Greeks attached to a graduated stylobate, and the necessity of giving it a relevant proportion in a columnar ordinance, are shown in the building above mentioned, which is the only example of this order of Grecian origin remaining to us. Unlike the Doric and Ionic in its application, this order is represented in a small circular structure, resting on a lofty square basement; and yet, like those orders, it has a stylobate in receding courses (see Plate XII. fig. 3), and in plan, too, corresponding with the arrangement of the columns, and not with that of the substructure,—this furnishing further proof that the stylobate was considered a part of the columnar ordinance. The Corinthian column is ten diameters in height. The base is composed of a torus and fillet; a scotia and another similar fillet, rather less than the former; and a second torus or reversed ovolo, on which rests a third fillet basing the apophyge of the shaft. The shaft diminishes with entasis to five-sixths of its diameter at the hypotrachelium, and, like that of the Ionic order, has twenty-four flutes and fillets. The flutes are semi-ellipses, so deep as nearly to approach semicircles, terminating at the head in leaves, to which the fillets are stalks. The fillets are rather more than one-fourth the width of the flutes. The hypotrachelium is a simple channel or groove immediately under the capital. The capital itself is rather more than $1\frac{1}{3}$ diameters in height, its core is a perfect cylinder, in bulk rather less than the superior diameter of the shaft. This is banded by a row of water-leaves, whose profile is a flat cavetto, one-sixth of the whole height, and another of leaves of the acanthus, with flowered buttons attaching them to the cylinder. The latter have the contour of a cyma-recta, and occupy one-third of the whole capital. Rather more than another third is occupied by calices and tendrils, which latter support a honeysuckle against the middle of the abacus. This member is in plan a square whose angles are cut off at 45°, and whose sides are deeply concaved. In profile it consists of a narrow fillet, an elliptical cavetto or reversed scotia, and another fillet surmounted by a small ovolo, or rather a moulding whose profile is the quadrant of an ellipse. In the entablature (which is $2\frac{2}{7}$ diameters in height), the architrave is divided, like that of the Ionic order, into three equal fascias, which are not perpendicular, but incline inwards, so that their lower angles are all in the same vertical line; this impends the surface of the shaft about one-third of the height from the base. The frieze is one plain band, slightly inclining inwards like the fascias of the architraves, and slightly projected beyond them. The cornice consists of a deep congeries of bed-mouldings, and a corona, with the accustomed small crown-mouldings and fillet. As in the Ionic cornice, additional height is given to the bed-moulds by undercutting the planceer. The cornice is surmounted by a cut fascia supporting honeysuckle antefixæ, which may indeed be taken as a part of the order, as the solitary example in question presents it.

Of Corinthian antæ we have no examples, nor indeed have we of insulated columns; but as we find in the Ionic examples quoted that the attached columns are less in proportion to the entablature than those which are insulated, we may conclude that it would be the same with this,—thus reducing the entablature to two diameters, the ordinary average of that part in Greek columnar architecture.

The Caryatides, or Caryatic Order (Plate XII.)

Besides the three species of columnar arrangement enumerated above, the Greeks employed another in which statues of women occupied the place of columns. The origin of this order is furnished by Vitruvius in a story which is as usual totally unsupported by history or analogy. Nevertheless it has fixed the nomenclature, such figures being called Caryatides, and the arrangement the Caryatic order. The use of representations of human and other figures with or instead of columns is, however, common in Egypt and India; and to the former the Greeks were doubtless indebted for the idea, though they appear to have restricted its application to human female figures. Mr Gwilt infers from various facts connected with the worship of Diana Caryatis, "that the statues called Caryatides were originally applied to or used about the temples of Diana; and instead of representing captives or persons in a state of ignominy (according to the Vitruvian story), were in fact nothing more than the figures of the virgins who celebrated the worship of that goddess."

Of these Caryatides there is but one existing example. It is the third portion of the triple temple in the Athenian Acropolis, and is a projection from the flank of the principal Ionic structure, formed by a stereobatic dado raised on the stylobate and antæ-base mouldings, with a sur-base consisting of a carved bead and carved ovolo covered by a broad listel, with a narrow projecting fillet above it. On this rests a square plinth, supporting a draped female figure, on the head of which there is imposed a circular moulded block, with a deep rectangular abacus, two-thirds of whose face is vertical, and the other third is a cavetto fillet, and small cyma-reversa. The stereobate, including the moulded base of the temple, is about three-fourths the height of the statue pillar with its base and capital. The entablature is rather less than two-fifths of the same, but it consists of architrave and cornice alone, between which parts the height is nearly equally divided. Details will be understood by reference to Plate XII. figs. 4, 5, 6. This Caryatidean portico displays very clearly the arrangement of the ceiling, with its coffers or cassoons. Internally the architrave is plain two-thirds of its height; of the remaining third rather more than one-half is a plain, slightly projected fascia; the other half is occupied by a carved bead and ovolo. In the absence of a frieze the ceiling rests on this, and is divided by carved beads into panels, which are deeply coffered, and diminished by three horizontal moulded fascias.

Of Grecian Mouldings and Ornaments.

Mouldings. Greek architecture is distinguished for nothing more than for the grace and beauty of its mouldings; and it may be remarked of them generally that they are eccentric, and not regular curves. (Plate XIII.) They must be drawn, for they cannot be described or struck; so that though they may be called circular, or elliptical, it is seldom that they are really so, and if they are, it is evidently the result of chance, and not of design. Hence all attempts to give rules for striking mouldings are worse than useless; the hand alone, directed by good taste, can adapt them to their purpose, and give them the spirit and feeling which render them effective and pleasing.

The leading outline of Greek moulding is the gracefully flowing cyma. This will, indeed, be found to enter into the composition of almost everything that diverges from a right line; and even combinations of mouldings are frequently made with this tendency. It is concave above and convex below, or the reverse; and though a long and but slightly flected line appears to connect two quickly-curving ends, it will always be found that the convexity and the concavity are in exactly the same curve, so that if the moulded surface were reversed, and the one made to assume the place, it would also have the appearance, of the other, and the effect would be the same. It is, in fact, the Hogarthian line of beauty; and it is not a little singular that Hogarth, in his well-known *Analysis of Beauty*, although he did not know, and indeed could not have known, the contours of Greek architectural mouldings, has given the principle of them, and, under his line of beauty, has described many of the finest Greek forms. The Roman and Italian mouldings were called Greek in his day, and he assumed them to be so; but they evidently do not agree with his theory, whereas, in principle, the now well-known Greek forms do most completely.

The cyma-recta is generally found to be more upright and less deeply flected than the cyma-reversa; it is almost always the profile of enrichments on flat surfaces, of foliage, of the covering moulding of pediments, of the undercut or hooked mouldings in antæ caps, the overhanging not affecting the general principle; and it pervades, as we have said, flected architectural lines generally, whether horizontal or vertical. The cyma-reversa has all the variety of inflection that its opposite possesses, but the line connecting its two ends is, for the most part, more horizontal, and its curves are deeper. It pervades many architectural combinations, but is most singularly evinced in the composition of the Greek Doric capital, which is a perfect cyma-reversa, with the ends slightly but sharply flected, as it flows out of the shaft below, and turns in under the abacus above. This may not be obvious, from the annulets dividing the cyma into an ovolo and a cavetto, but the principle is clear.[1] The cyma is the governing outline in the congeries of mouldings in bases also, as may be noticed in the Ionic and Corinthian examples quoted and referred to.

An ovolo is but the upper half of a cyma-reversa, even when it is used as a distinct moulding, and unconnected with the waving form. The name expresses its apparent rather than its real tendency; for its contour is not that of an egg in any section, though the ornament which is carved on it, when used as a running moulding, is formed like an egg; and from that the moulding was named.

The upper torus of a base forms, with the escape or apophyge of the shaft, a perfect cyma, and the scotia and lower torus do the same; so that the torus and scotia are referable to the same principle when in composition, and they are not found together except in the combination referred to.

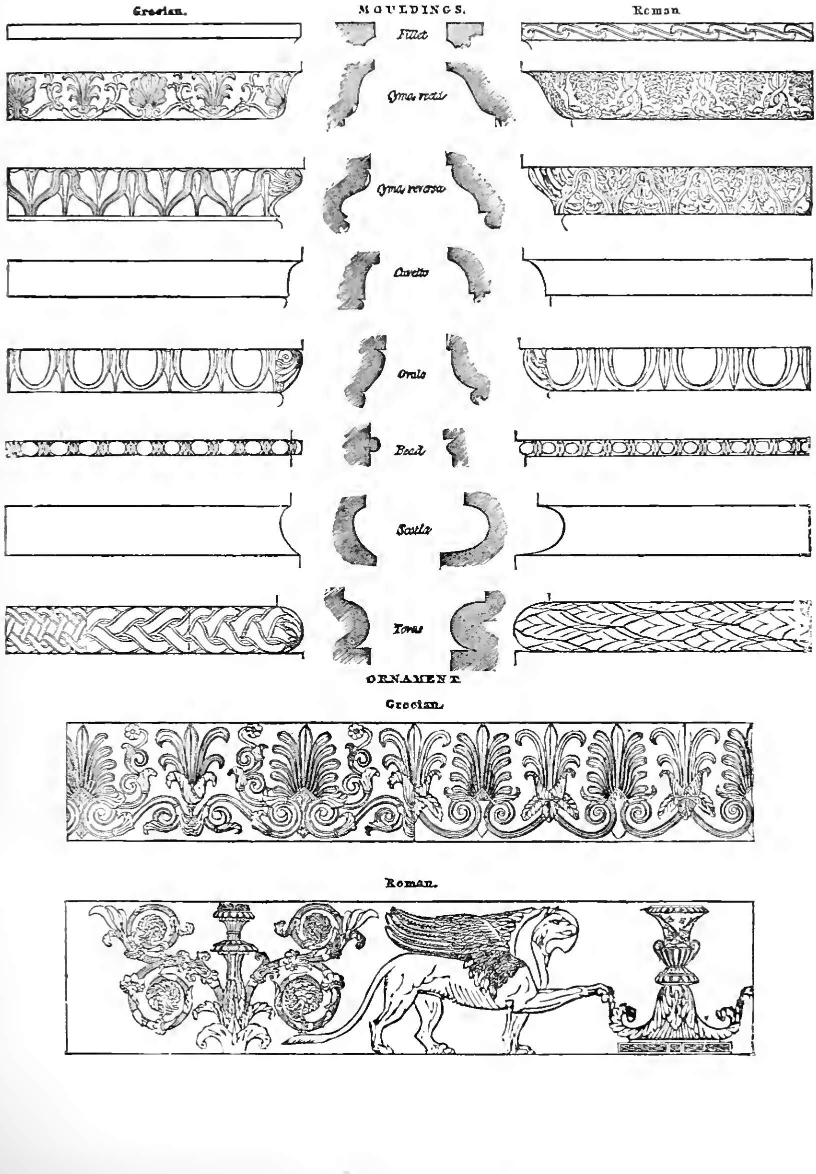
The bead is an independent moulding, varying in contour; but it is generally the larger segment of a circle. It is used, however, sometimes to mask the waving form, and sometimes to separate it.

The cavetto, or simple hollow, is part of a cyma also, as has been shown; but it is also applied independently to obviate a sharp angle, or to take from the formality of a vertical line, as in the abaci of Ionic antæ caps. Its form, nevertheless, is not the segment of a circle, for the upper part of a cavetto is the most flected, and it falls below almost into a straight line.

There is a hooked moulding common in Greek architecture, particularly in the Doric antæ caps, which is technically called the hawk's-beak. It is a combination of curves which cannot be described in words; but it has been already referred to in speaking of the cyma-recta, which is brought into its composition. This hawk's beak is a completely Gothic moulding, and throws a very bold, clear shadow. It is used generally to the antæ; and the fact that these were for the most part under the shadow of the peristyle, furnishes good reason for the employment of such a moulding.

The cyma-recta is never found carved, nor sunk within itself; but it sometimes has the honeysuckle, or some other ornament of the kind, wrought on it in relief, particularly when used as the covering moulding—the cymatium—or a pediment. The enrichment of the cyma-reversa consists of a contrasted repetition of its own contour meeting in a broad point below, and joining by a circular line above, making a sort of tongued or leafed ornament, whose surface is inflected horizontally also. Between the leaves a dart-formed tongue is wrought, extending from the circular flexure above to the bottom of the moulding, whose contour it takes in front alone. As this would not mitre or join well on the angles of the cyma, a honeysuckle is

[1] The presence of the cyma in the Doric capital was, we believe, first pointed out by Mr T. L. Donaldson, in a supplementary volume to Stuart's *Athens*.


Grecian.
MOULDINGS.
Roman.
Fillet
Cyma recta
Cyma reversa
Cavetto
Ovolo
Bead
Scotia
Torus
ORNAMENT.
Grecian.
Roman.

gracefully introduced in the manner shown in Plate XIII. This enrichment is not wrought in relief on the moulding, but is carved into it, so that the surfaces of the parts of the ornament alone retain the full outline of the cyma. The ovolo is enriched with what is called the egg and dart ornament. This will be best understood by reference to the plate. Its angles also are made with a honeysuckle, and the inflections are made in the moulding itself. The torus is sometimes enriched with the interlaced ornament called the guillochos; this, too, is cut into the moulding itself. We have no Greek example of an enriched scotia, and from its form and position, which, to be effective, must be below the eye, it hardly seems susceptible of ornament which could operate beneficially. The bead is carved in spheres or slightly prolate spheroids, with two thin rings or buttons, dilated at their axes, placed vertically between them. A cavetto is not enriched at all, nor is the hawk's beak, except by painting, which does not appear to have been an uncommon mode of enriching mouldings among the Greeks; that is, the ornament was painted on the moulded surface instead of being carved into it. Fascias are also found enriched by painted running ornaments, such as the fret or meander, the honeysuckle, and the lotus. Sometimes plain colour was given to a member, to heighten the effect it was intended to produce. Ornaments were also painted and gilt on the coffered panels of ceilings.

Sculptured ornaments.

The few examples which exist of sculptured ornament on straight surfaces exhibit varieties of nearly the same combinations as those last mentioned,—the honeysuckle, with the lotus, and sometimes a variety of itself, on scrolls, either throwing out tendrils, or plain. This is found on the necking of the Ionic columns of the Athenian Acropolis, and on those of their antæ, continuing along under the congeries of mouldings, as previously described. The varieties of foliage used in the enrichments of Greek architecture are few, and will be found generally exemplified in the Corinthian capital of the choragic monument of Lysicrates, and in the rich acroteral pedestal or stem of the same edifice, than which we possess no more elaborate specimen of foliated enrichment of the Greek school. There exist many specimens of architectural ornament on vases and fragments, in marble and terra-cotta, in which human figures, both male and female, are composed, with a greater variety of foliage than is generally found in Greek architectural works; and many of the beautiful marble and bronze utensils discovered in Herculaneum and Pompeii have enrichments obviously of Greek origin, from which, as well as from the specimens of ornament on positive architectural monuments, we may judge of their productions generally, as well as acquire or imbibe something of the fine taste which originated them. It will be remarked at once that Greek ornamentation is quite conventional, and that the plain scroll forms its main feature. The leaf-work is clasped round it, and helps to fill up the surface, and pleasingly vary the outline, but the scroll is prominent throughout. Then there is a peculiarity in the mode of carving the ornamentation. The scroll is not rounded off, as in the Roman, like the branch of a tree, but stands squarely and sharply out from the surface, so as to throw a well-defined sharp shadow. So with the foliage, whose leaves also, in place of having the rounded section used by the Romans, are cut sharply either with a square or triangular section, giving again a strong contrast of light and shade.

It may be inferred from some existing edifices, particularly the choragic monuments, that the Doric columnar style was not used by the Greeks except for the temples of the gods and some of their accessories. But whether this arose—if the feeling really did exist—from the sanctity of its character, in consequence of that appropriation, or from the difficulty of moulding it to general purposes, cannot be determined. It is very certain, however, that the few structures which do exist of Greek origin, not of a religious character, are either Ionic or Corinthian, or a mixture of one of them with some of the features of the Doric; and in all Greece and the Grecian colonies, except Ionia, there are very few examples of religious edifices not of the Doric order, and none which are of the Corinthian.

Regularity of the Doric style.

Like the architecture of Egypt, that of Greece is known to us principally by means of its sacred monuments, and from them is deduced almost all we know of its principles. The Doric temples of the Greeks are uniform in plan, and differ only in arrangement and proportion, according to their size; for every part depends on the same modulus. It has been said that if the dimensions of a single column, and the proportion the entablature should bear to it, were given to two individuals acquainted with the style, with directions to compose a hexastyle peripteral temple, or one of any other description, they would produce designs exactly similar in size, arrangement, features, and general proportions, differing only, if at all, in the relative proportions of minor parts, and slightly, perhaps, in the contour of some of the mouldings. This can only be the case with the Doric, and it arises from the intercolumniation being determined by the arrangement of the frieze with triglyphs and metopes; the frieze bearing a certain proportion in the entablature to the diameter of the column, and so on, in such a manner that the most perfect harmony is preserved between all the parts. Thus (Plate IX. fig. 1) the column is so many of its diameters in height; it diminishes gradually from the base upwards, with a slightly convexed tendency or swelling downwards; and is superimposed by a capital proportioned to it, and coming within its height. The entablature is so many diameters high also, and is divided, according to slightly varying proportions, into three parts —architrave, frieze, and cornice. A triglyph bearing a certain proportion to the diameter of the column is drawn immediately over its centre; the metope is then set off equal to the height of the frieze; another triglyph is drawn, which hangs over the void; then a metope as before; and a second triglyph, the centre of which is the central line for another column; and so on to the number required, which, in a front, will be four, six, eight, or ten columns, as the case may be, the temple being tetrastyle, hexastyle, octastyle, or decastyle; and on the flanks twice the number of those on the front and one more, counting the columns at the angles both ways. Thus, if the rules be strictly followed, a hexastyle temple will have thirteen columns on each flank, an octastyle seventeen, and so on. It must be observed, however, that to ease the columns at the angles, they are not placed so that the triglyph over them shall impend their centre as the others, but are set in towards the next columns, so far that a line let fall from the outer edge of the triglyph will touch the circumferential line of the column at the base, or at its greatest diameter. It has been generally thought that the object in this disposition was to bring the triglyph to the extreme angle, to obviate the necessity of a half-metope there; and many imitators have puzzled themselves to no avail to effect it without contracting the intercolumniation or elongating the first metope; though it is perfectly obvious that the intention of the Greek architects was to ease the columns in those important situations of a part of their burden, and for no such purpose as Vitruvius and his disciples have thought. Indeed, this has been a problem to the whole school, which their master proposed, and which they have settled only by putting a half-metope beyond the outer triglyph, thus preserving the intercolumniation equal, but rendering the quoins more infirm, or perhaps less stable than the Greek architects judiciously thought they should be. Besides contracting the intercolumniation, the Greeks also made the corner columns a little larger than the rest, thus counteracting in every way the danger that might accrue to them, or to the structure through them, from their exposed and partly unconnected situation. The graduated pyramidal stylobate on which the structure rests also bears a certain proportion to the standard which is measure of all the rest; and so every part is determined by the capacity of the sustaining power.[1] Though the Doric order thus possesses, as it were, a self-proportioning power, which will secure harmony in its composition under any circumstances, yet skill and taste in the architect are necessary to determine, in every instance, the number of diameters the column shall have in height, and to assign according to that the height of the entablature. According to Vitruvius the colonnades were spaced out according to one or other of the following arrangements of the intercolumniations:—

Pycnostyle,	1½ diameters	apart	and 10	high.
Systyle,	2 ,,	,,	9½	,,
Eustyle,	2¼ ,,	,,	about 8½	,,
Diastyle,	3 ,,	,,	8½	,,
Aræostyle,	4 ,,	,,	8	,,

But these rules, like many others of this author, seem to have been imaginary.

Columnar arrangement of temples.

The temples are described, according to their external arrangement, as being either *in antis* (*i.e.*, with two columns between two antæ), prostyle (with columns in front), amphiprostyle (with columns both in front and rear), peripteral (with a single row of columns at flanks as well as at ends), dipteral (with a double row of columns at flanks), or pseudo-dipteral (in which the inner range of columns in the peripteral is omitted). The columnar arrangement *in antis* is not common in Greek architecture, though there are examples of it, generally of the Doric order. The inner porticoes, or pronaoi, of peripteral temples are, for the most part, placed *in antis*, as may be seen by reference to the examples in which columns stand between the antæ. The Ionic temples of Athens are the principal examples of the simple prostyle. They may be called apteral, if it be necessary to distinguish them from peripteral, as the latter are prostylar; but the former term alone is sufficient. Neither does Greek architecture present more than one example, and that is at Athens also, of an amphiprostyle, except in the same peripteral structures, which are also amphiprostylar. Almost all the Doric temples are peripteral, and being peripteral, they are, as a matter of course, amphiprostylar, as has been just remarked; so that the former term alone is used in describing an edifice of that kind, with the numeral which expresses the number of columns in each of its prostyles. There are but two known examples of Greek antiquity of a pseudo-peripteral structure—the gigantic fane of Jupiter Olympius at Agrigentum, and the nine-columned edifice at Pæstum. The former is not even prostyle, for the columns on its fronts are attached, as well as those on its flanks. The dipteral arrangement is found at Selinus, in an octastyle temple; and in some cases the porticoes of peripteral temples have a pseudo-dipteral projection, though no perfect example of the pseudo-dipteral exists.

The Doric order was never used by the Greeks in mere prostyles; consequently there is no Doric temple of the tetrastyle arrangement, for it is incompatible with the peripteral, the tetrastyle examples which do exist being all Ionic. Athens itself, containing a Doric tetraprostyle, may seem to contradict this; but in speaking of Greek architecture, we exclude all the examples, even in Greece itself, which were executed under the Roman dominion, for they bear the Roman impress; and among these is the portico referred to. With very few exceptions, all the Doric temples of the Greeks are hexastyle. Their queen, however, the unmatched Parthenon, is octastyle; and the pseudo-peripteral fane of Jupiter Olympius at Agrigentum, just referred to, presents the singular arrangement, heptastyle. The misshapen monument called the Basilica, at Pæstum, the Thersites of its style, has a front of nine columns, or an enneastyle arrangement. The temples of Jupiter Olympius at Athens, and of Apollo at Branchidæ, had each a front of ten columns.

It may be here remarked in support of the opinion we have given as to the authority of Vitruvius, that, according to him, peripteral temples have on each flank twice the number of intercolumniations they have in front,—thus giving to a hexastyle eleven, to an octastyle fifteen columns, and so on,—whereas in the Greek temples this is never the case, for they always have more. The best examples have two, some have only one, but many have three, and in one instance there are four, more intercolumniations in flank than in front. The famous temple at Ephesus, recently disinterred by Mr Wood, has seven intercolumniations in front, and nineteen on the flanks. Again, he limits the internal hypæthral arrangement to those structures which are externally decastyle and dipteral, though an example, he says, existed in Greece of an octastyle hypæthros, and that was a Roman structure. Now the Parthenon is an octastyle hypæthros; but all the other hypæthral temples, both in Greece and her colonies, are hexastyles, except, perhaps, the octastyle-dipteral at Selinus, and there is no evidence that the Greeks ever constructed a decastyle-dipteral temple, except that of Apollo Didymæus at Branchidæ.

A Greek temple, whose columnar arrangement is simply *in antis*, whether distyle or tetrastyle, consists of pronaos and naos or cella. A tetraprostyle may have behind it a pronaos and naos. An amphiprostyle has, in addition to the preceding, a posticum, but is not understood to have a second entrance. The porticoes of a peripteral temple are distinguished as the porticus and posticum, and the lateral ambulatories are incorrectly called peristyles. It may, indeed, be here suggested, that as the admixture of Latin with Greek terms in the description of a Grecian edifice cannot be approved of, it would, perhaps, be better to apply the term *stoa* to the colonnaded platform or ambitus altogether, and distinguish the various parts of it by the addition of English adjectives; or the common term portico would be quite as well with front, back, and side, or lateral, prefixed, as the case may be. Within the back and front stoas or porticoes, then, a peripteral temple has similar arrangements *in antis*, which are relatively termed the pronaos and opisthodomus, with an entrance only from the former; unless there should exist, as there does in the Parthenon, a room or chamber within the opisthodomus, supposed to be the treasury, in which case a door opens into it from the latter. Besides these, a Greek temple consists only of a cell in those which are cleithral, and of a naos, which is divided into nave and aisles, to use modern ecclesiastical terms, in an hypæthral temple.

In comparing the Greek temple with the Egyptian, a marked difference at once appears. The cella is the nucleus of both. But whereas the Egyptian was almost hidden within a series of chambers for the priests, and surrounded by enormous enclosed courts, the Greek was made the one prominent object, and the subject of the highest efforts of art.

[1] We cannot discover that the elevation of the pediment depended so immediately on the common standard, though in the best examples the tympanum will be found to be about one diameter and a half in height.

Nothing was allowed to interfere with it or to abate its predominance. The tympan was the place in which the highest efforts of the sculptor were placed, the purest example of it being at the Parthenon. At Ægina the figures were entirely detached. Above the pediment at the top, and at the sides, were some very beautiful ornaments—the acroteria. These were in so prominent a position, and so delicately carved, that very few remains of them are left to us. The roofs were covered with thin slabs, or tiles, of marble, and the ends of the ribs, which covered their joints, were ornamented with antefixæ, forming a graceful finish to the flanks. These were mostly of marble, but at Ægina they were of terra-cotta. Further, in order to discharge the water from the gutters, were lions' heads, the original of our gurgoyles. The gutters themselves were made on the top member of the cornice. It is singular that we have no accurate description of the interior of a temple, nor any information as to how it was ceiled or lighted. We know that the cella had often a row of columns round it internally, and that upon this row was a second, as at the temples of Ceres at Eleusis, Minerva at Tegea, Neptune at Pæstum, and Jupiter at Ægina. At the temple of the Giants at Agrigentum a row of figures took the place of the upper columns. We may fairly suppose, then, that the first row supported a gallery much as in our Triforia. But as to the roof there is more difficulty. The span would be too great for flat marble beams, and would have a very poor and depressing effect. To obviate this difficulty Mr Fawkener suggests that the ceilings were arched, and a medal which shows the temple of Juno at Samos certainly appears to favour this theory. But another difficulty remains, viz., as to the light, for there were no windows; and the only light, therefore, if no other access for it were made, would have been through the doorway itself, deeply buried behind a massive portico. Vitruvius alludes to this in his third book, where he describes a hypæthral temple as being "*sine tecto et sub divo.*" But he states himself that this arrangement was rare, and if the cella was really in any case open to the sky, one can scarcely imagine how the delicate statues of ivory and gold could have been protected from the weather. At Bassæ some remains of roof tiles have been found, the centre part of which were open, and might thus have formed small openings for light. But the difficulty as to the statues remains. Mr Fergusson's solution of the problem is very ingenious, and so satisfactory that it seems to require only some reference to his arrangement in any of the old sculptures or writers to make it generally received. He supposes that the inner columns supported a sort of clerestory, formed by a channel on each side along the roof. This would give an excellent light, and the statues could easily be protected. This theory does not fulfil Vitruvius's description "*sine tecto,*" but he is generally so inaccurate in his references to Greek work that this objection does not seem to be very formidable.

According to the rules of Vitruvius, all temples should face east and west, and the door should be to the west; but in reality the doors in Ionia, Attica, and Sicily were to the east. The temple at Bassæ faces north and south, but it has a side door also. The temple was usually approached by a flight of steps, of an uneven number, so that the worshipper might place his right foot on the first step, and again on the temple floor. The ceilings of the porticoes and colonnades were formed by great beams of marble, and the spaces of the intercolumns were thus limited. This appears to be the reason for the closed colonnade of the temple of the Giants at Agrigentum, as the spaces between the columns, if open, as usual, would have been too wide to be spanned by a flat beam.

Propylæa.

The only pure Greek architectural works besides temples that remain to us, and of which we have certain information, are propylæa, choragic monuments, and theatres. The propylæum, or propylæa, as applied to the Acropolis of Athens, is the entrance or gateway through the wall of the peribolus. It consists of a Doric hexaprostyle portico internally, with a very singular arrangement of its columns, the central intercolumniation being ditriglyph. This was done, probably, to allow a certain procession to pass, which would have been incommoded by a narrower space. Within the portico there is a deep recess, similar to the pronaos in a temple, but without columns *in antis*; a wall pierced with five doorways, corresponding to the intercolumniations of the portico, close to the entrance; and beyond it is a vestibule, divided into three parts by two rows of three Ionic columns, and forming an outer portico, fronted externally by a hexaprostyle exactly similar to that on the outside. Right and left of it, and setting out about one intercolumniation of the portico from its end columns, at right angles, are two small triastyle porticoes *in antis*, with chambers behind them. These have been called temples, but most probably they were nothing more than porters' lodges or guard-houses. The whole structure, though extremely elegant and possessing many beauties, is not a good architectural composition: the unequal intercolumniation detracts from its simplicity and harmony. The use of Ionic columns in a Doric ordinance is equally objectionable; and their elevation from the floor of the portico on insulated pedestals is even worse, though their intention is obvious; and without raising them, the ceiling might have been too low, or they must have been made taller. The uneven style of the small temples or lodges is not pleasing, even though they be taken as flank and not as front compositions; and, moreover, their entablature abuts indefinitely against the walls of the larger structure, both internally and externally, to the total destruction of the harmony of the general composition. Indeed, the unequal heights of the entablature of the greater ordinance involves a fault which would require more than all the beauties of detail and harmony of proportion to countervail, if it were not impossible to embrace them in one view.

Choragic monuments.

The choragic monument of Lysicrates (or Lantern of Demosthenes), at Athens (Plate XII.), is a small structure, consisting of an elegant quadrangular basement or podium, which is more than two-fifths of the whole height, surmounted by a cyclostyle of six Corinthian columns, attached to, and projecting rather more than one-half from a wall which perfects the cylinder up to the top of their shafts, where it forms a stand for tripods the height of the capital. A characteristic entablature rests on the columns, and receives a tholus or dome, which is richly ornamented, and terminates in a foliated and heliced acroterium. To this Stuart has added dolphins as supporters, and has placed on the summit a tripod, which was the prize in the choragic festival; thus completing, perhaps, the most beautiful composition in its style ever executed. In Vitruvian language, the arrangement of this edifice would be called monopteral; but it is more correctly cyclostylar, or, perhaps, because of the wall or core, it may be termed a pseudo or attached cyclostyle. The basement of this monument is eminently bold and simple, admirably proportioned to the rest of the structure, and harmonising perfectly with it. The columnar ordinance is the only perfect specimen of the style in existence of pure Greek origin. It has never been surpassed, and is, perhaps, unequalled. The most exquisite harmony reigns throughout its composition; it is simple without being poor, and rich without being meretricious.

Totally different in style and arrangement, and far inferior in merit, is the choragic monument of Thrasyllus

It bears, however, the impress of the Grecian mind. This composition is merely a front to a cave, consisting of three pilasters, proportioned and moulded like Doric antæ, and supporting an entablature similar in style, but too shallow to harmonise with them. Above the entablature there is an attic or parapet, divided into three compartments horizontally. The two external form tablets, with a cornice or impost on them; and the central is composed of three receding courses, on the summit of which is seated a draped human figure, whether male or female, in its mutilated state, is not determinable. The entablature has laurel wreaths instead of triglyphs in the frieze, and it would appear as if the absence of the triglyph had deranged the whole composition. The two outer pilasters are of good proportion, and the architrave is well proportioned to them; but the frieze and cornice are both too narrow, and the spaces between the pilasters, equivalent to intercolumniations, are too wide. The third pilaster, itself inharmonious, is absurdly narrow, and, standing immediately under the statue, evidently to support it, its meagreness is the more obvious and striking. In spite of all this, the general outline of the structure is simple and pleasing; the detail is elegant, and the execution spirited and effective. This little monument is, however, a proof that the Greeks were not at all times so excellent in architectural compositions as in the self-composing Doric temples, and in the choragic monument of Lysicrates; and to this evidence may be added that of the triple temple in the Acropolis of Athens, already described.

The Erechtheum. In concluding this notice as to temples, we must now allude to one example, very beautiful in itself, but an exception to all rules—the Erechtheum at Athens. It consists of an Ionic hexaprostyle in front (Plate XI. fig. 1), resting on a bold, continuous, and well-proportioned stylobate, and forming the entrance to a parallelogramic cella, but, from all that has yet been discovered, without a pronaos *in antis.* The back front consists of four columns, like those of the portico, attached *in antis;* and the flanks are broad and bold, crowned by the well-proportioned and chaste entablature, with the enriched congeries of mouldings and running ornament of the antæ under it. In the absence of a pronaos to give depth to the portico, the composition was defective, but otherwise simple and harmonious. It was enlarged by the attachment of a tetraprostyle to one of its sides, Ionic certainly, like that in front, but different both in manner and in size; beautiful in itself, but a blot on the main building, with which it harmonises in no one particular, for the apex of its pediment only reaches to the cornice of the other. In a similar situation, against the other side, is attached a similar arrangement of Caryatides, a tetraprostyle of female figures raised on a lofty basement, and yet not reaching to the entablature of the main building—according in no one particular either with it or with the portico on the other side, and altogether forming one of the most heterogeneous compositions to be found in ancient art.

Tombs. TOMBS.—These, the grandest structures next to the temples in Egypt, present little worthy of notice in Greece proper; but in the colonies there are several of considerable importance. The grandest are in Caria and Lycia, to some of which, constructed much after the ancient outlines of the Lycian, &c., reference has already been made. The most singular of the pure Greek tombs are cut in the face of the solid rock, not in the forms of the ancient rock-cut tombs, but much resembling those of the temple.

The rock-cut tombs, as, *e.g.*, at Telmissus (Lycia), usually have a portico of columns *in antis*, with one or more chambers behind. In one example these are about 12 feet by 9 feet, and 6 feet high.

Most of the columns are Ionic, few being Doric. In one case, the whole tomb, which is 18 feet 6 inches deep, has been quite detached, the whole excavation being 26 feet deep from the face of the rock. Many of these tombs present curious examples of wooden details imitated in stone, *e.g.*, the doors are often exactly like those of wood, the panels, nails, knockers, &c., being copied in stone.

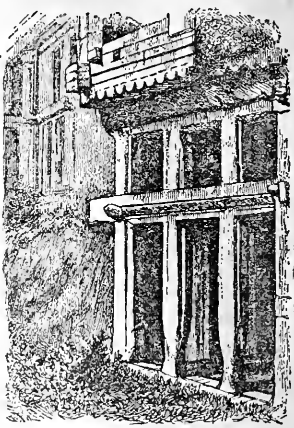


FIG. 44.—Rock Tomb at Myra, Lycia.[1]

Of a totally different class is a tomb at Cnidus, in Caria, discovered by Mr C. T. Newton. It consists of a square, low basement resting on four steps, and carrying four engaged Doric columns, with a cornice over the whole, being about 31 feet square on the basement. Above the cornice are gradini, forming a sort of pyramid of steps, having at the summit a lion, now in the British Museum. "Inside was a beehive-shaped chamber, with vaulting similar to that of the treasury of Atreus at Mycene, and with eleven smaller cells radiating from its circumference" (Newton). Its supposed date is about 396 B. C.

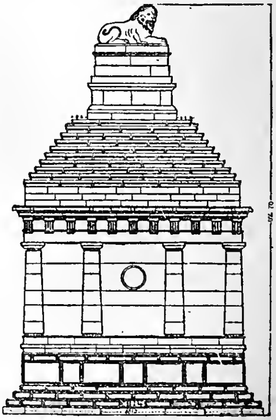


FIG. 45.—Lion Tomb at Cnidus, Caria.

More beautiful in detail is the tomb known as the Trophy, discovered by Sir C. Fellows, at Xanthus. It consists of a peristyle of fourteen Ionic columns, standing on a high basement about 33 feet by 22, which has, to all appearance, no access to it. In the centre, behind the columns, is a cella apparently solid also. The date usually given to this is about 540. But the edifice seems to be somewhat too refined in detail for this time, and another date assigned to it, viz., about 385, appears to be more likely. This would be about half-way, in point of time, between the Erechtheum and the temple at Priene.

More curious, though less elegant, is another tomb at Mylasa, in Caria, which has a high, square basement with

[1] Figs. 44 and 45 are taken from Newton's *Travels and Discoveries in the Levant*, by kind permission of the author.

a chamber in it. Over this, on each face, are two columns *in antis*, with entablature, the space between the columns being quite clear. Over the cornice are placed great stone beams, anglewise; on these, others, again, crosswise; so that the bearing is rapidly diminished, and a rough sort of dome formed, resembling those so often found in India. But of all Greek tombs the grandest was that of Mausolus, at Halicarnassus, in Caria, one of the seven wonders of the ancient world, which has given its name to all succeeding great tombs. Its date is about 352 B.C., Mausolus having died in 353. It was erect until the 10th century. Since then it has been so utterly ruined that there was doubt as to its actual site. This was indicated by Professor Donaldson; and in 1857, Mr Newton discovered the actual remains. "It consisted of a lofty basement, on which stood an oblong Ionic edifice surrounded by thirty-six Ionic columns, and surmounted by a pyramid of twenty-four steps. The whole structure, 140 feet in height, was crowned by a chariot group in white marble, on which, probably, stood Mausolus himself" (Newton). The size of the basement was 114 feet by 92. A considerable number of the fragments are now in the British Museum. The name of the architect was Pythius, and the sculpture, with which the edifice was richly adorned, was executed by four celebrated sculptors, of whom we may especially particularise Scopas, as he was also the architect of the celebrated temple of Tegea.

Theatres.

THEATRES.—The Greek theatre deserves a short notice. It was entirely different from ours, having neither pit, boxes, nor roof, except the usual velarium, as a protection from the sun. Its plan was somewhat more than a semicircle, having seats cut out of the side of some hill convenient for the purpose. Round the top was a colonnade, and at the back of the stage was the scena. This and the colonnade combined in an artistic way, must have formed a very effective composition. At first the theatres were of wood; the first of stone, at Athens, having been built, it is said, about the middle of the 4th century. Vitruvius makes some very singular statements as to the acoustic details of the theatres, but they have not been verified, and are not, in fact, quite understood. The theatres at Argos and Ephesus were 450 and 600 feet in diameter respectively, whereas Covent Garden Theatre, London, including the corridors, is only 100 feet.

HOUSES, &c.—No remains exist of the domestic structures of the Greeks. It may be taken for granted that the houses were less extensive than those of the Romans, as they were a poorer and less luxurious people, but the exquisite beauty of form and decoration, which pervades every article of Greek origin, whether coin, medallion, vase, implement of war or husbandry, or even the meanest article of domestic or personal use, is evidence of the fine taste with which their mansions must have been furnished.

Fortifications.

FORTIFICATIONS.—We have large remains of fortifications in Lycia, though few in Greece proper. They are not so picturesque as the mediæval, nor, we may say, as the Assyrian. They were massively built of masonry, with square towers at intervals, furnished sometimes with a pediment, sometimes with battlements. The doors and windows on the upper floor are still found at Alinda, in Caria. The Greek shield was often sculptured as hung on the walls. A bas-relief from Pinara, in Lycia, gives a complete sketch of the walls, with circular-topped battlements, a postern gate, and various openings, all square-headed; and a door is shown panelled, like our doors.

Building materials.

In the construction of their edifices the Greeks seldom, if ever, had recourse to foreign materials—the stone used in their temples being almost invariably from the nearest convenient quarries which supplied it of sufficiently good quality. The structures of Athens are built of marble, from the quarries of Pentelicus, and those of Agrigentum, of a fossil conglomerate which the place itself furnished.

Résumé.

RÉSUMÉ.—Taking now a rapid view of what we owe to the Greeks as architects, we may assume that the invention of columnar architecture is due to the Assyrians; but how far this had advanced before the Greeks began to practise it, we cannot as yet exactly determine. There is no doubt, however, that it owed to the Greeks the greater part of its beautiful and delicate details. Some of the finest examples of these are to be found at Athens in the Theseum, Parthenon, Propylæa, and Erechtheum, ranging in date from 469 to 409 B.C. Not only do we find there the most beautiful mouldings and other ornaments, but the most refined methods of obviating the minute defects in outline supposed to be caused by optical illusion. The lines of the shafts, for instance, in place of being perfectly straight, were slightly expanded between the base and necking, so as to form a very delicate curve (entasis). The apparent depression of the top of the cornice, supposed to be caused by the extra weight in the centre of the pediment, was obviated by curving the cornice so that the centre part was the highest. The steps were curved in a similar way. Then the whole of the columns of the peristyle sloped towards the centre. The architrave and frieze in the Parthenon followed the same slope of about 1 in 80, but its boldly overhanging cornice and antefixæ sloped forwards about 1 in 100.

We owe also to the Greeks one new form in art—the pediment. It is not found in Egypt; some slight suggestions as to its use may, perhaps, be found in the sculptures of Assyria, but in Greece it forms the crowning feature of every temple; and simple as the invention may seem, it led the way to a succession of others, which resulted in the grand gables of our Gothic architecture.

The details of the Grecian temples were heightened by colour and gold. Of the former, Dr Faraday detected many traces on the sculptures of the British Museum; and clear indications of it have been found in many of the ruins both in Greece proper and in the colonies. In fact, colour, or tinting of some kind, seems to have been absolutely requisite in order to relieve the monotonous and dazzling effect of new white marble. A striking example of this occurred recently when the palace of the king was built at Athens. The newly-worked marble had much the appearance of a smooth stucco or brilliant whitewash. But this would serve (and doubtless did serve in ancient times) as an admirably delicate base for decorative work in colour and gold.

What the effect was of a Greek temple, in all its glory, we can no more judge than we can in the case of one of ancient Egypt. For there is not one that is not a mere wreck; and even the most ambitious of modern copies, the Walhalla, wants the exquisitely delicate material out of which the Parthenon was wrought, and the sculpture which no modern Phidias was living to supply. But in Greece proper there was but this one type, viz., that of the pedimented temple with its colonnade. There was no arch, as in Assyria, to span an opening too wide for a stone beam; no dome to vary the outline by its bold and graceful form; no curved outline, as at Mycenæ, to vary that of the rectangle.

The form adopted by the Greeks was worked out in a manner which leaves all others of ancient art, wrought in the same likeness, far behind; and the details which adorned that form charm the eye with their exquisitely chaste beauty. But in our admiration of them we must not forget that numerous other forms, beautiful in themselves, and familiar in their beauty to the Assyrians and Pelasgi, as they are to us were unknown to, or neglected by, the Greeks.

Etruscan Architecture.

Little of the history of Etruria is as yet known, for accounts of Roman historians are not to be relied on, and the Etruscan language is as yet unread. Our acquaintance with its architecture, too, is very meagre, for the comparatively few remains show us simply the forms used by the Etruscans in their tombs; and even these have been as yet imperfectly explored, owing to the nature of the climate, and the desolation of those parts of the country in which they are chiefly found. Little was, in fact, known of them at all until the careful descriptions of Sig. Canina and Mr Dennis appeared, from whose works the principal ascertained facts are derived. The sites of the Etruscan towns are nearly all on or near a line, curving slightly from the sea, extending from Fiesole, near Florence, through Arretium, Cortona, Volsinii, and Falerii, to Rome. The only sites of much importance near the sea were Cossa and Tarquinii. The towns were generally planted on the tops of high hills, as if for the purpose of defence. Much of the town-walling remains in various places, as at Fiesole, Cortona, Cossa, and Volterra, and furnishes grand examples both of the polygonal and of the squared masonry, which has been described as belonging to the early period of Greek architecture.

The tombs were of two classes, the first being nearly of the same external form as that described at Tantalais, viz., with a massive stereobate, circular in plan, having one or more chambers in the centre of it, and above it a tumulus of earth. Of these, hundreds of specimens of various sizes remain. At Volci there was one 240 feet in diameter. The grandest of all is, perhaps, that at Cervetri, drawn by Canina, and known as the Regulini Galeassi. The chambers here, and in other instances, are ceiled with oversailing courses of stone, cut into an arched form as at Mycenæ. A completely voussoired arch exists over a tomb chamber, known as the Grotto of Pythagoras, at Cortona, but the date of this is very doubtful. In these tombs have been found some of the beautiful specimens of jewellery which adorn the museums of Europe. The mouldings used are very few and simple, but of a section which is quite peculiar to Etruria. They occur in two places only, viz., as a base, and as a capping to the basement. In none of the tombs of the kind above described are found any of the paintings which form so characteristic a feature in the second and better known class of tombs, viz., those cut in the face of the rock in the vicinity of most of the Etruscan towns. The apparent entrances to these tombs are by doorways of a peculiar form, and often placed very high up the rock. But these are false, and merely carved in it, the real entrance being often 40 to 50 feet below. This leads into one or more chambers, which are mostly square, but in some few instances are circular, as at Chiusi, where there is one 25 feet in diameter, supported by a pillar in the centre. Whatever their shape, they are cut out of the solid rock; and, apparently, bore some resemblance to the house which the occupant of the tomb had inhabited during life. None of the chambers are domed or vaulted, all the ceilings being cut in the shape of flat beams or sloping rafters supported by pillars,—another instance of the construction of built edifices being copied in rock-cut caves. One of these, at Cervetri, is given in D'Agincourt's work. There is another chamber at Tarquinii, 50 feet square, supported by four pillars, each 6 to 7 feet square.

The manner in which the chambers were fitted up depended on the mode of burial. Cremation was sometimes used, and then, as at Veii, Sutri, and Toscanella, we find niches for urns. But usually there was a bench cut in the rock round the sides of the chambers, and on them were ranged the sarcophagi, of which specimens are so well known in most of the museums of Europe. In some instances, which seem of a late date, the bodies were placed in recesses.

The paintings which decorated the chambers were very peculiar, being of the same character, and with figures of divinities, &c., of the same well-known attenuated forms as are found in the earlier vases. The colouring is as peculiar as the drawing, *e.g.*, at Veii there is a horse depicted with a red neck, yellow mane and tail, one leg yellow spotted with red, and the rest of the horse black. At Tarquinii is another horse with blue mane and hoofs, white tail, and all the rest red. All these paintings were executed, much as were those of the Greeks and Egyptians, on a very thin coating of fine stucco over the rock. In the later tombs domestic scenes appear to have taken the place of the allegorical ones formerly used.

One of the best examples, though of very late (Roman) date, is a tomb at Cervetri. The chamber was supported on two pillars. In each side of it were recesses, 2 feet in height, each having a bed, with cushion for the head, tassels, &c., all sculptured and painted. The sides and pillars were decorated with painting and sculpture, representing the helmets, shields, swords, and other accoutrements of the officer whose tomb it was. But there were also depicted in the same way the personal ornaments of his wife, her mirrors, jewellery, &c. Her slippers are marked on the floor, and by the side of the recess near, is carved her husband's walking-stick. Even the kitchen utensils appear in effigy, so as to give the whole fittings of the house of a Roman officer.

Another class of funeral monument is described to us by some writers, the most noted example being that of the great King Porsena, but the descriptions are too vague to allow of even this being restored with certainty. It is said to have had three ranges of pillars, the lowest one 150 feet high and 75 feet square, standing on a basement 300 feet square. There were five sets of these pillars, viz., one at each angle and one in the centre, and they are said to have been enriched with bronze ornamental work at the top of each division. This class of tomb was probably somewhat like one of late date, near Rome, which has been known by various names (the tomb of the Horatii and Curiatii, of Aruns, of Pompey, &c.), and if there were two ranges of pillars above, all tied in with metal rings at the point of junction, it would agree tolerably well with what we read of Porsena's tomb.

Of Etruscan temples no remains exist, and the accounts of them are so conflicting that any restoration of them must be very uncertain.

Roman Architecture.

We have taken it for granted that the Greeks were ignorant or neglectful of the properties of the arch. If the great sewer at Rome, called the Cloaca Maxima, belongs to the time of Tarquinius Priscus, it must be conceded that the properties of the arch were known, and the arch constructed in that city. But it is contended that the Cloaca Maxima, as it now exists, is a work of much more recent date, and that it may have succeeded the sewer constructed by the first Tarquinius, who was, moreover, himself a Greek. It is, however, now certain that the construction of the arch was known to the Egyptians, and used by them at a very early date, although, for some reason which we do not quite understand, they neglected it in their greatest works. That it was known to and made great use of by the Assyrians is also certain. Whoever it was that invented it, and at whatever date, the Romans made extensive practical use of it, and by its means they succeeded in doing what their predecessors in civilisation had never effected. It enabled

Use of the arch.

them to carry secure and permanent roads across wide and rapid rivers, and to make a comparatively fragile material, such as brick, more extensively useful than the finest marble was in the hands of the Greeks. To the Greeks, however, the Romans were indebted for their knowledge of the more polished forms of columnar architecture. Before the conquest of Greece the structures of Rome appear to have been rude and inelegant, and from that time the existing style of architecture either gave place to the superior merit and beauty of what the Romans found in that country, or was combined with it, though frequently the combination tended to destroy the beauty of both.

Comparison of Greek and Roman architecture.

In the transference of Greek columnar architecture to Rome, a great change was effected independently of those combinations, for the Romans could not appreciate the simple grandeur and dignified beauty of the Doric, as it existed in Greece. They appear to have moulded it on what we suppose their own Tuscan to have been; and the result was the mean and characterless ordinance exemplified in the lowest story of the theatre of Marcellus at Rome, and in the temple at Cora, between 30 and 40 miles south of that city. Not less inferior to the Athenian examples of the Ionic order, than the Doric of Cora is to the Doric of Athens, are the mean and tasteless deteriorations of them in the Roman temples of Fortuna Virilis and Concord. It was different, however, with the foliated Corinthian, which became to the Romans what the Doric had been to the Greeks—their national style. But though they borrowed the style, they did not copy the Greek examples. In Rome the Corinthian order assumed a new and not less beautiful form and character, and was varied to a wonderful extent, but without losing its original and distinctive features. The temple of Vesta, at Tivoli, differs from that commonly, but erroneously, named the temple of Jupiter Stator, in Rome, as much as the latter does from the choragic monument of Lysicrates at Athens; all three are among the most beautiful examples of the Corinthian order in existence,—if indeed they are not pre-eminently so,—and yet they do not possess a single proportion in common. It must be confessed, moreover, that if the Romans had not good taste enough to admire the Doric and Ionic models of Greece, they had too much to be fond of their own; for they seldom used them. Both at home and abroad, in all their conquests and colonies, wherever they built, they employed the Corinthian order. Corinthian edifices were raised in Iberia and in Gaul, in Istria and in Greece, in Syria and in Egypt; and to the present day, Nismes, Pola, Athens, Palmyra, and the banks of the Nile, alike attest the fondness of the Romans for that peculiar style. We cannot agree with the generally received opinion, that Greek architects were employed by the Romans after the connection between the two countries took place; for the difference between the Greek and Roman styles of architecture is not merely in the preference given to one over another peculiar mode of columnar arrangement and composition, but a different taste pervades even the details though the mouldings are the same; they differ more in spirit and character than do those of Greece and Egypt, which certainly would not have been the case if Roman architecture had been the work of Greek architects. Indeed, were it not for historical evidence, which cannot absolutely be refuted, an examination and comparison of the architectural monuments of the two countries would lead an architect to the conclusion, that the Corinthian order had its origin in Italy, and that the almost solitary perfect example of it in Greece was the result of an accidental communication with that country, modified by Greek taste; or that the foliated style was common to both, without either being indebted to the other for it. If, however, Greek architects were employed by the Romans, they must have made their taste and mode of design conform to those of their conquerors much more readily than we can imagine they would as the civilised slaves of barbarian masters; and it cannot be disputed that the Roman architecture is a style essentially distinct from the Greek. This is apparent from the fact that many of the minor works of sculpture in connection with architecture, such as candelabra, vases, and various articles of household furniture, discovered at the villa of Adrian, near Tivoli, and at Herculaneum and Pompeii, are fashioned and ornamented in the Greek style, while others are as decidedly Roman in those particulars,—rendering it evident that such things were either imported from Greece, or that Greek artists and artisans were employed in Italy, who retained their own national taste and modes of design. It is probable that both the architects and the artists, natives of Rome, modified their own less elegant productions by reference to Greek models; but that the Romans derived their architecture entirely from the Greeks, may certainly be disputed.

Building materials.

Much of the extent and magnificence of the architectural works of the Romans is attributable to their knowledge and use of the arch, which enabled them to utilise inferior materials. Almost all their structures were of brick—aqueducts, palaces, villas, baths, and temples. Of the present remains, only a few columns and their entablatures are of marble or granite, and two or three buildings are of Travertine stone,— all the rest are brick. The Colosseum, the mausoleum of Adrian, the tunnel sewer, the temple of Fortuna Virilis, and the ancient bridges on the Tiber, are of Travertine stone; the remaining columns of the more splendid temples, the internal columns, and their accessories, of the Pantheon, the exterior of the imperial arches, and the cenotaph columns of Trajan and of Antonine, are of marble; but the Imperial Mount of the Palatine, which holds the ruins of the palace of the Cæsars, is one mass of brick; the Pantheon, except its portico and internal columns, &c., is of brick; the temples of Peace, of Venus and Rome, and of Minerva Medica, are of brick; and so, for the most part, were the walls of others, though they may have been faced with marble or freestone. The baths of Titus, of Caracalla, and Diocletian, are of brick; the city walls are of brick; so are the extensive remains of the splendid villa of Adrian, and those of the villa of Mæcenas at Tivoli; the palaces of the Roman emperors and patricians at Baiæ and in other parts of Italy; and so, it may be said, are the remains of Herculaneum and Pompeii, for the houses in these cities are generally built of alternate double courses of brick and courses of stone or lava. In most cases, at Rome and in the provinces, stucco formed the surface which received the decorations. From the above enumeration, it will appear how much more variously the Romans built than any of their predecessors. In Egypt we find no indications of edifices of real utility or convenience, nothing but temples and tombs,—and in Greece there is but a small addition to this list; but in Rome are found specimens of almost every variety of structure that men in civilised communities require.

The Roman Corinthian.

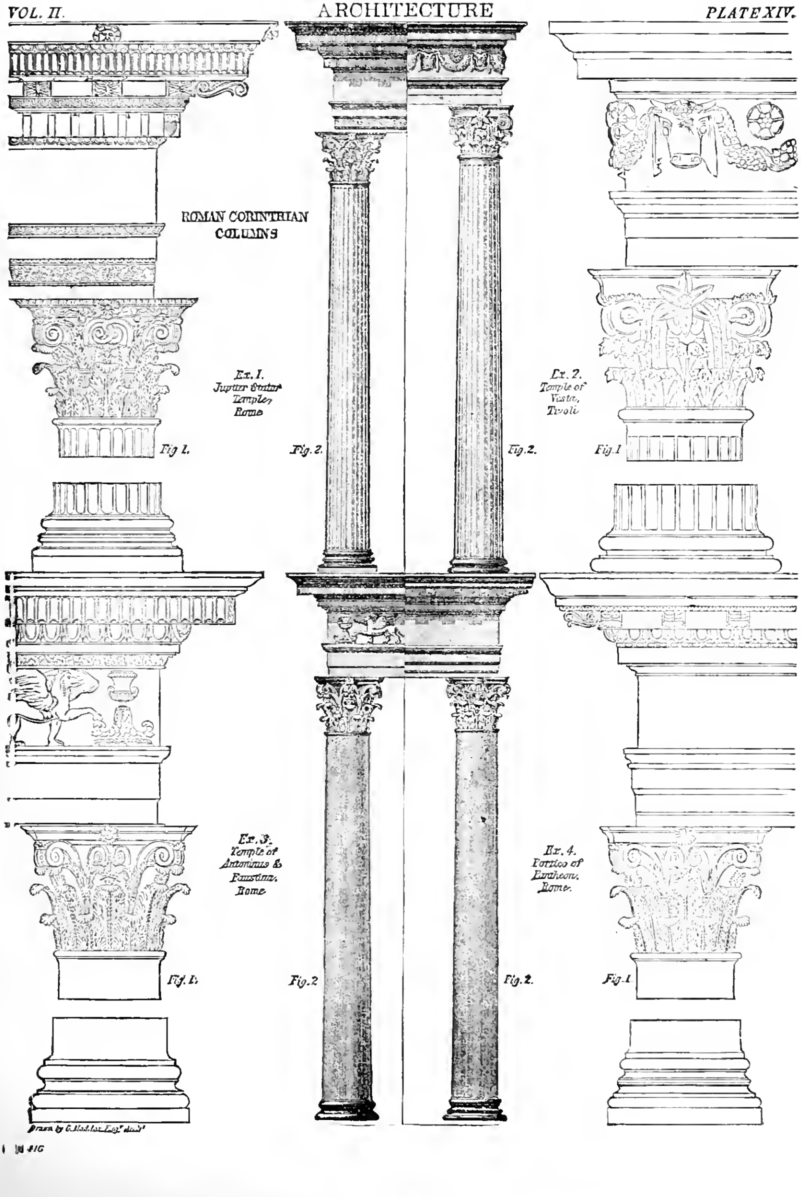
Like the Greek orders the Roman Corinthian may be said to consist of three parts,—stybolate, column, and entablature; but, unlike them, the stylobate is much loftier, and is not graduated, except for the purposes of access before a portico. Its usual height is not exactly determinable, in consequence of the ruined state of most of the best examples; but it may be taken at from two and a half to three diameters. In the triumphal arches the height of the stylobate sometimes amounts to four, and even to five diameters. It is variously arranged, moreover, having, in the shallower examples, simply a congeries of mouldings to form its base, with, perhaps, a narrow square member under it, a plain dado, and a covering cornice or coping, on the back of which the columns rest. In the loftier examples a single and sometimes a double plinth comes under the base mouldings; and a blocking course rests upon the coping, to receive the bases of the columns. This last is only necessary when the height of the stylobate is such as to take the columnar base above the human eye, when the coping cornice would intercept it if a blocking course did not intervene.

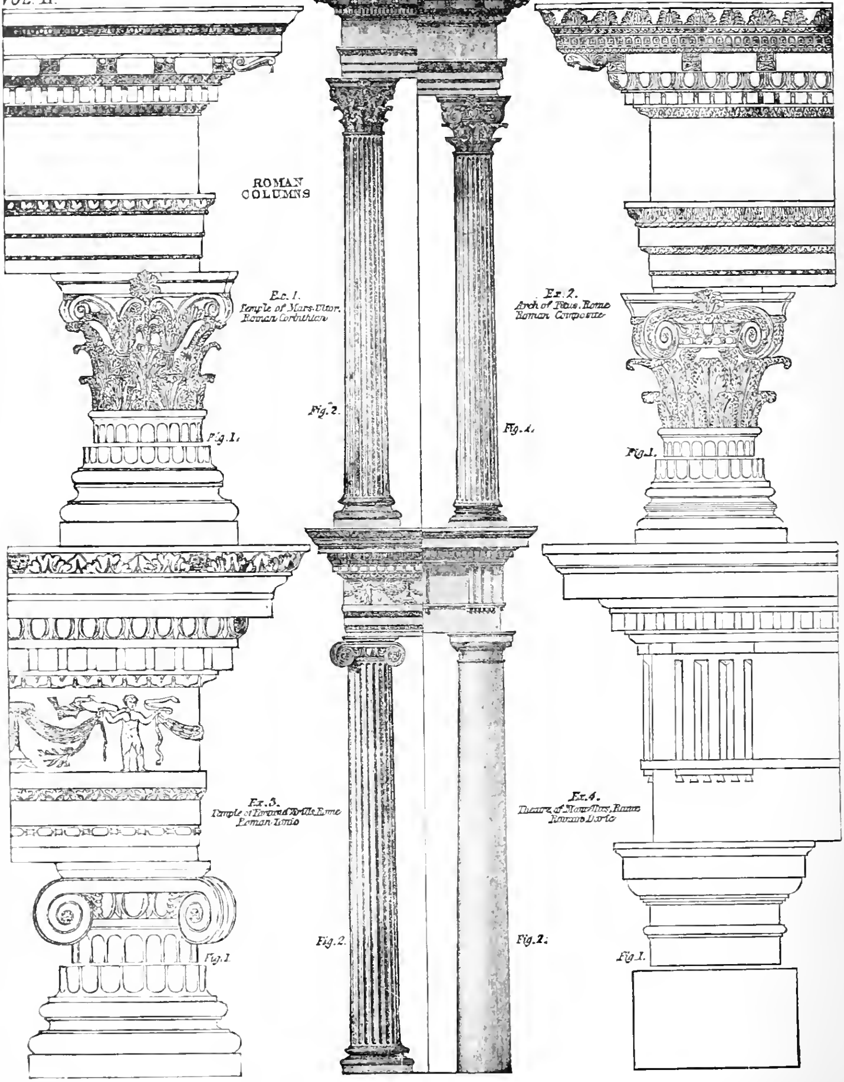
The column (Plate XIV.) consists of base, shaft, and capital, and varies in height from nine and a half to ten diameters. The base has, ordinarily, in addition to the diminishing congeries of mouldings which follows the circular form of the shafts, a square member or plinth, whose edges are vertical; with this the whole height of the base is about half diameter. The rest of this part of the column is variously composed, but it generally consists of two plain tori and a scotia, with fillets intervening, as in Greek examples of this order, but differently proportioned and projected, as the examples indicate. Sometimes the scotia is divided into two parts by two beads, with fillets, as in the Jupiter Stator example, in which also a bead is placed between the upper torus and the fillet of the apophyge. The spread of the base varies from a diameter and one-third to a diameter and four-ninths. In the best Roman examples, as well as in the Greek, the shaft diminishes with entasis; the average diminution is one-eighth of a diameter. The shaft was always fluted when the material of which it was composed did not oppose itself; for the Romans often used granites, and sometimes an onion-like marble, called therefore *cipollino*, for the shafts of columns; the former of which could not be easily wrought and polished in flutes, and the latter would scale away if it were cut into narrow fillets. Like the Greek Corinthian and Ionic orders, the Roman Corinthian has twenty-four fillets and flutes. The flutes are generally semicircles, and they terminate at both ends, for the most part with that contour. Dividing the space for a fillet and a flute into five parts, four are given to the latter, and one to the former. The hypotrachelium is a plain torus, about half the size of the upper torus of the base, or half the width of a flute, as these nearly correspond; it rests on a fillet above the cavetto at the head of the shaft.

The ordinary height of the capital is a diameter and one-eighth; but there is a very fine example, in which it barely exceeds a diameter, and another in which it is not quite so much. It is composed of two rows or bands of acanthus leaves, each row consisting of eight leaves ranged side by side, but not in contact; of helices and tendrils trussed with foliage; and an abacus, whose faces are moulded and variously enriched. The lower row of acanthus leaves is two-sevenths the whole height of the capital; the upper row is two-thirds the height of the lower above it, and its leaves rest on the hypotrachelium below, in the spaces left between the others. They are placed regularly, too, under the helices and tendrils above, which support the angles, and are under the middle of each side of the abacus. The construction and arrangement of the next compartment above must be gathered from the examples, for a competent idea cannot be conveyed in words. The abacus is one-seventh of the height of the capital; in plan it is a square whose angles are cut off, and whose sides are concaved in segments of a circle, under an angle at the centre of from 55° to 60°. Its vertical face is generally a flat cavetto, with a fillet and carved ovolo corbelling over at an angle of about 125°. The cavetto is sometimes enriched with trailing foliage, and a rosette or flower of some kind overhangs the tendrils from the middle of each side of the abacus.

Every example of this order differs so much from others in the form, proportion, and distribution of the various parts of its capital particularly, that it cannot be described in general terms like the Greek Doric and Ionic. The example referred to in the definition is that of the so-called Jupiter Stator, the most elegant, perhaps, of all the Roman specimens (Plate XIV. ex. 1).

The entablature varies in different examples from one diameter and seven-eighths to more than two diameters and a half in height. Perhaps the best proportioned are those of the portico of the Partheon (Plate XIV. ex. 4) and of the temple of Antoninus and Faustina (Plate XIV. ex. 3), the former being rather more than two diameters and a quarter, and the latter rather less than that ratio. The entablature of the Jupiter Stator example is more than two diameters and a half in height, of which the cornice alone occupies one-sixth more than a full diameter, leaving to the frieze and architrave somewhat less than one diameter and a half between them. In this latter particular it nearly agrees with the other two quoted examples, so that the great difference in the general height is in the cornice almost alone, the cornices of the others being about a sixth less, instead of as much more, than a diameter in height. The Roman Corinthian entablature may be taken, then, at two diameters and a quarter in height. Rather more than three-fifths of this is nearly equally divided between the architrave and frieze, the advantage, if any, being given to the former; the cornice, of course, takes the remaining two-fifths, or thereabouts. The architrave is divided into three unequal fasciæ and a small congeries of mouldings, separating it from the frieze. The first fascia is one-fifth the whole height; one-third of what remains is given to the second, and the remainder is divided between the third fascia and the band of mouldings,—two-thirds to the former, and one to the latter. A bead, sometimes plain and sometimes carved, taken from the second fascia, which is itself enriched in the Jupiter Stator example, marks its projection over the first; and a small cyma-reversa, carved or plain as the bead may be, taken from the third fascia, marks its projection over the second. The band consists of a bead, a cyma-reversa, carved or plain according to the general character of the ordinance, and a fillet. In non-accordance with the practice of the Greeks, the face of the lowest or first fascia of the architrave, in the Roman Corinthian, impends the face of the column at the top of the shaft, or at its smallest diameter; and every face inclines inwards from its lowest face up. The whole projection of the architrave, that of the covering fillet of the band, is nearly equal to the height of the first fascia. The frieze impends the lowest angle of the architrave. Its face is either perpendicular, or it slightly inclines inwards, like the fasciæ of that part of the entablature: in some cases it is quite plain, and in others is enriched with a foliated composition, or with sculptures in low or half relief. The cornice consists of a deep bed-mould, variously proportioned to the corona; but it may be taken generally, when it has modillions, at three-fifths, and when it has none, at one-half of the whole height. It is composed of a bead, an ovolo or cyma-reversa, and a fillet, a plain vertical member, sometimes dentilled, another bead, and a cyma-reversa, with fillet or ovolo, as the lower may *not* be; this is surmounted, when modillions are used, by another plain member, with a small carved cyma-reversa above it. On this the modillions are placed, and the cyma breaks round them. They are about as wide as the member from which they project, and are about two thicknesses apart. In form they are horizontal trusses or consoles, with a wavy profile, finishing at one end in a large, and at the other in a small volute; and under each there is generally placed a raffled or acanthus leaf. In proportion-


ROMAN CORINTHIAN COLUMNS
Ex. 1. Jupiter Stator Temple, Rome
Fig 1.
Fig. 2.
Fig. 2.
Ex. 2. Temple of Vesta, Tivoli
Fig. 1
Ex. 3. Temple of Antoninus & Faustina, Rome
Fig. 1.
Fig. 2
Fig. 2.
Ex. 4. Portico of Pantheon, Rome.
Fig. 1


ROMAN COLUMNS
Ex. 1.
Temple of Mars Ultor.
Roman Corinthian
Ex. 2.
Arch of Titus, Rome
Roman Composite
Ex. 3.
Roman Ionic
Ex. 4.
Fig. 1.
Fig. 2.
Fig. 2.
Fig. 1.
Fig. 1.
Fig. 2.
Fig. 2.
Fig. 1.

ing the parts of this bed-mould in itself, one-third of its height may be given to the modillion member, and the other two-thirds divided nearly equally, but increasing upwards into three parts, one for the lowest mouldings, one for the plain or dentil member, and the third, and rather largest portion, for the mouldings under the modillion member. The mouldings of this part of the cornice are carved or left plain, according to the character of the ordinance; and its greatest projection, except the modillions themselves, that of the modillion member, is about equal to half its height. The upper part of the cornice—the corona, with its crown-mouldings—consists of the vertical member called the corona, which is two-fifths the whole height;—this, in the examples of the temples of Jupiter Stator and Antoninus and Faustina, is enriched with vertical flutes;—a narrow fillet, an ovolo, and a wider fillet, occupy one-third of the rest, the other two-third being given to cyma-recta, with a covering fillet which crowns the whole. Its extreme projection is nearly equal to the whole height of the cornice.

The ordinance of the temple of Vesta, or of the sibyl, at Tivoli (Plate XIV. ex. 2), whose entablature is the very low one mentioned, is not generally in accordance with the scale we have given, and it must be referred to for its own peculiar proportions.

Pediments with the Roman Corinthian order are found to be steeper than they were made by the Greeks, varying in inclination from 18° to 25°; but they are formed by the cornice of the entablature in the same manner. Antefixæ do not appear to have been used on flank cornices as in Greek ordinances, in which the cymatium is confined to pediments; but in Roman works it is continued over the horizontal or flank cornice, as we have described; and frequently it is enriched with lions' heads, which were at the first introduced as waterspouts. The planceer or soffit of the corona is, in the Jupiter Stator example, coffered between the modillions, and in every coffer there is a flower. The soffit of the entablature in this order is generally panelled and enriched with foliated or other ornament. The intercolumniation is not the same in any two examples. In the temple of Vesta, in Rome, it hardly exceeds a diameter and a quarter; in the Jupiter Stator example it is a fraction less than one diameter and a half, in that of Antoninus and Faustina, nearly a diameter and three quarters; in the portico at Assisi, rather more than that ratio; in the portico of the Pantheon, almost two diameters; and in the Tivoli example, a fraction more than that proportion.

The antæ of the Roman Corinthian order are generally parallel; but pilasters are mostly diminished and fluted as the columns. Of two of the existing examples of antæ, in one—that of the temple of Mars Ultor—they are plain, to fluted columns; and in the other—that of the Pantheon portico—they are fluted, to plain columns. The capitals and bases are transcripts of those of the columns, fitted to the square forms.

Ceilings of porticoes are formed, as in the Greek style, by the frieze returning in beams from the internal architrave to the wall or front of the structure, supporting coffers more or less enriched with foliage or flowers. This, however, could only have been effected when the projection was not more than one, or at the most two, intercolumniations, if stone was used; and it is only in such that examples exist. Porticoes ordinarily must have had arched ceilings, as that of the Pantheon has, or the beams must have been of wood; in the latter case the compartments of the ceiling would probably be larger. How it was arranged in the former we cannot tell, as the arches only remain, and they may not be of the date of the rest of the portico.

The Roman Composite.

The ancient examples of what is called the Composite order (Plate XV. ex. 2) do not differ so much from the ordinary examples of the Corinthian as the latter do among themselves, except in the peculiar conformation of the capital of the column. In other respects, indeed, its arrangement and general proportions are exactly those of the Corinthian. The Composite was used in triumphal arches, and, in the best ages of Roman architecture, in them alone. The difference in the capital consists in the enlargement of the volutes to nearly one-fourth the whole height of the capital, and in the connection of their stems horizontally under the abacus, giving the appearance of a distorted Ionic capital. The central tendrils of the Corinthian are omitted, and the drum of the capital is girded under the stem of the volutes by an ovolo and bead, as in the Ionic. Acanthus leaves, in two rows, fill up the whole height from the hypotrachelium to the bottom of the volutes, and are consequently higher than in the Corinthian capital: this difference is given to the upper row. Besides this Composite, however, the Romans made many others, the arrangements and proportions of the ordinances being generally those of the Corinthian order, and the capitals corresponding also in general form, though in themselves differently composed. In these, animals of different species, the human figure, armour, a variety of foliage, and other peculiarities are found. Shafts of columns also are sometimes corded or cabled instead of being fluted: those of the internal ordinance of the Pantheon are cabled to one-third their height, and the flutes of the antæ of that ordinance are flat, eccentric curves. There are fragments of others existing, in which the fillets between the flutes are beaded; some in which they are wider than usual, and grooved; others, again, whose whole surface is wrought with foliage in various ways; and it would be no less absurd to arrange all these in different orders, than to make a distorted and hybrid capital the ground-work of an order.

The Roman Ionic.

The only existing example of Ionic in Rome, in which the columns are insulated, is in the temple of Fortuna Virilis (Plate XV. ex. 3; Plate XVI. fig. 12), for the temple of Concord is too barbarous to deserve consideration. Its stylobate, like that of the Roman Corinthian, is lofty and not graduated, having a moulded base and cornice or surbase. In the column the base consists of a plinth, two tori, a scotia, and two fillets; the shaft has twenty fillets and flutes, and diminishes one-tenth of a diameter; the capital is two-fifths of a diameter in height, the volutes, however, dip a little lower, being themselves about that depth without the abacus; the corbelling for the volutes is formed by a bead and large ovolo,—the latter being carved. A straight band connects the generating lines of the volutes, whose ends are bolstered and enriched with foliage; and a square abacus, moulded on the edges, covers the whole. In the entablature the architrave is unequally divided into three fasciæ and a band consisting of a cyma-reversa and fillet; the lowest angle impends the upper face of the shaft of the column. The frieze is in the same vertical line, and is covered with a fillet which receives the cornice; it is also enriched with a composition of figures and foliage. The cornice consists of a bed-mould, two-fifths of its height, and a corona with crown-mouldings. The cymatium is enriched with acanthus leaves and lions heads, and the mouldings of the bed-mould and architrave band are carved. The soffit of the corona is hollowed out in a wide groove, whose internal angles are rounded off in a cavetto, but without ornament of any kind, forming indeed a mere throating. Like the angular capitals of the Greek

Ionic, the external volute of this is turned out and repeated on the flank: either that or the abuse of it in the Composite capital gave rise to distortions of this order, in which all the volutes of the capital are angular, and consequently all its four faces are alike. In other respects, however, it does not differ generally from the ordinary Roman examples of Ionic. The temple of Fortuna Virilis is pseudo-peripteral, and consequently has neither antæ nor pilasters, nor do ancient examples exist of either.

The Roman Doric.

The Roman Doric is even a ruder imitation of the Grecian original than the mean and tasteless deterioration of the voluted Ionic is of the graceful Athenian examples. The specimen of it which is considered preferable to the others is that of the theatre of Marcellus, in Rome (Plate XV. ex. 4). The column is nearly 8 diameters in height: it consists of shaft and capital only. The shaft is quite plain, except fillets above and below, with escape and cavetto; and it diminishes one-fifth of its diameter. The arrangement of the capital, composed of a torus, the necking, and three deep fillets, with a semitorus, surmounted by the abacus, is shown in Plate XV. ex. 4. The corona and crown-mouldings of the cornice being destroyed, the whole height of the entablature cannot be correctly ascertained; but from analogy it may be taken, with the bed-mould, part of which exists, at about two-thirds of a diameter, making, with the architrave and frieze, an entablature nearly 2 diameters high. Of this the architrave is exactly half a diameter. Three-tenths of its depth are unequally occupied by the tænia, regula, and guttæ, the last of which are six in number, and truncated semicones in form. The rest of the surface of the architrave is plain and vertical, impending a point rather within the superior diameter of the column. A fascia, one-eighth of its own height, bands the frieze above the triglyphs; the rest of its surface is plain vertically, but horizontally it is divided into triglyphs, half a diameter in width, and placed over the centres of the columns. The space between the triglyphs is equal to the height of the frieze without its plat-band or fascia, making in effect perfectly square metopes. All that can be traced of the cornice is a small cyma-reversa, immediately over the frieze, and a square member with dentils on it. In the example, the cornice is completed from that of the Doric of the Colosseum.

The temple at Cora presents a singular specimen of the Doric order, evidently the result of an examination of some Greek examples, but moulded to the Roman proportions and to Roman taste. The columns are enormously tall, but the shafts are partly fluted and partly chamfered for fluting, like the Greek. The capital is ridiculously shallow, but the abacus is plain, and the echinus of a somewhat Hellenic form. The entablature is very little more than a diameter and one-third in height, and the architrave of it is shallower even than the capital; but the frieze and cornice are tolerably well proportioned, though the triglyphs in the former are meagre, narrow slips, and the latter is covered by a deep widely-projecting cavetto, that would be injurious to even a better composition. Instead of regular mutules with guttæ, the whole of the planceer of the cornice is studded with the latter; but, like the Greek, the triglyph over the angular column extends to the angle of the architrave, which does not appear to have been the practice of the Romans; yet the reason for this does not appear to have been understood, for the external intercolumniations are the same as the others.

As far as we have the means of judging, the Romans made the antæ of their Doric similar to the columns, only that they were, of course, square instead of round; though, indeed, an attached column appears to have been generally preferred.

It is, however, to be remembered, that these two orders, the Ionic and Doric of the Roman school, ought hardly to be considered as belonging to the architecture of the Romans. They are merely coarse and vulgar adaptations of the Greek originals, of which we now possess records of the finest examples. Yet their meanness and tastelessness, when compared with the Grecian models, more strikingly evince the superiority of the latter, and show to what extent the architects of the Italian school must have been blinded by their system, when they fancied such wretched examples to be beautiful.

Roman Mouldings and Ornament (Plate XIII.)

The mouldings used in Roman architectural works are the same as the Grecian in general form, but they vary materially from them in contour. The Roman cyma-recta is projected much more than the Greek, with a deeper flexure. The ovolo is represented in the Roman style by a moulding whose outline is nearly the convex quadrant of a circle, or a quarter round, and sometimes it is nearly that of the quadrant of an ellipse. The Roman torus is either a semicircle or a semi-ellipse; and the bead is a torus, except in its application, and in being smaller, and generally projected rather more than half the figure whose form it bears. The cavetto, in Roman architecture, is nearly a regular curve, being sometimes the concave quadrant of a circle, or the reverse of an ovolo, and sometimes a smaller segment. A Roman scotia is more deeply cut, and is consequently less delicate than the same member in a Greek congeries: its form frequently approaches that of a concave semi-ellipse.

The enrichments of Roman mouldings are, for the most part, similar to those of the Greek, but less delicate and graceful both in design and drawing. Those of the cyma and ovolo are particularly referred to, but the Romans used others besides. Raffled leaves form a favourite enrichment in the architecture of the Romans; indeed these are hardly less frequent in their works than the honeysuckle is in those of the Greeks. Mouldings were enriched with them; and a raffled leaf masks the angles of carved cymas and ovolos in the former, as a honeysuckle does in the latter. Nevertheless, the honeysuckle and lotus are both found in Roman enrichments, particularly the latter, and perhaps even more than in Greek. It is not uncommon to find examples of Roman architecture completely overdone with ornament,—every moulding carved, and every straight surface, whether vertical or horizontal, sculptured with foliage or with historical or characteristic subjects in relief.

Particular Roman Structures.

TEMPLES.—Whatever forms were adopted from the Greeks by the Romans were rapidly altered by the latter. The temples, for example, were, no doubt, constructed, in the main, after the Greek model. But we find three-quarter columns used in the flanks, as at the temple of Fortuna Virilis at Rome and at Nismes, in place of the open peristyle or the plain flat wall. These three-quarter columns were, it is true, used at the rear of the Erechtheum and at the temple of the Giants at Agrigentum. But these were quite exceptions. Then, in the portico of the Pantheon (Plate XVI. fig. 4) the Romans availed themselves of the properties of the arch to effect an immense change in the internal design and appearance. Temples.

From the forest of columns, as at the Parthenon, all placed at equal distances, or nearly so, the Romans boldly removed four rows (two in centre and one at each side, as at the Pantheon, Plate XVI. fig. 5), arched over the space thus left, and so obtained a picturesque effect quite un-

VOL. II

ARCHITECTURE

ROMAN

PLATE XV

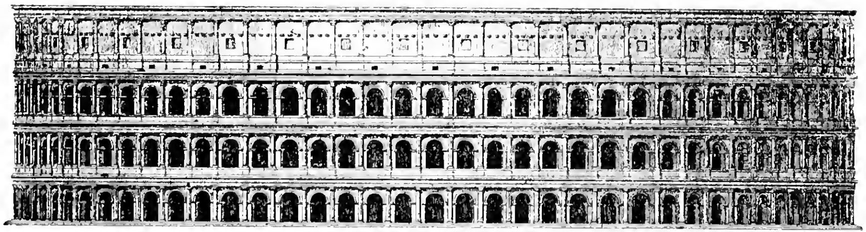
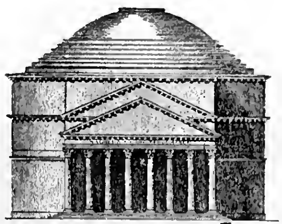


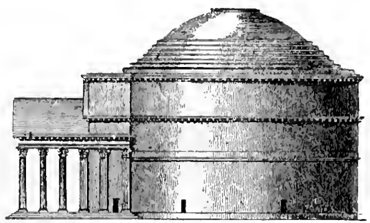
Fig 1. The Colosseum (Amphitheatre), Rome

Fig. 2.



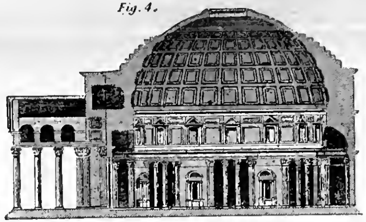
The Pantheon, Rome Front Elevation

Fig. 3.

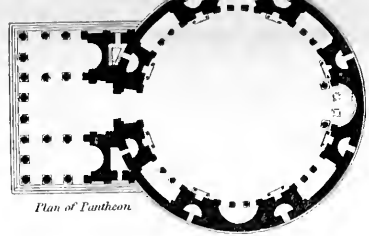


The Pantheon, Flank Elevation

Fig. 4.



Section of Pantheon



Plan of Pantheon

Fig 6

Fig. 7.

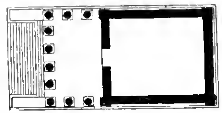
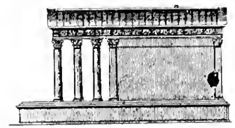


Fig 8



Front elevation, plan, and flank elevation of Temple of Antoninus & Faustina

Temple of Fig 9 Vesta, Tivoli

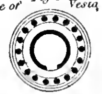


Fig 10.
Arch of Septimius Severus

Fig 11
Arch of Titus

Fig 12.
Temple of Fortuna Virilis, Rome

All the figures are drawn to the same scale

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ENCYCLOPAEDIA BRITANNICA, NINTH EDITION

known to the Greeks. Then the ends were rounded off into apses, and the same was done at the temple of Venus and Rome. In each of the above cases the exterior still conformed almost entirely to the outlines of the Greeks. But we now come to the circular edifices, as the temple of Minerva Medica, 110 feet in diameter, and the Pantheon, 139. As to the age of these and their purpose there is some doubt; but there can be none as to the temples of Vesta at Tivoli and Rome, which have an external peristyle of columns, and thus present an entirely new form. Whether these temples were finished with domes or not is doubtful. In any case the exterior would probably have shown merely a sloping roof, as has been common enough in Italy down to late times.

Theatres.

THEATRES.—The best remaining specimens of Roman theatres are those of Pompeii and Herculaneum. Like those of the Greeks, they rest on the side of a hill, but instead of being hewn out of the hill they are built on it. Others in a more or less ruined state remain in Italy, France, Sicily, &c., *e.g.*, at Rome, Verona, Pola, Taormina, and Arles. At first they were of wood, and one by Æmilius Scaurus, 58 B.C., is said to have held 80,000 spectators. That they were copied mainly from the Greeks there can be no doubt. In fact, one built by Pompey is expressly stated to have been copied from another at Mytilene, and their general form is very similar to that of the Greek theatre. But the Roman theatre received a greater degree of architectural decoration than the Greek. Of this the theatre of Marcellus, in Rome, is an example; for though otherwise destroyed, its external wall remains and presents columnar ordinances, with intervening arches in stories, according to the practice of the Roman school.

Amphitheatres

AMPHITHEATRES.—These are altogether Roman in general design. The first is said to have been built by Julius Cæsar, and others were afterwards built by Caligula and Nero. The first of stone is said to have been the Colosseum, built by Vespasian and Titus, and so called from the Colossus of Nero which stood near. It was injured and then restored under Severus and Decius, in whose time it is probable that the upper row was added. As to the awning, we know that the main portion at least of the audience was protected from the fierce rays of the sun by a strong velarium. This was supported on the outside by heavy masts, which passed through holes still existing in the top cornice, and stepped down on to the corbels, which show so conspicuously in the top order. Recent excavations have disclosed the original arena, about 20 feet below the present level of the ground. Evidence has also been obtained that the arena was sometimes a movable platform. To obtain an approximate idea of the size of this enormous structure, we must remember that the Albert Hall (the largest diameter of which is 276 feet) could have been placed in the arena alone of the Colosseum, the exterior of which measures 622 feet by 528 (Plate XVI. fig. 1). Other amphitheatres of great size were constructed in the various towns of the empire. Amongst them we may mention that at Verona, 500 feet by 404, and Nismes (still used for public shows), 434 by 340. Extensive remains of another, 376 feet by 220, have been discovered recently at El-Djemm, in Tunis. (See AMPHITHEATRE, vol. i. pp. 774–776.)

Tombs.

TOMBS.—Some very grand examples of tombs of circular forms remain, as well as many others of great beauty. It must be remembered that with the Romans both burial and cremation were used. The columbaria (vaults lined with small recesses for the urns, which contained the ashes of the dead) present the most ordinary specimens of architectural forms adapted to cremation. The sarcophagus, of which that of the Scipios is the best known example, presents the ordinary form used in connection with burial. But when the family of the deceased was rich or distinguished, the ashes or the sarcophagi were enclosed in buildings of the most magnificent kind. The tomb of Cecilia Metella, so well known to all by Byron's beautiful lines in *Childe Harold*, commencing—

> "There is a stern round tower of other days,"

is a bold tower 90 feet in diameter and 62 feet high, so solidly built as to contain only a chamber 19 feet in diameter. Much grander was the mausoleum of Augustus, which has perished. Of the mausoleum of Hadrian the skeleton only remains. But it shows that the base was 170 feet square, supporting a circular edifice 115 feet in diameter. It would seem that this mass, now formed into the castle of St Angelo, and showing the naked brickwork, had, in its glory, two ranges of marble columns and probably a domed roof. From its position on the banks of the Tiber, near the bridge, it must have formed one of the grandest architectural compositions of the Romans.[1]

Forums.

FORUMS.—At first these great buildings were used for merchants, and were open spaces with porticoes, shops, counting-houses, &c., all round. The best example existing is, perhaps, that of the Forum of Pompeii. In later times these erections expanded into grand architectural ranges of porticoes, with statues, &c. Leading out of them, in various positions, were temples, law courts, theatres, &c. It was in Trajan's Forum that his famous column was erected.

Aqueducts.

The AQUEDUCTS show little of the skill of the architect, but they are very picturesque as they stretch along the Campagna and other places. Across a valley, at Tarragona, one rises to a height of 100 feet, and another, the Pont du Gard, at Nismes, to 180. But they do not reach the level of true architectural beauty, and derive their chief value from their immense length and size. (See AQUEDUCT, pp. 219–221 of the present volume.)

Triumphal arches.

The TRIUMPHAL ARCH is peculiarly Roman, and it is in this form that the arch appears to have been most boldly used as an external feature. The arch is, in fact, the form to which all other parts of the structure are mere decorative adjuncts. The principal examples are the arches of Titus, Severus, Janus, and Constantine at Rome, and that of Trajan at Ancona.

Dwellings.

DWELLINGS.—The still extensive remains of the villa of Hadrian, near Tivoli, bespeak its original magnificence. Everything appears to have been directed to internal splendour and effect alone; and, indeed, all collateral evidence tends to the conclusion, that the exterior of Roman palaces and mansions was not heeded, being merely plain brick walls. This is the case at Pompeii, and the ruins of mansions in various parts of Italy, from that of Sallust on the Benacus or Lago di Garda, to those of other Roman nobles on the shores of the Bay of Baiæ, present no indications whatever that their exteriors were subjected to architectural decoration. The palace of Diocletian at Spalatro, and the splendid remains of Baalbec and Palmyra, some of which, perhaps, belonged to secular structures, offer evidence to the contrary of this, if they are correctly restored in the works which treat of them. Notwithstanding the extent of the structure and its general magnificence, however, the

[1] Singular enough, mausoleums, though they have been destroyed in Greece and Rome, have been preserved in Africa. There we have a singular structure, the Medricen, in Algeria, 180 feet in diameter, with a row of engaged columns of a rude Doric type as a stereobate, and on these a series of gradini. The whole outline greatly resembles that of the circular Etruscan-built tombs already described. Much grander and more ornate is the Koubr, also in Algeria, which is of the same form, but 200 feet in diameter, and 108 feet high to the platform at top. The order is a curious imitation of the Erechtheum Ionic. The Medricen has not been entered, at least, in modern times. The Koubr has a singular arched passage, entered from below the ground-level, and winding all round to a chamber in the centre. The rest is solid.

mouldings and ornaments in the interior of the villa of Hadrian, though in themselves classical and elegant, are small, and have a general air of littleness, especially when compared with the apartments to which they belong,—not that the apartments are generally large, but they are for the most part lofty. The ceilings appear to have been formed by vaulting; there are no indications of windows, and none of stairs of any magnitude—so that the rooms must have been nearly, if not quite, open at one end to admit light and air; and the probability is that there were seldom apartments above the ground floor, though it is likely enough that terraces formed on the vaulted roofs were used for the purposes of recreation and pleasure. Of the floors, which were of mosaic, several are preserved entire in the museum of the Vatican; where also are deposited many fine specimens of ornamental sculpture in vases and candelabra, besides busts, statues, and groups in bronze, marble, porphyry, and granite, of various styles, remains of the noble collection Hadrian made during his progress through his extensive dominions, which have been found among the ruins of the villa.

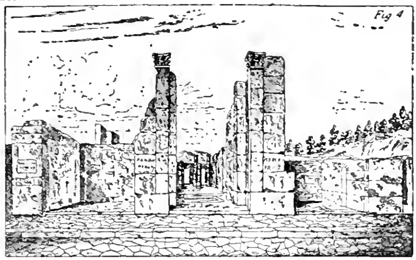
In Pompeii we may see the domestic as well as public architecture of ancient Rome, although it must be remembered that Pompeii was a Greek colony, and that it was destroyed as early as 79 A.D. We have, therefore, probably to expect more Greek character than would be met with elsewhere.

The streets of Pompeii are very narrow, their average width being not more than 12 or 15 feet; frequently they are not more than 8 feet wide, and very few in any part exceed 20. The principal excavated street in the city, that leading from the Forum to the gate towards Herculaneum, and the street of the tombs, is, at the widest, 23 feet 6 inches, including two footways, each 5 feet wide. The streets are all paved with lava, and almost all have side pavements or footways, which, however, are for the most part so narrow, that, with few exceptions, two persons cannot pass on them. That the cars or carriages of the inhabitants could not pass each other in most of the streets, is proved by the wheel-ruts which have been worn on the stones, and the recesses made here and there for the purpose of passing. They are lined on both sides with small cells, which served for shops of various kinds; and they are strikingly like the ordinary shops in towns in the south of Italy and in Sicily at the present time (Plate XVII. fig. 1). They resemble these, too, in this respect, that there appear in very few cases to be accommodations in connection with the shops for the occupiers and their families, who must have lived elsewhere, as modern Italian shopkeepers very commonly do. They present no architectural decoration whatever; the fronts are merely plain stuccoed brick walls, with a large square opening in each, part of which is the door, and part the window, for lighting the place and showing the goods.

Whenever a private house or gentleman's mansion was situated in a good place for business (like the ground floor of many modern Italian noblemen's palaces), the street-front, or fronts, were entirely occupied with shops, a comparatively narrow entrance to the house being preserved in a convenient part between some two of them (Plate XVII. fig. 3). The door to this is sometimes quite plain, but at times is decorated with pilasters. When the site permitted such an arrangement, the entrance door being open, a passer-by could look completely through the house to the garden, or, in the absence of a garden, to the extreme boundary-wall, on which was painted a landscape or other picture. An arrangement, it may be observed, not unlike this, is common in some of the Italian cities at the present day; but the mansions being now built in stories, and the upper stories alone being occupied by the families, a merely pleasing effect is produced; whilst in the former, persons crossing from one apartment to another were exposed to view, and domestic privacy thus completely invaded, to produce a pretty picture. Inside the entrance passage, which may be from 10 to 12 feet in depth, there is a space, the atrium, generally square, or nearly so, on which different rooms open, that vary in size from 10 feet square to 10 feet by 12, or even 12 feet square; they have doorways only, and were probably used as sleeping-chambers by the male servants of the family. In the centre of this court there is a sunk basin or reservoir for receiving the rain, called the impluvium, rendering it likely that this was roofed over, with a well-hole to admit light and air, and allow the rain to drop from the roof into the reservoir. Connected with this outer court was the kitchen and its accessories. If the site allowed the second court to be placed beyond the first in the same direction from the entrance, the communication was by a wide opening not unlike folding doors between rooms in modern houses, generally with a space intervening, which was variously occupied; or a mere passage led from one to the other. The second or inner court is generally much larger than the first, and is for the most part a parallelogram, but variously proportioned. It forms a tetrastoön, being open in the middle and arranged with a peristyle of columns, colonnading a covered walk all round. On this the best and most finished apartments open; but they are of such various sizes, and are so variously arranged, that it is not easy to determine more than that they included the refectory, the library, and sleeping-rooms. Some of them, indeed, are such as must have been useless except for the last purpose; these, perhaps, were the apartments of the female branches of a family, at least in most cases. Some houses, however, have a nest of small cells in an inner corner or secluded recess, which may have been the gynæceum; but that is far from being common. Exhedræ or recesses, open in front to the atrium, are common, and are often painted with more care and elegance than any other part of the house; but generally the walls are everywhere painted—in the more common places flat, with a slight degree of ornament, perhaps, and in the best rooms, with arabesques and pictures in compartments. The architectural decorations are mostly painted; the ornaments are not unfrequently elegant, but the architecture itself of the mansions is bad in almost every sense. The rooms being windowless, would, when covered, be necessarily dark; the doors are arranged without any regard to uniformity, either in size or situation. The street-fronts of those houses which, not being in a good business situation, were not occupied with shops, were not merely unadorned, but were actually deformed by loop-holes, to light some passage or inner closet which had no door on one of the courts. (Plate XVII. fig. 8.) The columns of the second courts are generally in the worst style possible: those which have foliated capitals, and may be considered compositions of the Corinthian order, are the best; but the imitations of Doric and Ionic are both mean and ugly. From the uses to which they were put, and the wideness of their intercolumniations, together with the fact that none of them have been found in Pompeii, it is probable that the entablatures were of wood, and were consequently burnt at the time of the destruction of the city, and broken up by the inhabitants, almost all of whom certainly escaped, and who, it is very evident, returned, when the fiery shower and the conflagration had ceased, to remove whatever they could find of their property undestroyed; for it must be remembered that the roofs and ceilings all over the city are entirely gone, and the uncovered and broken walls remain, from 8 to 10 feet only in height. Everything, indeed, clearly demonstrates that great exertions were used

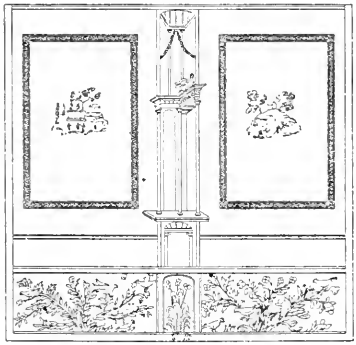
ARCHITECTURE
ROMAN

Fig 4



Sketch of the Entrance to the Mansion (Figs 1 2 & 3) in its present state

Fig 5



Specimen of the mode of ornamenting the sides of rooms in Pompeii

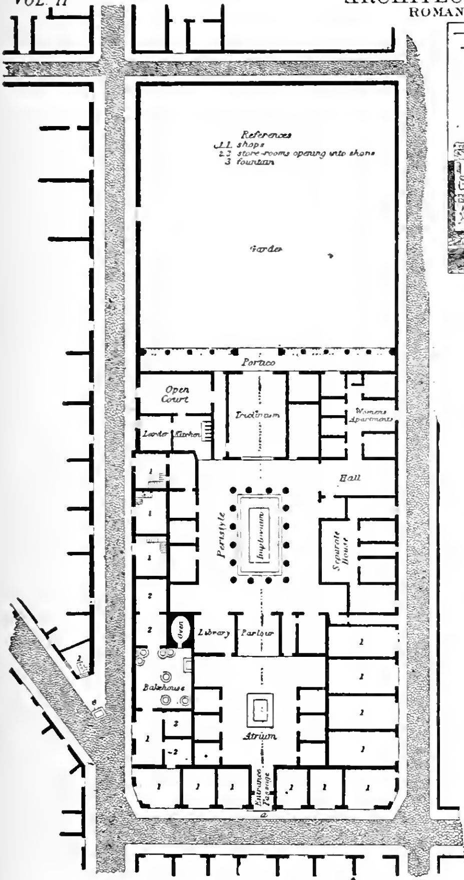
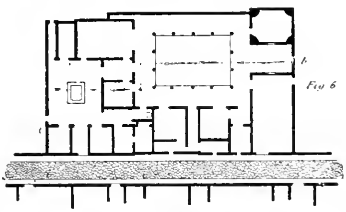


Fig 1 Plan of a Roman Mansion, with the houses, shops & streets, surrounding it from Pompeii.

Fig 6



Plan of a Roman Mansion in a private street from Pompeii.

Fig. 2.

Section of the above Mansion (Fig 1) on the line a a

Fig. 7

Section of the above Mansion (Fig 6) on the line b b

Fig 3

Entrance Elevation to the street of the above Mansion (Fig 1)

Fig 8

Elevation to the street of the above Mansion (Fig 6)

Scale of 10 5 0 10 20 30 40 50 60 70 80 90 100 Feet

to recover whatever was valuable; and it is very probable, moreover, that the place was constantly resorted to by treasure-seekers for perhaps centuries after the calamity occurred. It may also be remarked that the loftier edifices, which would have been unburied by the ashes, had been thrown down by an earthquake about sixteen years before the volcanic shower fell, and, therefore, were the more easily covered. Other showers must have fallen since that which destroyed the city, to produce the complete filling up of every part and the general level throughout. Hence we are still uninformed as to the structure and disposition of the roofs and ceilings of the houses of the ancients. The doors, too, of whatever materials they were composed, are entirely gone: there remain, however, here and there indications—and even charred fragments—of wooden door-posts, but they belong to outer or street doors, leaving it probable that a matting of some kind, suspended from the lintel, formed the usual doors to rooms. It is, in fact, supposed that curtains answered the purposes of doors to the interiors. In these particulars, unfortunately, Herculaneum affords but little assistance, as the mode of its destruction was similar to that of Pompeii, though, upon the whole, Herculaneum is more likely to furnish information on these particulars than its sister in misfortune. Although it has been ascertained that the Romans understood the manufacture of glass, it must not be supposed that they were accustomed to apply it as freely as we do to exclude the weather and transmit light. It was, however, sometimes used; one wooden frame with four small squares of glass has been found; another brass frame with the glass movable; and one piece of glass of considerable size was found in one of the walls of a bath. The floors of the houses of Pompeii and Herculaneum are all of mosaic work, coarser and simpler in the less important parts, and finer and more ornate in the more finished apartments: the ornaments are borders, dots, frets, labyrinths, flowers, and sometimes figures. In this, too, the superior advantages the moderns enjoy are evident. The ancients did not understand how to construct wooden floors, or, at least, they did not apply timber to that use. A few rude and narrow staircases are found in Pompeii, which, it is very probable, were to afford access to the terraces or flat roofs, for they are not common, and no portion of an upper story remains in any part. Sufficient remains have, however, been found to show that the upper stories often overhung the lower front, as in mediæval houses; the fronts being made of woodwork, supported on a prolongation of the floor joists. In one part of the city the houses on one side of the street are on a declivity: there a commodious flight of stairs is found to lead from the atrium in front to another lower court and rooms, not under the houses but behind them; for we do not find an under-ground story in the Pompeian houses. On the shores of the Bay of Baiæ, and at Cicero's Formian Villa on the Gulf of Gaeta, however, there are crypts or arched chambers under the level of the mansions, the sites requiring substructions; but it may be questioned whether even these were used as parts of the house, and as we use cellars, for they present no indications of stairs, and have no regular means of intercommunication.

Numerous remains of Roman houses are found in all the colonies, and notices of many in England will be found in the *Archæologia*, and other archæological publications. They are not of sufficient importance to be quoted here, but they serve to show that the Romans carried with them into other lands the same habits, and even practised the same mode of construction which they adopted at home. One very remarkable exception exists, viz., in the Hauran in Syria. The edifices there were first, we believe, noticed by Humboldt. They have since been described in detail by Mr Cyril Graham and others, and have been admirably illustrated by Count Vogüé. The country was conquered by the Romans at the end of the 1st century A.D., and the houses, &c., seem to range in date from that time, or, perhaps, earlier, to the end of the 4th. They are contained within stone walls, forming small towns, and so numerous that sixty of these walled cities have been counted, all now desolate, but in many cases remaining almost perfect even to the doors, shutters, and paving of streets. The remains are chiefly of houses whose walls are of basalt. The rooms are 12 to 20 or 25 feet square, with strong, arched ribs thrown across, supporting a ceiling of thick slabs of basalt. Some of these are as much as 18 by 12 feet, and 6 inches thick. The doors and shutters are of the same material, often panelled as though of wood. A specimen of these, and also some of the carvings, are in the British Museum.

BASILICAS.—We have left these to the last, as they are more intimately connected than any other ancient architectural forms with those of the Christians. They seem to have been at first much the same class of building as our Royal Exchange, both as regards use and plan; open in the centre, with porticoes round. Then all was roofed over, and a sort of triforium or gallery formed over the porticoes. At one end was a recess, often circular and parted off from the rest by a screen of columns. This, with the space in front of it, formed the Tribunal. In Trajan's, there seems to have been an apse at each end. Remains are found at Pompeii and Herculaneum, Treves, &c. A complete exception to the ordinary form is found in the Basilica of Maxentius (formerly known as the temple of Peace) at Rome. Basilicas

RÉSUMÉ.—Roman architecture, as we know it, dates only from about the Christian era, and the rapidity with which it spread from that time is something marvellous. Through nearly the whole extent of the Roman empire, through Italy, Asia Minor, Sicily, Britain, France, Syria, Africa,—with one great exception, Egypt,—all was Roman in mouldings, ornaments, details, the very style of carving and the construction. No matter what the country or the architect, all seem to have lost their nationality when the Roman came, and to have adopted implicitly his system of design and decoration. It has been seen that he copied the orders and much of the leading forms of his buildings from the Greeks. But he speedily added others. The apse and the circle on plan were his; so were the dome and the arch in elevation; and thus he enlarged at once the whole range of the architect's powers, and whilst utterly disregarding the delicate refinements of the Greeks, secured a freedom of design which resulted at length in our Pointed architecture. Résumé.

But great as the advance was, it seems to have been arrested just when opportunities were offered, on the grandest scale, for bringing about the noblest results. The Roman architect seems to have been unable to reach the highest effort of art, viz., to bring the whole of any grand edifice into one splendid mass, to concentrate the detailed parts into one grand whole. But in reflecting on what the Roman did *not* do, we must not forget that we owe to him some of the grandest forms to which we too are now accustomed.

We now come to a complete change in the structures which we have to describe. Henceforth we shall find no Forum, no public bath, theatre, temple, or house. All these forms disappear, and for nearly 700 years, until the time when the Norman castle arose, well-nigh every building of architectural merit was in some way or other ecclesiastical. But with our Christian faith there arose forms of beauty utterly unknown to the Pagan, which culminated in the glories of Lincoln and Canterbury.

POINTED ARCHITECTURE.

In those countries which received the Christian religion from Rome, but which did not contain such mines of architectural material in temples, amphitheatres, and palaces, as Italy did, and, indeed, in the remoter parts of Italy itself, which did not contain them as Rome did, churches were constructed in imitation of those of the metropolis of the Christian world. These being the work of a semibarbarous and unpolished people, were of necessity comparatively rude, and from them arose the Gothic architecture of the Middle Ages,—not from any previously existing style of architecture among the northern nations who overran Italy and subverted the Roman power, the rude Celtic monuments being the only specimens of architecture they possessed. The transitional style of architecture referred to will be found in what are called the Saxon and Norman buildings of England, and to a greater or less extent in all parts of Europe in which the Romans had been masters, and particularly in those which adhered to the Roman communion in the great division of the churches. The general forms and modes of arrangement peculiar to Roman architecture may be traced throughout; in some specimens they are more and in others less obvious, but the leading features are the same. This is more evident in Italy than elsewhere. In the early Roman basilicas and churches, some of which are of the age of Constantine, and which were constructed in the Roman style, the first divergencies occur; in those which are later they are still greater, and distance of time and place appears still to have increased them, till what may be called a new style was formed, having peculiarities of its own, but even more clearly deducible from its origin than Roman is from Greek or Greek from Egyptian. The variation in the development from the parent stock is great, but in all cases there is more or less evidence of the descent. It must be noted, however, that there was one important modification of Roman art, and this was the Roman art modified by contact with the East, and known commonly as Byzantine. Its influence was felt first and most strongly in St Mark's, Venice, a building which is entirely Byzantine in style as opposed to Romanesque. From Venice it was copied in Périgueux in the church of St Front, and this copy influenced the style of a vast number of buildings in the south-west of France. St Mark's, again, had a great influence on the Lombard works of Northern Italy, and these were the originals from which Germany, by way of the valley of the Rhine, derived all its mediæval buildings. To the greater part of France and to England the stream of art was much more purely Romanesque, being the result of knowledge of genuine Roman art, with little, if any, influence from the East In Spain we see the direct influence of the Romans, the direct influence of the Arab, and the indirect Byzantine influence of the south-west of France, all materially affecting the development of the national architecture. As might be expected, this style was not the same in all the countries which practised it; it was derived, in them all, from the same source, as we have shown, but was materially influenced by the habits, manners, and state of civilisation of the various nations, and much, too, by their means of communication with Rome. This, in strictness, may be called Gothic architecture, as it was partly induced by the Gothic invasions of Italy, and was invariably practised by the nations to whom that term may with propriety be applied. It arose in the 4th century, and was subverted in the 12th by the invention or introduction of the pointed arch, which marks a new era, and was destined to give birth to a new style in architecture.

Where, when, and with whom the pointed form originated has been more discussed and disputed than the discovery of the properties of the arch itself. Some have contended that it was suggested by the intersections of semicircular arches, as they were employed in ornamenting the fronts of edifices in the preceding style; some, that groined arches of the same form gave the idea; others have referred it to the interlacing of the branches of trees when planted in parallel rows,—to an imitation of wicker-work,—to a figure used on conventual seals,—to the principle of the pyramid,—to Noah's ark,—to chance. Such a mass of conflicting opinions, almost all supported by some show of reason, and more or less by evidence, may be called a proof of the impossibility of determining the question. There is one striking fact, however, which has been overlooked by many of the theorists in the discussion of the question; it is, that the pointed arch made its appearance almost at the same moment of time in all the civilised countries of Europe. This is proved by the controversies of those who claim its invention for their respective nations; for none of them can produce genuine specimens of it before a certain period, to which they can all reach. Now, if it had been invented in any of the European nations, that one would certainly have been able to show specimens of it of a date considerably anterior to *some* of the others; for though it might by chance have been soon communicated to any one of them, the improbability is great that it would immediately have reached them all, and have been at once adopted by all, to the subversion of their previously practised forms of construction. The infrequent and imperfect modes of communication between the different countries of Europe at the period referred to, furnish another reason why it is not probable that a discovery of the kind should travel rapidly from one to another. Considering these things, and particularly the fact of the almost simultaneous introduction of the pointed arch to the various nations of Europe, as it appears by their monuments immediately after the first Crusade, in which they all bore a part, connected with existing evidence that it was commonly used in the East at and anterior to that period, the most rational and satisfactory theory seems to be that a knowledge of it was acquired by the Crusaders in the Holy Land, and brought home to their respective countries by them. In Europe there are found rude approaches to the pointed form in some of the earlier Gothic structures; but we believe it may be safely asserted that nothing can be indicated of a date beyond that of the first Crusade, approaching the simple but perfect lancet arch, which, it is not denied, came into use immediately after that period; whereas tolerably well-authenticated examples of it are found in the East, of sufficient antiquity to induce the opinion that it was at that time imported thence. It is, moreover, indisputable that the Saracenic or Mahometan nations, who were never known in those times to adopt any European custom or invention of any kind, do use, and have used, the pointed arch. It was very extensively employed in various parts of Asia, and nowhere in more sumptuous edifices or with greater effect than in the structures erected by the Mahometan conquerors of India. With what nation of the East, and in what manner, the pointed arch originated, are problems equally difficult to solve. We have not been able to discover that the properties of the arch were known to the Egyptians or to the Greeks, and there is no evidence to show that they were known to the Persians or to the Indians of ancient times; but structures are found in the countries of those nations in which chambers are domed, and apertures covered with a pointed arch, produced, however, by gathering or corbelling over, and not by arched structure. It is not improbable, therefore, that, such things existing, when the properties of the arch became known, that form would be repeated upon it, and the result would be the lancet arch,—the prototype, the germ of the style. The pointed arch, on its introduction into Europe, was not accompanied by any of its ordinary accessories in after-time,—its light clustered pillars, its mullions, foliations or featherings, and graceful tracery. These developments resulted from its adoption; so that whether the arch itself was invented in Europe or imported from the East, to the European nations must be assigned the credit of developing the beautiful style of architecture whose distinguishing feature it is.

Before proceeding further with this subject, it is necessary to determine by what name this style is to be designated. There have been only too many arguments and discussions on the name which is most appropriate to the style. By common consent the word Gothic is used all over Europe to designate it, and it now hardly matters whether or not there was originally good reason for the use of such a term. One of the first in England to use the term was Sir Henry Wotton. It was continued by Evelyn, who applied it more directly; and the authority of Sir Christopher Wren finally settled its application. But they used the term as one of reproach for what they thought a savage and uncivilised sort of art, though it was in vain that, by the use of a bad name, they attempted to deny the merit of that which was after all the only nationally developed style of their own country as well as of the whole of Northern Europe. In the last century, through the influence and enthusiasm of Horace Walpole, and afterwards of John Carter, an eminent artist and architect, a better taste was formed, and this led to the appreciation of that which is, indeed, the English national style. Many attempts were made to explode the totally irrelevant appellation of "Gothic" which had been applied to the style, but without effect. Some writers have called it Italian, others German, others Norman or French, others British, and many have contended for the exclusive term English. To this last the Society of Antiquaries lent its influence, but with equal inefficiency, for the term Gothic still prevails. Mr Britton, than whom perhaps no man possessed a greater right to affix an appellation to the pointed arch style, from the splendid services he has done it in the publication of his *Cathedral and Architectural Antiquities*, wished to introduce a term which is not at all unlikely to succeed, as it is equally appropriate and independent of national feeling and hypothetic origin. He called it Christian architecture, and in this he was followed by the younger Pugin and many others. This, as a generic term, would admit each nation possessing specimens of it to distinguish its own species or style; and as the varieties of Hellenic architecture are known by the names of the tribes or nations who are presumed to have originated them,—Dorian, Ionian, and Corinthian,—so might Christian architecture be English or British, German, French, &c., for each has its peculiarities. These species would again individually admit of classification, according to the changes each underwent in the course of its career. One objection, however, has been taken to Mr Britton's distinctive appellation. It is, that "Christian" applies as well to what may also properly be called the Gothic style—that which arose on the extinction of Roman architecture, and was subverted by the introduction of the pointed arch, and which, indeed, owed its diffusion and progress, if not its origin, to the Christian religion. We are therefore still left to seek a suitable appellation; and in the absence of a better, are inclined to use the term Pointed, which is not only distinctive, but descriptive; it has, too, the merit of being general, so that it may mark the genus, while the national species and their varieties may be distinguished by their peculiarities as before.

The pointed arch was a graft on the Romanesque, Lombard, and Byzantine architecture of Europe, just as the circular arch of the Romans had been on the columnar ordinances of the Greeks; but with a widely different result. The amalgamation in the latter case destroyed the beauty of both the stock and the scion; while in the former the stock lent itself to the modifying influence of its parasitical nursling, gradually gave up its heavy, dull, and cheerless forms, and was eventually lost in its beautiful offspring, as the unlovely caterpillar is in the gay and graceful butterfly.

We all know that architecture has had its origin in religious feelings and observances—that its noblest monuments among the pagan nations of antiquity were temples to the gods—whilst the rude nations of the north in the Middle Ages devoted their energies, after their conversion to Christianity, to the construction of suitable edifices for the worship of the Almighty; and we find, again, that the most extensive and most splendid structures raised by the same people, when the light of learning had begun to shine upon them, and a new and more beautiful style of architecture had been developed, were dedicated to the same purpose. In addition, however, many, hardly less magnificent, and not less beautiful, were raised for the purposes of education, and became the nurseries of science and literature. Kings and nobles also employed architecture in the composition, arrangement, and decoration of their palaces and castles; and though for domestic purposes its aid was not so largely required, it was equally used. The remains which have come down to us from the earlier portion of the Middle Ages are comparatively small, but there is ample evidence to show that the style was universal in its application, and so full of life and vigour that every implement, every piece of furniture, and every detail of dress or ornament, was governed then, just as in the best period of classic art, by the rules of art which were observed in the largest and stateliest of the public buildings of the time.

When the practice of building houses in stories commenced cannot be correctly ascertained, though it was usual among the Romans, as we know by the example of Pompeii, and it appears to have been usual during the Middle Ages. We frequently, indeed, find an apparent equivalent for the term *story* used by the ancient writers, both sacred and profane; but it must be remarked that none of the ancient remains, whether of public or private structures, afford evidence that it was a common practice even among the Romans to build more than one story above the ground floor; and it was less likely to be common among the Eastern nations, with whom the practice is not very general, even at the present day. Indeed, without considerable proficiency in the art of construction, it is hardly practicable to erect buildings in stories with such slight materials as were used by the Romans in some of their domestic edifices. We find, however, in the oldest existing works of the Middle Ages, and particularly in some of the secular structures of Venice, a degree of intelligence evinced in this respect far surpassing anything found in ancient remains. Possibly the skill was principally acquired in that city from the necessity of making artificial foundations, which consequently required a superstructure not unnecessarily cumbrous; and again, to make slight walls sufficiently strong, they must be skilfully bonded in themselves, and bound together, which could only be done by means of a material possessing considerable length and great fibrous tenacity—whence arose framed floors of timber. These, by their strength, their obvious utility and convenience, added to the want of space which existed in a thriving and populous community on a very restricted spot of dry land, superinduced, in the second place, the building of additional stories, which would soon be imitated in other places. But in whatever manner the improvement took place, the fact that it was made is certain; and we find it applied in all the works of the European nations, both ecclesiastical and civil, from the 9th and 10th centuries downwards. The combination of masonry and carpentry in building tended greatly to the advancement of both; for, it being required at times to make them act independently of each other, additional science and art were necessary, as the proportions must be retained that were given to similar works in which they co-operated. To this is to be traced the skill displayed in the vaulted roofs and ceilings, in the towers and lofty spires of some of our Pointed cathedrals for the one, and such splendid examples of construction as the roof of Westminster Hall for the other. On this point Sir William Chambers, who was certainly no depreciator of the merits of the Romans in architecture, says: "In the constructive part of architecture the ancients do not seem to have been great proficients" (Gwilt's *Chambers's Civ. Arch.*, p. 128); then having referred many of what he calls the "deformities observable in Grecian buildings" to want of skill in construction, he continues, "neither were the Romans much more skilful; the precepts of Vitruvius and Pliny on that subject are imperfect, sometimes erroneous, and the strength or duration of their structures is more owing to the quantity and goodness of their materials than to any great art in putting them together. It is not, therefore, from any of the ancient works that much information can be obtained in that branch of the art. To those usually called Gothic architects we are indebted for the first considerable improvement in construction. There is a lightness in their works, an art and boldness in their execution, to which the ancients never arrived, and which the moderns comprehend and imitate with difficulty. England contains many magnificent specimens of this species of architecture, equally admirable for the art with which they are built, the taste and ingenuity with which they are composed." To this Mr Gwilt, in his edition of Sir William's work, adds, with much truth, in a note, "There is more constructive skill shown in Salisbury, and others of our cathedrals, than in all the works of the ancients put together."

Pointed architecture took root and grew with almost equal vigour, though under different conditions, in almost every part of Europe. But the honour of having developed the style to the very highest perfection must undoubtedly be adjudged to France, or rather to the small portion of the country, including Paris, which formed the old Ile de France. In Germany there was much less natural development. For a long period after the Lombard style had been perfected on the Rhine no variation of moment was adopted, until German architects attempted at Cologne to outvie and rival the magnificence of Amiens. In Spain the architects of some of the finest buildings were Frenchmen, and the style can hardly be said to have been developed there at all. In England, on the contrary, though our earliest Pointed buildings were undoubtedly to a great extent French in their origin, the developments of the art were soon entirely national, and were but little modified even by the influence of the foreign religious orders, which (as at Fountains Abbey) had so much power over many of our ecclesiastical foundations. From England the style was carried by Englishmen to Scotland,—a poor country, with no style of its own, and no cultivation such as is necessary to produce an order of architects, and to Ireland, where the English architects followed the footsteps of the invading armies; and finally, if we may trust the evidence of the stones themselves, to the coast of Norway, where the cathedral of Trondhjem is as unmistakably English in much of the style and detail as any English cathedral. In England the development of the style is plainly marked, and its advances are easily traceable. We find in various portions of the same edifice, according to the period of its construction, exemplifications of the style, from the ingrafting of the simple lancet arch on the Norman piers in the time of Henry II., to the highly enriched groinings and ramified traceries of the age of Henry VII.; but the changes are so gradual, and are so finely blended, that the one in advance appears naturally to result from that which comes before it. Although the nations of the Continent never borrowed from us, but were themselves originators, it is very clear that after the first we did not borrow; for our structures bear the strongest possible marks of originality, as the gradual advances can be traced from one feature to another in a way which is quite peculiar to this country. This, however, will be explained more in detail further on.

The Pointed Architecture of Europe generally.

There are so many local and national varieties of this style that it is quite impossible to dismiss it with an account of its features in one district or country only. To do this would be to give an entirely wrong and inadequate conception of the subject. It must be treated generally under the heads of the several countries in which it has flourished most—as England, France, Germany, and Spain. It must certainly not be forgotten in talking of Italy. And in most of these countries it might properly be subdivided according to the local varieties caused either by changes in the political geography, or by physical conditions which so largely affect the details and variations of style in architecture. For the origin of all these developments of the style we must go back to Rome. It is not only that in the Roman states we see the origin of Romanesque architecture gradually developed out of the Roman buildings. The same process was going on at the same time all over Europe wherever the Roman empire extended. We have only to look at the Roman occupation of the south of France, as evidenced by the still magnificent remains of theatres and tombs at Arles, of the amphitheatre at Nismes, of the theatre at Orange, or the aqueduct of Pont de Gard; or at the similar works on the coast of Spain, at Tarragona, or in its very centre at Segovia; or at the basilica, gateway, and theatre at Treves; or in our own country at the remains of Roman buildings in various directions, of which Silchester is surpassed in interest by none;—we have only to look at all these in order to see that, erected as they were in countries which at the time were little better than barbarous, they must of necessity have prepared men all over Europe for the same sort of development. The Romans had shown them the use of the arch, the column, and the vault; the conversion to Christianity gave them a great want to satisfy; and finally, the revulsion of feeling when the supposed mystical year of our Lord 1000, with all its apprehended accompanying dangers, had passed in safety, gave such an impetus to buildings for religious purposes as the world had never before seen. It was a time for development, therefore, and nearly everywhere the development proceeded from the same premisses. Roman art, pure and simple, was the general foundation of all Romanesque building, and it was only slightly modified in certain districts by the introduction of the Byzantine influence from Constantinople to Venice, and thence in some degree to some other cities and towns, or, as in Pisan buildings, and in those of the south of Italy and south of Spain, by the Greek and Arab influence which was so great down to the end of the 13th century. An examination of the earliest European churches—such, for instance, as San Clemente and San Lorenzo at Rome—will show how entirely they were constructed on Roman models. From them we go in Italy to Ravenna or Toscanella, to

Sectional compartment of the Nave of Lincoln Cathedral.

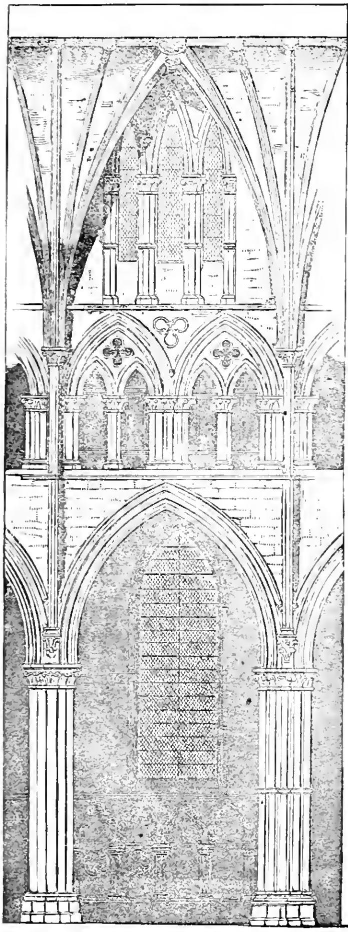


Fig. 1.

a

b

Sectional compartment of the Choir of Lincoln Cathedral.

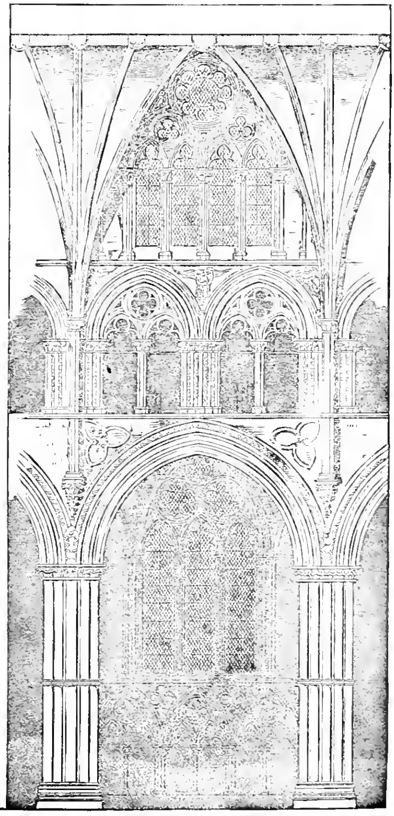


Fig. 2.

San Miniato at Florence, to the cathedral of Torcello, to San Zenone, Verona, and San Michele, Pavia, and see how gradually but surely the plan and details were being developed into what soon became a new style; and from these examples we may follow the stream of art from the south to the centre of France, and thence to this country and Germany. Or looking at other developments in Italy, we may in the same way trace a succession of circular buildings, in which the connection and sequence is clear, leading us as it does from the Pantheon, and other circular Roman temples, through the old cathedral of Brescia and the grand church of San Vitale, Ravenna, to the cathedral at Aachen, and so to our own circular churches, and to many of those which, like the Marien Kirche, Treves, though not really circular in appearance, are yet so planned as to fall properly within the same class.

The course of progress of European art was to a great extent first of all geographical and political. For, in addition to the influence exercised by conquest or the political connection of one district with another, it is remarkable how much particular styles are limited by geographical divisions and boundaries, by the courses of rivers, the occurrence of convenient building materials, and other such secondary causes. And with so many causes for variations of style in existence, it will be quite necessary, in order to give any intelligible account of the whole course of Gothic architecture, even in the shortest compass, to treat separately each of the great national divisions. We will take England first, only premising that, following strict order, we ought to have begun with Italy, were it not that, in spite of the origin of all northern art having to be looked for there, as soon as it came to be a question of development, almost all the life and vigour of architecture in the Middle Ages is to be seen north and not south of the Alps; and whatever was borrowed, in the first instance, from Italy was paid back again with interest afterwards. And in taking England first, we have the advantage of speaking of a national art, of which every educated Englishman knows some of the examples, so as to be more able to follow the course of our argument than would be the case were all the examples of its application foreign and unknown to him.

English Gothic Architecture.

The history of the development of Gothic architecture is, perhaps, more easily read on the buildings themselves here than it is in any other part of Europe. The Roman buildings in England were never of very great importance, and were not always standing as evidences of the existence of an older style, which might be looked back and up to with respect and admiration, even where they did not harmonise with popular customs. Such art, nevertheless, as did exist in this country before the 11th century, was, no doubt, derived from Roman examples existing in the country, and copied in a rude and unskilful fashion by native workmen. The existing Roman remains show that there was quite enough architectural and decorative art introduced into the country by the Romans to have formed a school of masons, sculptors, and builders, if the civilisation of the people had been sufficient to make them desire it. Such a school can hardly be said to have been formed if we look at the few and comparatively rude remains of buildings certainly erected before the Norman Conquest. In such work as the beautiful archway recently discovered in Britford church, Wilts, where carving of stone-work is joined with brick or tile and stooc in a very elegant fashion, we see the immediate effect of cultured Roman influence and example. At a later date, in such fine works as the steeple of Earl's Barton, Northants, we see only the rude grandeur of comparatively uncivilised workmen cognizant only at a distance of good Roman work. In upwards of a hundred churches, dispersed in various parts of England, fragments more or less complete of these early buildings, erected before the Norman Conquest, still remain. They are numerous enough to enable us to classify their features in a general way, and they agree in certain definite points of difference from the architecture which prevailed after the Norman Conquest. It is probable that a considerable proportion of these buildings were erected after the year 1000, when we recollect the influence which the expected end of the world had in discouraging building shortly before that date, and how enormous the zeal for building was as soon as it was safely passed. The leading features of the buildings erected before the Conquest are as follows:—(*a.*) Quoins at angles alternately long and short, the difference being so marked as to be seen on the most casual inspection; (*b.*) Arrangement of wall faces into panels by means of vertical strips or pilasters of stone; (*c.*) Arches built not only in semicircular form, but frequently (and especially for arcading) with straight sides; (*d.*) Rude balusters, generally bulging outwards in the centre, used to divide openings of more than one divison (as, *e.g.*, belfry windows); (*e.*) Introduction of rudely moulded, chamfered, or plain square abaci at the springings of arches; (*f.*) Towers, in several cases of some importance, adorned with arcading, formed by pilasters and round or straight sided arches. These features are all represented in illuminated MSS. of the same period, and are not seen in works executed after about the date of the Conquest. It is this fact that makes the year 1066 a convenient year for dealing with as the assumed commencement of a new epoch. But in fixing this date, we must remember that, though the Conquest of William would account satisfactorily for the changed style of building which is universally seen after this time, there can be no doubt that Edward the Confessor's Norman education led naturally to the introduction of many Norman features into English work. The considerable remains of that king's foundation at Westminster Abbey afford good evidence of the fact, that the so-called Saxon style had been abandoned by the workmen employed by him, and that the way was being prepared for the adoption of all the Norman architectural features even before the imposition of the Norman rule.

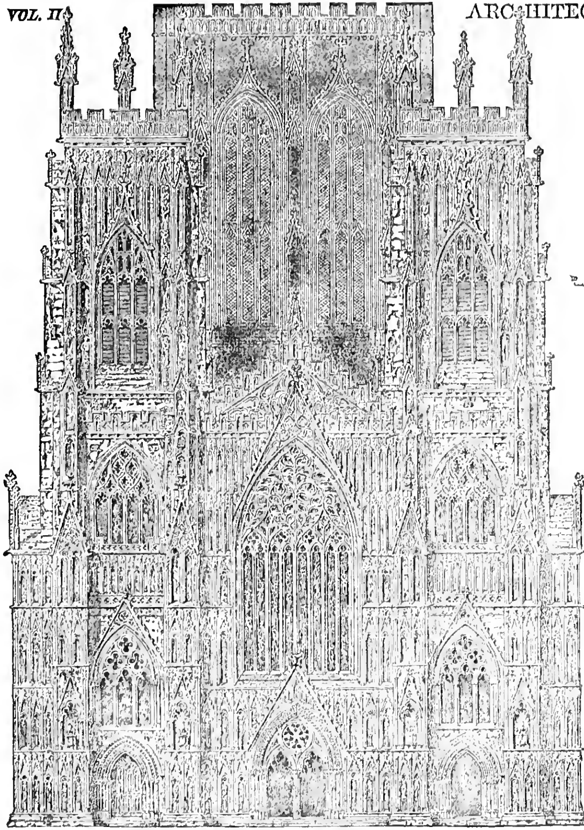
The succeeding periods of English architecture have been generally divided upon similar systems, the main dispute among antiquaries and architects being as to the nomenclature of the various styles which followed each other in a regular course of development, rather than as to the exact period of change. Between the complete styles there is always a period of transition, during which the features of the styles were not so well marked, and during which the progress of the art was by no means uniformly rapid in all parts of the country. The following chronological table gives the main divisions:—

	Style.
From the reign of William I. to the end of Stephen, 1066 to 1154	Norman; or Romanesque.
Henry II., 1154 to 1189	Transitional from Norman to Pointed.
Richard I. to Henry III., 1189 to 1272	Early English; First Pointed; or Lancet.
Edward I., 1272 to 1307	Transition from Early Pointed to Complete, or Geometrical Pointed.
Edward II., 1307 to 1327	Geometrical Pointed.
Edward III., 1327 to 1377	Flowing; or Curvilinear Style. These two are generally treated as one style, called by Rickman Decorated, by others Middle Pointed.
Richard II., 1377 to 1399	Transition from the flowing lines of Decorated or Middle Pointed to the stiff and hard lines of the succeeding style.
Henry IV. to Henry VIII., 1399 to 1546	Third Pointed; or Rectilinear (Sharpe); or Perpendicular (Rickman).

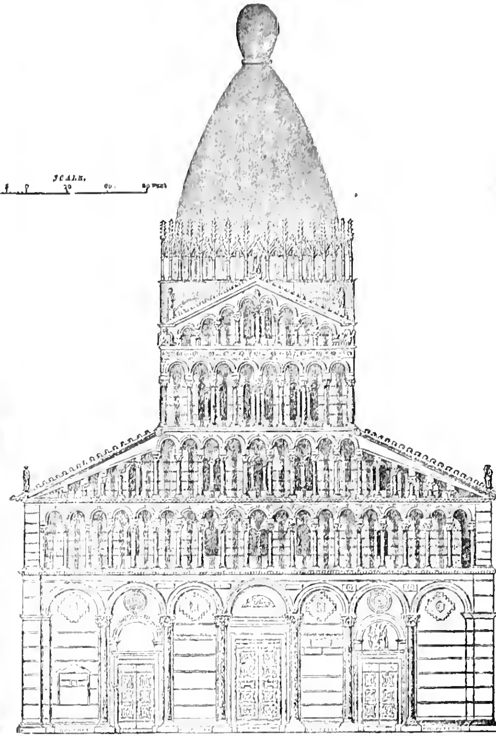
Even after this period many buildings were erected in a debased imitation of Gothic, but their features do not admit of their being classified with the same precision as those which obtained from about the year 1066 to 1546. For that period of just 500 years so regular was the development, that it is not too much to say that a well-informed architect or antiquary ought always to be able to give, within ten or at most twenty years, the date of any, however small a portion of mediæval architecture, with almost absolute certainty of being correct when his judgment can be tested by documentary evidence. With this preface we will now describe, in as concise a manner as possible, the features of the various divisions given in the foregoing table.

Norman. The characteristics of the Norman style are, no doubt, generally known. The works executed during this period were on so colossal a scale, and so many of them are still perfect, that every opportunity is afforded for studying them in all parts of England. It may be observed, too, that there is less variety in the character of the style in different dioceses or counties than there is in the case of subsequent works. The earlier works, as, *e.g.*, Walkelyn's transepts at Winchester Cathedral, are comparatively simple and rude. The arches are unmoulded, the capitals are of the simplest form of cushion capital; and grand and solemn as the work is, it cannot, for refinement and beauty of detail, be compared to the later Norman work in which, instead of minute directions being given to the workmen, they were encouraged to develop their own taste and ingenuity in the decorative sculpture with which they so elaborately covered their architectural mouldings But still, the principles of construction, and of the decoration of it, were identical throughout the whole period. The ground-plan of most Norman churches was cruciform, with a central tower, the east end being very frequently apsidal. The aisles were divided from the naves by columns of vast size, sometimes circular, sometimes octagonal, and sometimes simply clustered The arches were for the most part semicircular, save towards the end of the period when the pointed arch was often used where much strength was required, though the round arch was still used everywhere for ornament. The windows in small buildings were mere narrow slits in the wall, probably not meant to receive glazing, and opening out with a wide splay on the inside; in larger buildings they were much more important features, being of large size and adorned with columns, with capitals and bases both inside and outside. The treatment of mouldings was accurate and scientific. As large arches are naturally constructed with a series of orders or layers of stones, the masons wrought each of these with a separate moulding, so as to define them well, and provided capitals whose upper surface was ingeniously planned, even where it fitted a circular column below, so as to fit exactly the several orders of the arch. This is one only out of many features which prove how skilful the Norman architects were. All their best works are in no sense haphazard works of art, but carefully ordered and arranged with almost classic attention to regularity. The masonry is at the same time unusually beautiful and well executed. There is probably not a finer piece of masonry in England than the late Norman central tower of Winchester Cathedral,—the stones being all uniformly wrought, close jointed, and regularly coursed. The doorways are the great glory of many of these buildings. Sometimes the mouldings are continuous round jamb and arch (as in the well-known examples at Malmesbury Abbey and at Iffley), but more usually they are adorned with a series of columns, sometimes carved or diapered, and carrying on their capitals a grand succession of enriched arch mouldings. These doorways do not occur only in large and important churches, but are to be seen also in out-of-the-way country churches in all parts, even the most remote, of England. The walls were often arcaded with single or intersecting arches, treated in the most elaborate manner. They were usually of so great a thickness that no buttresses were required, even where, as in the aisles of large churches, stone vaulted roofs rested against them. The Norman buttress, wherever introduced, is consequently only a slight development of a pilaster, used for the purpose of defining the divisions or panels of an elevation, and not introduced for the sake of giving support to the wall. The walls are frequently enriched with moulded or carved string-cornices, and with a cornice supported on corbels under the eaves of the roof, and in the best works are entirely of wrought stone, and built in regular courses. The roofs which surmounted the walls were usually of steep pitch, showing the whole of the cross framing of the timbers used in them; and sometimes, as in the case of Peterborough Cathedral, boarded on the under side so as to form a flat or slightly canted ceiling, which was then decorated with colour. At Adel, near Leeds, are remains of a richly-moulded Norman roof, in which every pair of rafters seems to have been furnished with a tie-beam. But it need hardly be said that not many wooden roofs of this period exist; and the stone roofs which, as time wore on, were more and more often erected, were not only more permanent in their character, but, no doubt, played the most important part in the gradual development of the style and the introduction of the pointed arch. The succession of vaults was the same here and on the Continent. First of all the plain barrel vault, then one formed by the intersection of two such vaults at right angles; and finally, this vault with well-defined arches between the bays, and mouldings or ribs under the angles of the intersecting vaults. It was impossible for men to go on long forming such vaults as these without realising, not only that a pointed arch might be built, but, at the same time, that its form enabled a builder to overcome many practical difficulties in the formation of vaults, which could only be got over otherwise, and then badly, by the expedient of stilting the round arch. The Norman vaults were seldom applied to any but the aisles of churches at no great height from the ground. They were very heavy, and exerted more thrust on the wall than the later Gothic vaults, and the Norman masons shrank consequently from venturing to put them on their lofty clerestories.

Transition to Pointed. It was in the next period—that of the transition to Pointed—that the science of vaulting received a great impetus, whilst the whole architectural construction at the same time tended to assume more graceful and elegant lines. In so general a view of the case as this, it is impossible to do more here than point to salient examples which illustrate generally the progress of the art. Just as the cathedrals of Peterborough, Durham, Norwich, and Ely illustrate, on the grandest scale, the features of the best Norman art in England, the eastern part of Canterbury illustrates the whole period of the transition from that to Pointed, and is consequently one of the most valuable buildings that we have for the purpose of study, as well as one of almost unrivalled beauty and magnificence. Professor Willis has made this church classical ground to the archæologist who, under his guidance, and with the advantage of the description of the work written by the monk Gervase, who saw it in process of building, examines its many curious evidences of gradual development. Gervase himself describes the changed mode of workmanship and design, as he chronicles the difference between the new work and that older Romanesque choir which had before his time been called "the glorious choir of Conrad." He says,—"The pillars of the old and new work are alike in form and thickness, but different in length; for the new



YORK CATHEDRAL. (West Front)



SCALE. 20 60 80 FEET

PISA CATHEDRAL. (West Front)

pillars were elongated by almost twelve feet. In the old capitals the work was plain, in the new ones exquisite in sculpture. There the arches and everything else was plain or sculptured with an axe and not with a chisel, but here almost throughout is appropriate sculpture. No marble columns were there, but here are innumerable ones. There, in the circuit around the choir, the vaults were plain, but here they are arch-ribbed and have key-stones." "There was a ceiling of wood decorated with excellent painting, but here is a vault beautifully constructed of stone and light tufa. There was a single triforium, but here are two in the choir, and a third in the aisle of the church," &c. This great work was begun under a French architect, William of Sens, in the year 1175; he was killed by injuries received in a fall from the scaffolding in 1179, and was succeeded by his assistant, William the Englishman; and to these two men is due the credit of the design as we now see it. One of the most noteworthy points in its history is the obvious and simple mode of accounting for the French character and state of much of the work, which it presents; and looking at it, no one can be surprised at the enormous development which immediately took place throughout the country. The change from heavy piers, with carving rather elaborate than beautiful, to delicate columns carrying on exquisite capitals lofty and graceful pointed arches and vaults, was so great that it was impossible not to prefer it to the stately but comparatively rude work which it supplanted; and so the tide of change having set in, further improvements were soon desired. Mouldings became much more delicate and subtle in their contour. Groining was then more tastefully planned and disposed, windows and doorways were made far more graceful, whilst the system of construction was largely improved upon. Instead of thick, massive walls without buttresses, the walls were reduced in thickness, and the material saved was transferred to the buttress, where it could most effectually fulfil its office of supporting the vaults and walls above. From buttresses conceived in this view the transition to flying buttresses was easy; then to stiffen these, pinnacles were added. And in the same way one lancet window led the way to groups of lancets; and these in their turn by combinations with pierced circular windows, to completely developed traceries.

First Pointed. The First Pointed, Lancet, or Early English style to which the transitional work thus led up, may fairly be considered to be a purely English variety of Gothic. It is more consistently graceful and delicate in its details, as well as in its general character, than any foreign work of the same period. There was no longer any observable foreign influence brought to bear as there had been at Canterbury. Intelligent artists all over the country were rapid in seizing the best features of executed works, and carrying them farther with as little delay as possible. There were various centres from which distinct local varieties of style were sent out. If we compare York (transepts), Lincoln, and Salisbury Cathedrals, we shall find that, though there are certain general similarities of treatment, the distinct mark of the one presiding individual architect or artist is found in each. Compared to the architect of York Minster, the one who built Salisbury was altogether inferior. This feature of local varieties in style, the result of the influence of individuals, is from this period one of the most noteworthy features in English art; and generally one man influenced the work in his own diocese or district, and no further. Throughout the period before us—1189 to 1272—the developments were all in the same direction as during the previous time of transition. The tendency was always to greater lightness and elegance; skilful combinations were much thought of; and, towards the end of the period, there was even too great a display sometimes of the cleverness of the artist. But with work so really beautiful as it all was, and so uniformly good in the smallest nearly as much as in the largest building, it is ungracious, if not conceited, to affect to criticise the spirit in which the artist worked. The use of delicate shafts of polished marble (obtained in great part from the Isle of Purbeck) for doorways, windows, and arcades, is one of the distinguishing features of the style at this time. Generally they are treated with great beauty, but there were structural inconveniences about them which soon began to be felt. The columns were of necessity set out of their natural bed, and so began very soon to decay. It was necessary also to combine them together in groups, and to trust to the capitals, bands, and bases holding them together, and such construction not only looks dangerously slight, but is so. A radical defect also in engaged marble shafts is that, though they seem to be intended to do all the work and carry all the weight, they do in point of fact, wherever it can be contrived, carry no weight at all, and it was, no doubt, when and as this was discovered, that the mediæval builders gradually lost their liking for them, and returned to safer, if less brilliant, construction in stone, with piers formed with mouldings instead of shafts detached from the wall.

The characteristic elegance of the general architectural design was carried out in all the details. The mouldings were delicately rounded and alternated with hollows so drawn as to give here delicate and there most forcible effects of light and shade. Thus the dark line produced by marble in a pier was continued by means of a dark shadow in the arch; and without considerable knowledge of the science of moulding, it is impossible to do justice to this part of the English Early Pointed work, which has never been surpassed, if, indeed, it has ever been equalled at any period elsewhere. The groined roofs were still simple in design, but a ridge rib was often added to the necessary transverse and diagonal ribs of the previous period. This gave a certain hardness of line to the vault; it was the first step to the more elaborate and later systems of vaulting, and was soon followed by the introduction of other ribs on the surface of the vaulting cells. Few works are more admirable than some of the towers and spires of this period, but space will not allow of mention even of many of its best features. Probably the greatest excellence ever attained in English art was reached in this period by the architects of the great Yorkshire abbeys. No buildings in Europe surpass them in purity of general design, excellence of construction, beauty of detail, or suitability for their purposes. And it is a misfortune of the gravest kind for future generations, that their ruined condition forbids the possibility of our descendants appreciating as we can these consummate works of the most golden period of English art.

Later styles. The transition from the simplest Early Pointed to a more advanced style can be seen as well in Westminster Abbey as anywhere. Here traceries began to take the place of simple lancet openings, and led to that system of window tracery which was, in fact, the distinguishing feature of the succeeding style. When the invention of tracery was complete, everything in Gothic architecture rapidly changed. The art of masonry and stone-cutting was rapidly developed. Moulded stones, from being made continuous round the intricate combinations of window traceries, came naturally to be used much more largely than before in place of simple bearing shafts. So columns came to be formed of clusters of mouldings; and, in the case of groined buildings, each moulding of the shaft was developed into more mouldings above the capital, or even frequently carried on to the vault without any capital at all. Traceries were first of all commenced by merely piercing geometrical patterns or circles through the thickness of the walls. Then these patterns were combined under one enclosing arch; and then, when this sort of tracery had reached perfection, it was found possible to vary it indefinitely by making use of double curves (or ogee lines); and then, when these had been used for a short time, flowing lines, wandering gracefully over the space to be filled, and sometimes drawn by hand, supplanted the more formal outlines of the earlier work. The difference was great between an opening which was made (as the earlier examples were) with a sole view to the opening for glass, and one which was the accidental result only of the pretty lines and curves made by regarding the monial of the window, and not the light, as the thing to be considered. The tendency of the modification was to make men think lines of more importance than masses; and, whether consciously or not, this was just what happened: not only window traceries but mouldings, carvings, and every other feature, were entirely changed in character. The soft gradations of the early mouldings were given up for combinations of more hardly defined and thinner lines of light and shade, and, in harmony with this change, a crisp and sharp imitation of natural foliage was devised, which supplanted the rich and round forms of the earlier sculpture. The whole practice of art was becoming more scholarly, perhaps, but at the same time it was more conscious, and the cleverness of the architect was almost as often suggested as the noble character of his work. Merton College chapel, Oxford, the nave of York Minster, the choir of Selby, the whole of Exeter Cathedral, are a few among the many examples of this period of which this country can boast, and it will be seen that the change in character which is evident between the earliest and latest Middle Pointed works is enough to justify those who would again subdivide the nomenclature. The difficulty is that, where progress was so constant, it will be necessary, in order to be exact, to subdivide each century five or more times in order to be really definite.

Towards the end of Edward the Third's reign, the last great change was made. The first example of this is seen in the western end of the nave of Winchester, followed soon after by William of Wykeham's magnificent (if somewhat cold) reconstruction of the rest of the nave. It may fairly be held that the moving cause for the change was a sense of disgust at the vagaries into which the votaries of curvilinear window traceries had been led. There was something weak and effeminate about their work, and Edyngton and Wykeham, when they built the nave of Winchester, were evidently endeavouring to return to a simpler and more dignified style of building. The first thing they found to amend was the exuberant tracery which was ruining architecture. They did not return to earlier forms, but they corrected this exuberance by introducing vigorous, straight, vertical, and horizontal lines. These, combined with subarcuation, gave their work at first a vigour which had latterly been wanting; and no one can look at Wykeham's great work without feeling that he succeeded in his effort to impress a sense of vigour and manliness on the whole of it. Unfortunately, the love of display and of the exhibition of skill which was so strong before was in no degree lessened, and the change in style did nothing permanently to check it. The fondness for straight in place of flowing lines was more and more developed. Doorways and arches were enclosed within well-defined square outlines, walls were divided by panelling into rectangular divisions; vertical lines were emphasised by the addition of pinnacles, and buttresses used more for ornament than strength, whilst horizontal lines were multiplied in string-courses, parapets, and transomes to windows. Groined roofs, which in the 14th century had been enriched by the multiplication of surface ribs, were now most elaborately enriched by cross ribs subdividing the simple spaces naturally produced by the intersection of necessary ribs into small panels; these, again, were filled in with tracery, and finally, the key-stones were formed into pendants, and the branching ribs so radiated as to produce the really beautiful and very English variety of groining called fan-tracery. The amount of skill shown in the construction of these vaults was very great, and most of them have proved their authors' science by the perfect way in which they have endured to the present time. In other respects the architects of the 15th century were very successful. Few things can be seen more beautiful than the steeples of Gloucester Cathedral, or of St Mary's, Taunton. The open timber roofs, as for instance that of St Peter, Mancroft, Norwich, are superb. And, finally, they left us a large number of enormous parish churches all over the country, full of interesting furniture and decoration, and also a store of interesting examples of domestic architecture which are still the ornaments, and are associated with all the most interesting historical localities, of the country.

After the middle of the 16th century the practice of Gothic architecture practically died out, though traces of its influence, especially in rural districts, were hardly lost until the end of the 17th century. Good, sound, solid, and simple forms, well constructed by men who respected themselves and their work, and did not build only for the passing hour, were still popular and general, so that the vernacular architecture to a late period was often good and never absolutely uninteresting. But it presents none of the characteristics of a school, and cannot be treated of here.

The history of the development of Gothic architecture in England has been gone into at rather greater length than will be desirable in the case of other national developments. And this for two reasons: the examples which illustrate it are more generally known; and as the developments in other countries north of the Alps went through very nearly the same course of change at the same time, much has been said which need not be repeated in treating of them.

A few words will suffice for the necessary notice of the progress of Gothic architecture in Scotland and Ireland. In point of fact, most of what was done in the best period—that is, during the 13th and 14th centuries—was done by English artists, and is in no way more distinct in character than their work was in different dioceses or counties. The Gothic of Lincolnshire, of the eastern counties, of Kent and Sussex, of Somersetshire and South Wales, of Devon and Cornwall, and of Yorkshire, were distinct varieties of style full of local peculiarities. In the case of Scotland, the Scotland. best buildings which remain did not grow up in the same way by the efforts of local architects, but appear to have been the work of architects brought for the purpose from England, north of the Humber. There is a broad distinction between English art north and south of the Humber; and though it is easy to point to evidences of similarity between Scotch buildings and those north of the Humber, it is not possible to show the same connection with any buildings to the south of it. The evidences of general similarity are to be seen everywhere; it will suffice to mention one or two examples of particular similarity. The beautiful 13th century transept of Hexham Abbey church has some of its most marked features repeated in the also very beautiful transept of Pluscardine Abbey near Elgin. The architect of Lanercost in Cumberland was certainly responsible also for Dryburgh Abbey, either as actual architect, or as having inspired the architect. The buildings generally have, on both sides of the border, the same details, the same general disposition of plan, the same traceries; and there is nothing to indicate that those to the north of the border are not English. In truth, until the end of the 14th century the two styles are identical. Then Scotch art became more national, because it separated itself from

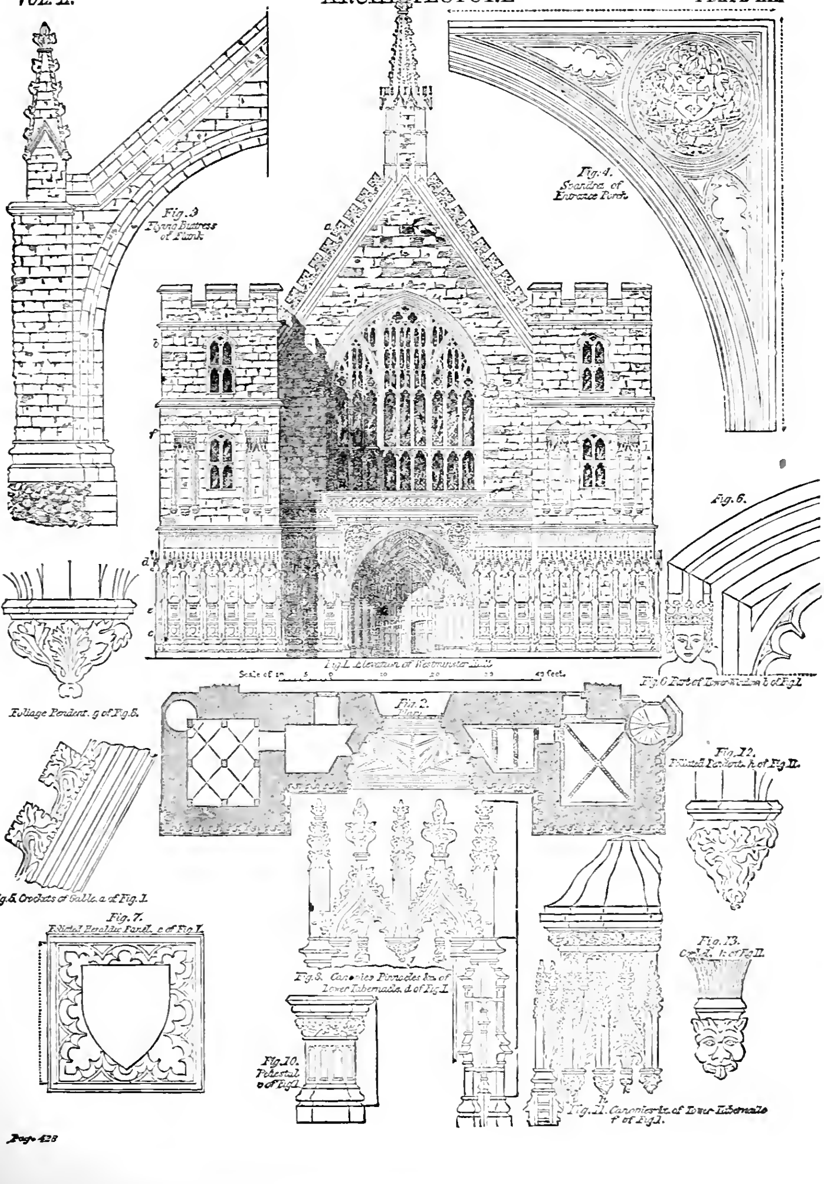


Fig. 3
Flying Buttress
of Flank
Fig. 4.
Spandrel of
Entrance Porch
Fig. 6.
Fig. 1. Elevation of Westminster Hall
Fig. 6 Part of Lower Window b of Fig. 1.
Foliage Pendent. g of Fig. 8.
Fig. 2.
Plan
Fig. 12.
Foliated Pendent. h of Fig. 11.
Fig. 5. Crockets of Gable. a of Fig. 1.
Fig. 7.
Foliated Heraldic Panel. c of Fig. 1.
Fig. 8. Canopies Pinnacles &c. of
Lower Tabernacle. d of Fig. 1.
Fig. 13.
Fig. 10.
Pedestal
e of Fig. 1.
Fig. 11. Canopies &c. of Lower Tabernacle
f of Fig. 1.

English, and, borrowing some of its inspiration from abroad, developed in a certainly picturesque and interesting line. Melrose Abbey is one of the most national, as it certainly is one of the most charming, of Scotch buildings; but its influence does not seem to have been extensive, and it must be classed as a variety of the latest English Middle Pointed, executed by Scotchmen who knew something of English work, and as much of French (if not of Iberian) art, but who were determined to leave the mark of their own hands and minds on their buildings. The other most remarkable late ecclesiastical building is the famous chapel at Rosslyn; but the art of this is in no sense whatever Scotch, and we must look again, probably, to Portugal as the country of whose art it is an example. Scotland has been unfortunate, in that ecclesiastical changes have involved the disuse and ruin of so many of her ecclesiastical buildings. But still enough remains to make the country a most interesting field of study in regard especially to the art of the 13th century. Glasgow, St Andrews, Kirkwall, Dunblane, and Elgin Cathedrals, and the Abbeys of Pluscardine, Sweetheart, Kelso, Dryburgh, Jedburgh, Holyrood, Dundrennan, and Melrose, afford a series as beautiful as any that can be named elsewhere, though most of them are on a moderate scale in their dimensions.

The domestic remains in Scotland are far more numerous, and full of picturesque beauty and magnificence. They are a distinctly national class of buildings of great solidity, and a great deal was sacrificed by their builders to the genius of the picturesque. They can only be classed with the latest Gothic buildings of other countries, but the mode of design shown in them lasted much later than the late Gothic style did in England. The vast height to which their walls were carried, the picturesque use made of circular towers, the freedom with which buildings were planned at various angles of contact to each other, and the general simplicity of the ordinary face of the walling, are all distinct features in them, and make them more worthy of admiration than most works of the corresponding period in England.

Ireland. In Ireland the progress of Gothic was very similar to that which we have seen in Scotland; but here may be seen art carried in the train of an invading army to the advantage of the country conquered, just as in England a similar benefit had been conferred by the Normans. Strongbow's invasion may be said to have been the introduction to Ireland of Gothic art. He went from South Wales to the south of Ireland. The art in his time in South Wales was to a great extent the development of the monks of Glastonbury. Their influence is visible plainly not only over their own district, but equally at Llandaff and at St David's. It was a very English influence. The Norman art of Canterbury hardly reached or touched them in a very direct way; and their art was taken directly and unmodified to Ireland. Among the buildings erected by the English in Ireland, Kilkenny Cathedral and the two 13th century cathedrals of Dublin—Christ Church and St Patrick's—are the most remarkable, but there are many others. Their style is most plainly that of the Englishmen who followed Strongbow, with no concession to, or consideration of, previous Irish forms of art. That these forms deserved respect cannot be doubted by those who have examined the existing remains. Cormac's chapel, which still stands uninjured by the side of the ruined English cathedral on the rock of Cashel, is one of the most interesting relics left. It is a much decorated Romanesque chapel; of two stages in height, groined in stone, and covered with an ingeniously and admirably constructed, lofty stone roof. For ever is a long time, but few buildings have ever been built which seem more likely to defy eternally the ordinary wear and tear of time than this. It is still perfect; and where beautiful design and perfect construction are combined as they are here, the highest excellence of which architecture is capable has been achieved. The round towers of Ireland are well-known and remarkable erections, but they can hardly be said to have any architectural character. In a mastery of the finer kind of decorative work few workmen have ever equalled the Irish; none have surpassed them. Their ornaments in metal-work and in illuminated MSS. are truly exquisite and marvellous in their ingenuity. But in masonry, the only works in which the same mastery is shown are the beautiful memorial or churchyard crosses which are so well known and so characteristic.

Gothic Architecture in France.

The remarks which have already been made as to the variation in style visible in various parts of the same country, apply with more force, perhaps, in what we now call France than to any other part of Europe. For the purposes of complete study it would be necessary to keep entirely distinct from each other in the mind the following important divisions:—(1.) Provence and Auvergne; (2.) Aquitaine; (3.) Burgundy; (4.) Anjou and Poitou; (5.) Brittany; (6.) Normandy; (7.) the Ile de France and Picardy; (8.) Champagne; and, finally, (9.) the eastern border-land (neither quite German nor quite French in its character), the meeting-point of the two very different developments of French and German art. Speaking generally, it is safe to say that Gothic architecture was never brought to its highest perfection in any portion of the south of France. Aquitaine, Auvergne, and Provence were too wedded to classic traditions to excel in an art which seems to have required for its perfection no sort of looking back to such a past. Hence there is no Gothic work in the south for which it is possible to feel the same admiration and enthusiasm as must be felt by every artist in presence of the great works of the north. In Anjou this is less the case; but even there the art is extremely inferior to that which is seen in Normandy and the Ile de France. Brittany may be dismissed from consideration, as being, like our own Cornwall, so provincial and so cut off from neighbours, that its art could not fail to be very local, and without much influence outside its own borders. The interest felt by the student of the history of the art need not, however, be less in the south than in the north. The Romanesque churches of Aquitaine and the south had immense influence. The church of St Front at Périgueux was built by a Venetian colony, in imitation (as far as its plan and section) of St Mark's at Venice. Its plan, a simple Greek cross, covered with four cupolas, is as essentially Venetian and Byzantine as it was possible to be; and the Venetian church was essentially Byzantine as opposed to Romanesque. This Byzantine or Venetian example spread far and wide over the great province of Aquitaine, and beyond its limits. A long series of churches might be named in all of which the domical character of the roofing is remarkable; and it need hardly be said that such a system of roofing cannot be adopted without a great influence on the form of the ground-plan. Sometimes these domes were treated, as at Loches, like great cones; and nearly always one of the objects of their constructors was to finish them with masonry, inside and out, in what might be held to be an indestructible manner. At the same time that these churches were rising, we see that in the valley of the Rhone churches were being built, strictly Romanesque in style, founded on the Roman traditions developed from the basilica, and without any evidence whatever of Byzantine influence. Ere long each of these two schools reacted on the other, and the result is seen in the extraordinarily interesting churches of the Puy de Dome and of Auvergne, where the Romanesque plan is adopted, with the addition of domical vaults at the crossings, and domically roofed chapels round the domical apses. But in these examples the plan is not that of the Greek, but distinctly that of the Latin cross. The architects of Aquitaine, again, influenced those of Poitou and Anjou. The church at Fontevrault, for instance, has a nave covered with a series of domes, but is of the long form of the Latin cross; and the churches of the Gothic period along the banks of the Loire, as at Saumur and elsewhere, have domical vaults entirely unlike the Gothic vaults which were being constructed at the same time to the north of them. So, too, the cathedral at Angers, where the domes are carried on pointed arches, and date from the 13th century. And it is not a little strange, considering the connection which existed between this part of France and England for so considerable a period, that absolutely no architectural influence should be traceable of one upon the other. In plan, in detail, and, above all, in systems of vaulting, the English and the Angevine schools are as distinct and as unlike each other as they well could be. The mode of roofing adopted by the Romanesque architects of France was generally quite different from the Byzantine plans just referred to. Their favourite mode was to cover the nave with a waggon vault, and to support this by a quadrant vault over the aisles, which gave, in fact, a continuous flying buttress along the whole length of the vault. These vaults were covered with flat stone roofs; there was no timber in their construction, and they have generally been preserved perfect to the present day. In all these churches the distinguishing feature is the plan of the eastern arm of the cross, a circular-ended apse with an aisle round it, and small apsidal chapels at intervals projecting beyond the aisle. What the exact origin of this beautiful termination was it is difficult to say certainly. But it is obvious that such a plan at that of the temple of Minerva Medica at Rome—a decagon surrounded by apsidal recesses—led naturally to that of the Christian church of San Vitale, Ravenna, and this to the almost similarly planned termination of the great abbey church at Cluny in Burgundy. But in whatever way these early *chevets* (as the French term them) grew up, there is no doubt that they contained the germ of the magnificent *chevets* of the complete Gothic churches of the north of France. A point to be noticed, in comparing these buildings with those in England, is the much greater frequency of stone vaults all over France from the first. The wooden roof to the nave, so common in England, was very rare in France; and the variety of early stone roofs was much greater there than here. As has been seen, the earliest forms were the waggon vault and the dome; the former constructed on aisled churches, the latter upon aisleless buildings. One of the earliest examples of a quadripartite vault (*i.e.*, one formed by the intersection of two barrel vaults at right angles to each other), is that over the nave of the grand abbey of Vézelay in Burgundy. This was erected in the middle of the 12th century; it was a hazardous experiment, and though it still stands, the wonder of all who see it for its magnificent size and architectural character, its construction was not satisfactory, and the thrust of its vaults had to be met by the erection of rude flying buttresses soon after its foundation. But the covering of so vast a building with such a vault was an achievement sure to be imitated, and it is easy to see how the influence of such an example could be felt all over the country at the time that the pointed arch was coming into use, with all its convenient aids for the construction of such vast vaults. At Vézelay there is no triforium; the space against which the roof of the aisles abuts is a plain wall, and the example of many Romanesque churches, in which the double aisles of Roman buildings (*e.g.*, St Agnese) were imitated, soon suggested the introduction of the triforium gallery between the arcades and the clerestory; whilst the necessity for light in northern climates developed of necessity the lofty clerestory. Here, therefore, the French architects found themselves in possession of all the elements of design, out of which they developed their magnificent Gothic works. There were difficulties, however, with their ground-plans, which were hardly ever quite surmounted; but as English architects were wedded to the square east end, Frenchmen were devoted to the apsidal. And it was in the planning of the apse, with its surrounding aisles and chapels, that all their ingenuity and science were displayed. A simple apse is easy enough of construction, but directly it is surrounded by an aisle or aisles, with chapels again beyond them, the difficulties are great. The bays of the circular aisle, instead of being square, are very much wider on one side than the other, and it is most difficult to fit the vaulting to the unequal space. In order to get over this various plans were tried. At Notre Dame, Paris, the vaulting bays were all triangular on plan, so that the points of support might be twice as many on the outside line of the circle as on the inside. But this was rather an unsightly contrivance, and was not often repeated, though at Bourges there is something of the same sort. At Le Mans the aisle vaulting bays are alternately triangular and square; and this is, perhaps, the best arrangement of all, as the latter are true and square, and none of the lines of the vault are twisted or distorted in the slightest degree. The arrangement of the chapels round the apse was equally varied. Usually they are too crowded in effect; and, perhaps, the most beautiful plan is that of Rouen Cathedral, where there are only three chapels with unoccupied bays between, affording much greater relief and variety of lighting than the commoner plan which provided a chapel to every bay.

Space will not admit of carrying this point farther, but it has been necessary to say thus much, because the planning and design of the *chevet* is the great glory of the French mediæval school. When the same thing was attempted, as by us at Westminster, or by the Germans at Cologne, it was evidently a copy, and usually an inferior copy, of French work. No English works led up to Westminster Abbey, and no German works to the cathedral at Cologne. When once the Gothic style was well established, the zeal with which the work of building was pursued in France was almost incredibly great. A series of churches exists there within short distances of each other, so superb in all their features, that it is impossible to contest their superiority to any corresponding group of buildings. The old Domaine Royale is that in which French art is seen in its perfection. Notre Dame, Paris, is a monument second to nothing in the world; but for completeness in all its parts it would be better to cite the cathedral of Chartres, a short description of which must suffice as an explanation of what French art at its zenith was. The plan has a nave with aisles, transepts with aisles on each side, a choir with two aisles all round it, and chapels beyond them. There are two immense steeples at the west end, two towers to each transept, and two towers at the junction of the choir with its apse. The doorways are triple at the west end, whilst to each transept is a vast triple porch in front of the three doorways. The whole of these doorways are covered with sculpture, much of it refined, spirited, and interesting in the highest degree. You enter and find the interior surpassing even the exterior. The order of the columns and arches, and of all the details, is so noble and simple that no fault can be found with it. The whole is admirably executed; and, finally, every window throughout its vast interior is full of the richest glass coeval with the fabric. This is a French cathedral at its best, but Amiens and Bourges, and Rheims and Laon, and Caen, Troyes, Le Mans, and a host of other churches, might be named only inferior to this. As compared with English churches of the same class, there are striking differences. The French architects aimed at greater height, greater size, but much less effect of length. Their roofs were so lofty that it was almost impossible for them to build steeples which should have the sort of effect that ours have. The turret on Amiens Cathedral is nearly as lofty as Salisbury spire, but is only a turret; and so throughout. Few French churches afford the exquisite complete views of the exterior which English churches do; but, on the other hand, their interiors are more majestic, and man feels himself smaller and more insignificant in them than in ours. The palm must certainly be given to them above all others.

Later French architecture ran a very similar course to that which has been already described in England. The 13th century was that in which it was seen at its best. In the 14th the same sort of change took place as elsewhere; the art was beautiful, but it was too much an evidence of skilfulness and adroitness. It was harder and colder also than English work of the same age; and when it fell, it did so before the inroads of a taste for what has been called Flamboyant architecture,—a gay and meretricious style which trusted to ornament for all its effect, and, in spite of many beauties. had none of the sturdy magnificence of much of our English Perpendicular style.

There is no country richer in examples of architecture than France.. It has been seen how infinitely varied they are in the different provinces; but the student who wishes to understand what it was possible for a country to do in the way of creating monuments of its grandeur, would find in almost every part of the country, at every turn and in great profusion, works of the rarest interest and beauty. The 19th century may be the consummation of all, but the evidences of its existence to posterity will not be one-tenth in number of those which such a reign as that of Philip Augustus has left us, whilst none of them will come up to the high standard which in his time was invariably reached.

Gothic Architecture in Germany.

It is impossible to say so much in praise of the German examples of Pointed architecture as has been said of both French and English. The history of the development of the art is very different, but in many respects very curious. We have first certain absolutely Roman works, such as those at Trèves; then others, of which the convent at Lorsch is a conspicuous example, which are in the truest sense Romanesque, *i.e.*, works directly founded on the Roman buildings of the country. Then comes a great group of churches, of which those in Cologne and the Rhineland are the best known examples, which are evidently founded on the Lombard churches of the north of Italy. The earlier of these churches date from the beginning of the 12th century, and the same style is continued on with but little serious alteration down to the end of the 13th century, when the strange spectacle is seen of a style which is completely Romanesque in its general character being suddenly supplanted by a style which in no way grew out of it, but which was rather an imitation of a foreign style, and which is distinguished by the perfect and complete form which it at once assumed. This style, the complete Gothic of Germany, in its turn retained its sway much longer than the corresponding styles elsewhere, and was finally supplanted by a very national German style, answering in point of date to our own late Third Pointed and to French Flamboyant. The question naturally arises, whether these styles, which are so wanting in evidence of natural growth, are to be looked at as sudden German inventions, or whether they are not illustrations of the conservative character of a people not fond of change, resisting it as long as possible, and at last, when obliged to take it at all, compelled to accept it in the most decided form. In illustration of what has been said, the following dates will be useful:—St Gereon, Cologne, was begun in 1200, and vaulted in 1227; St Cunibert, also in Cologne, was building from 1205 to 1248; Naumburg Cathedral has a nave of 1200; Limburg is but little later; Gelnhausen was begun in 1250, and Munster-Maifeld about the same time. All these churches are of such a character, that if we were to see them in France we should, no doubt, put them down as works of the end of the 12th century, and should look for another class to fill up the gap between that time and the commencement of the cathedral at Cologne in 1270. In short, transitional works are as rare in Germany as they are common in England and France. There is comparatively little evidence of natural growth, and a very practical refutation, therefore, of the claim which has been advanced by some German writers on behalf of their country, for the honour of being the real mother and inventor of northern Gothic.

The ground-plans of German Gothic churches have a character of their own. The apsidal termination of the east end is usual, though not quite universal; but it is to be noted that German apses are very rarely surrounded by aisles and chapels. Cologne Cathedral, which is the grandest exception to the rule, was notoriously inspired by, and in a way copied from, Amiens, and St Godehard at Hildesheim, Magdeburg Cathedral, and the Marien-Kirche, Lübeck, are inferior to French examples of the same ages. The German churches were either simply apsidal, or parallel triapsidal, or transverse triapsidal; and the main difference between early and late examples is that the former were circular, the latter polygonal in outline. Another feature peculiar to Germany is that of double choirs, *i.e.*, churches with apses both at the east and west ends. Examples of this are seen in Laach, Bamberg, Naumburg; in St Sebaldus, Nuremberg; and in Augsburg Cathedral. Even when the ground-plan shows a disposition of aisles and chapels like the French *chevet*, the design is treated very differently, the whole being generally covered in by one vast roof, instead of a series of roofs, and the aisles being of the same height as the choir. This class of building is very striking internally, owing to the vast height of the piers and arches; there is no triforium or clerestory, and the windows are extravagantly lengthened out. Still the examples of this kind of design—St Stephen, Vienna; Münster; the Wiesen-Kirche, Soest; St Laurence, Nuremberg; and Munich Cathedral, among a host of others—are very grand. The details of the earlier churches are evidently borrowed from the north of Italy. The walls are arcaded, and almost always finished under the eaves with open galleries, which were the beautiful substitutes of the Lombard architects for the classic cornice. The steeples of the same period are very peculiar. They are either square or octangular in plan, arcaded or pierced with windows regularly all over their face, and roofed with gables, or with spires rising out of the gables. The early groining was very simple, but always more or less domical in section. The windows were plain and rude, and the mouldings very simple and unskilful. In the interior the most marked feature of these churches is the great height of the triforium, which is still generally in use as a gallery, and is groined in the same way as the aisle. On the exterior the peculiarity of the plan and the large number of generally rather small, though lofty, steeples of picturesque outline are the most striking peculiarities.

The German Complete Gothic is essentially national in its complete character. It has a similarity to English and French Middle Pointed, but no more than this. It has many and obvious defects. From the first there is conspicuous in it that love of lines, and that desire to play with geometrical figures, which in time degenerated into work more full of conceit and triviality than that of any school of mediæval artists. These conceits are worked out most elaborately in the traceries of windows and panelling. The finest early examples are in the cathedral at Minden; a little later, perhaps, the best series is in the cloister of Constance Cathedral; and of the latest description the examples are innumerable. But it is worth observing that they rarely at any time have any ogee lines. They are severely geometrical and regular in their form, and quite unlike our own late Middle Pointed, or the French Flamboyant. In sculpture the Germans did not shine. They, like the English, did not introduce it with profusion, though they were very prone to the representations of effigies of the deceased as monuments.

In one or two respects, however, Germany is still possessed of a wealth of mediæval examples, such as is hardly to be paralleled in Europe. The vast collection of brick buildings, for instance, is unequalled. If a line be drawn due east and west, and passing through Berlin, the whole of the plain lying to the north, and extending from Russia to Holland, is destitute of stone, and the mediæval architects, who always availed themselves of the material which was most natural in the district, built all over this vast extent of country almost entirely in brick. The examples of their works in this humble material are not at all confined to ecclesiastical works; houses, castles, town-halls, town walls, and gateways, are so plentiful and so invariably picturesque and striking in their character, that it is impossible to pass a harsh verdict on the architects who left behind them such extraordinary examples of their skill and fertility of resource. Then, again, in regard to the furniture which before the period of the Renaissance of art and the Reformation of religion filled the ancient buildings, the Germans have more than any other people been happily conservative. There are still churches in Germany in which it may be said that nothing has been changed since Luther's day except the use of the buildings. St Katharine's at Lubeck is turned into a museum, but is full of its old furniture. The choir of Halberstadt is unused, but everything, even to the hangings on the walls, remains as of old. In Nuremberg all the altars are preserved, and decked with altar-cloths and candles, though they are never used; and when so much toleration as to these externals has been shown, and so little desire for change exists, it may well be imagined that the opportunities for the study of the works of German Gothic architects in their completeness are unusually plentiful. During the last few years a vast number of books have been published on the subject of their national antiquities by German writers, and the amount of detailed information on the subject, which may be obtained by those who care for the study, is unbounded.

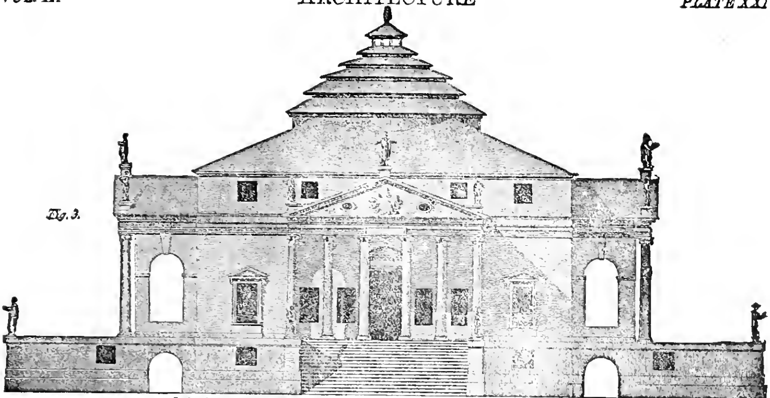
Gothic Architecture in Spain.

That which strikes the architectural student most forcibly in Spain is the concurrent existence of two schools of art during the best part of the Gothic period The Moors invaded Spain in 711 A.D., and were not finally expelled from Granada until 1492 A.D. During the whole of this period they were engaged, with more or less success, in contests for superiority with the Christian natives. In those portions of the country which they held longest, and with the firmest hand, they enforced their own customs and taste in art almost to the exclusion of all Gothic work. Where their rule was not permanent their artistic influence was still felt, and even beyond what were ever the boundaries of their dominion, there are still to be seen in Gothic buildings some traces of acquaintance with Arabic art not seen elsewhere in Europe, with the exception, perhaps, of the southern part of the Italian peninsula, and there differing much in its development. The mosque of Cordova in the 9th century, the Alcazar and Giralda at Seville in the 13th, the Court of Lions in the Alhambra in the 14th, several houses in Toledo in the 15th century, are examples of what the Moors were building during the period of the Middle Ages in which the best Gothic buildings were being erected Some portions of Spain were never conquered by the Moors These were the greater part of Aragon, Navarre, the Asturias, Biscay, and the northern portion of Galicia. Toledo was retaken by the Christians in 1085 A.D.; Tarragona in 1089, Saragossa in 1118, Lérida in 1149 Valencia in 1239, and Seville in 1248. In the districts occupied by the Moors Gothic architecture had no natural growth, whilst even in those which were not held by them the arts of war were of necessity so much more thought of than those of peace, that the services of foreign architects were made use of to an extent unequalled in any other part of Europe.

Of early Christian buildings, erected probably from the 8th to the 11th centuries, there is every reason to believe that some remains still exist. The most interesting of these is Sta Maria de Naranco, near Oviedo, a building whose details are founded on Roman, but whose plan has all that adaptation to special requirements which is so distinct a mark of mediæval work. The buildings which come next in point of date to these are all evidently derived from, or erected by the architects of those which were at the time being built in the south of France. These churches are uniform in plan, with central lanterns and three eastern apses. The nave has usually a waggon or barrel vault, supported by quadrant vaults in the aisles, and the steeples are frequently polygonal in plan. If these churches are compared with examples like that of the cathedral at Carcassonne on the other side of the Pyrenees, their identity in style will at once be seen. A still more remarkable evidence of similarity has been pointed out between the church of St Sernin, Toulouse, and the cathedral of Santiago. The plan, proportions, and general design of the two churches are identical. Here we see a noble ground-plan, consisting of nave with aisles, transepts, central lantern, and *chevet*, consisting of an apsidal choir, with a surrounding aisle and chapels opening into it at intervals. This example is the more remarkable, inasmuch as the early Spanish architects very rarely built a regular *chevet*, and almost always preferred the simpler plan of apsidal chapels on either side of the choir. And its magnificent scale and perfect preservation to the present day combine to make it one of the most interesting architectural relics in the country.

Among the more remarkable buildings of the 12th and the beginning of the 13th century are San Isidoro, Leon; San Vicente, Avila; several churches in Segovia; and the old cathedral at Lérida. They are much more uniform in character than are the churches of the same period in the various provinces of France, and the developments in style, where they are seen at all, seldom have much appearance of being natural local developments. This, indeed, is the most marked feature of Spanish architecture in all periods of its history. In such a country it might have been expected that many interesting local developments would have been seen; but of these there are but one or two that deserve notice. One of them is illustrated admirably in the church of St Millan, Segovia, where beyond the aisles of the nave are open cloisters or aisles arcaded on the outside, and opening by doors into the aisles of the nave. It would be difficult to devise a more charming arrangement for buildings in a hot country, whilst at the same time the architectural effect is in the highest degree beautiful. The universality of the central tower and lantern has been already mentioned. This was often polygonal, and its use led to the erection of some lanterns or domes of almost unique beauty and interest. The old cathedral at Sala-

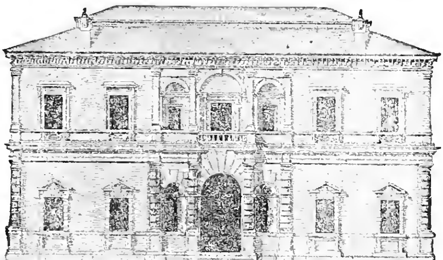
Fig. 3.



Scale of 10 5 0 10 20 30 40 50 60 feet.

VILLA CAPRA
near Vicenza.

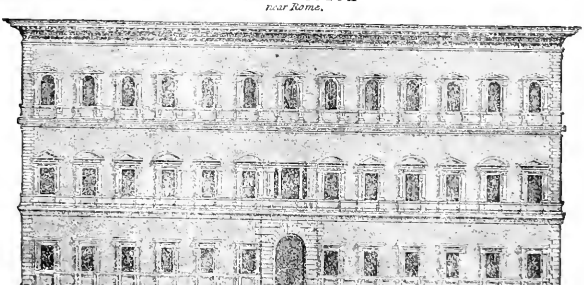
Fig. 2.



Scale of 10 5 0 10 20 30 40 50 60 feet.

VILLA GIULIA
near Rome.

Fig. I.



Scale of 10 5 0 10 20 30 40 50 60 70 80 90 100 feet.

FARNESE PALACE — ROME
front elevation.

manca, the church at Toro, and the cathedral of Zamora, all deserve most careful study on this score. Their lanterns are almost too lofty in proportion to be properly called domes, and yet their treatment inside and outside suggests a very beautiful form of raised dome. They are carried on pointed arches, and are circular in plan internally, and octagonal on the exterior, the angles of the octagon being filled with large turrets, which add much to the beauty of the design, and greatly also to its strength. Between the supporting arches and the vault there are, at Salamanca, two tiers of arcades continued all round the lantern, the lower one pierced with four, and the upper with twelve lights, and the vault or dome is decorated with ribs radiating from the centre. On the exterior the effect is rather that of a low steeple covered with a stone roof with spherical sides than of a dome, but the design is so novel and so suggestive, that it is well worth detailed description. Nothing can be more happy than the way in which the light is admitted, whilst it is also to be noted that the whole work is of stone, and that there is nothing in the design but what is essentially permanent and monumental in construction. The only other Spanish development is the introduction, to a very moderate extent, of features derived from the practice of the Moorish architects. This is, however, much less seen than might have been expected, and is usually confined to some small feature of detail, such, *e.g.*, as the carving of a boss, or the filling in of small tracery in circular windows, where it would in no way clash with the generally Christian character of the art.

The debateable period of transition which is usually so interesting is very sterile in Spain. A good model once adopted from the French was adhered to with but little modification, and it was not till the 13th century style was well established in France and England that any introduction of its features is seen here; and then, again, it is the work of foreign architects imported for the work and occasion, bringing with them a fully developed style to which nothing whatever in Spain itself led up by a natural or evident development. The three great Spanish churches of this period are the cathedrals of Toledo, Leon, and Burgos. Those of Siguënza, Lérida, and Tarragona, fine as they are, illustrate the art of the 12th rather than of the 13th century, but these three great churches are perfect Early Pointed works, and most complete in all their parts. The cathedral of Toledo is one of the most nobly designed churches in Europe. In dimensions it is surpassed only by the cathedrals of Milan and Seville, whilst in beauty of plan it leaves both those great churches far behind. The *chevet*, in which two broad aisles are carried round the apse with chapels alternately square and apsidal opening out of them, is perhaps the most perfect of all the schemes we know. It is as if the French *chevets*, all of which were more or less tentative in their plan, had culminated in this grand work to which they had led the way. The architectural detail of this great church is generally on a par with the beauty and grandeur of its plan, but is perhaps surpassed by the somewhat later church at Leon. Here we have a church built by architects, whose sole idea was the erection of a building with as few and small points of support as possible, and with the largest possible amount of window opening. It was the work of men whose art had been formed in a country where as much sun and light as possible were necessary, and is quite unsuited for such a country as Spain. Nevertheless it is a building of rare beauty and delicacy of design. Burgos, better known than either of the others, is inferior in scale and interest, and its character has been much altered by added works more or less Rococo in character, so that it is only by analysis and investigation that the 13th century church is still seen under and behind the more modern excrescences.

The next period is again marked by work which seems to be that of foreigners. The fully developed Middle Pointed or Geometrical Gothic is indeed very uniform all over Europe. Here, however, its efforts were neither grand in scale nor interesting. Some of the church furniture, as, *e.g.*, the choir screens at Toledo, and some of the cloisters, are among the best features. The work is all correct, tame, and academical, and has none of the dignity, power, and interest which marked the earlier Spanish buildings. Towards the end of the 14th century the work of Spanish architects becomes infinitely more interesting. The country was free from trouble with the Moors; it was rich and prosperous, and certainly its buildings at this period were so numerous, so grand, and so original, that they cannot be too much praised. Moreover, they were carefully designed to suit the requirements of the climate, and also with a sole view to the accommodation conveniently of enormous congregations, all within sight of the preacher or the altar. This last development seems to have been very much the work of a great architect of Majorca, Jayme Fabre by name. The grandest works of his school are still to be seen in Catalonia. Their churches are so vast in their dimensions that the largest French and English buildings seem to be small by comparison, and being invariably covered with stone vaults, they cannot be compared to the great wooden-roofed churches of the preaching orders in Italy and elsewhere, in which the only approach is made to their magnificent dimensions. The cathedral of Gerona is the most remarkable example. Here the choir is planned like the French *chevet* with an aisle and chapels round it, and opens with three lofty arches into the east wall of a nave which measures no less than 73 feet in the clear, and is covered with a stone vaulted ceiling. In Barcelona there are several churches of very similar description; at Manresa another, but with aisles to its nave; and at Palma in Majorca one of the same plan as the last, but of even much larger dimensions. Perhaps there is no effort of any local school of architects more worthy of study and respect than this Catalonian work of the 14th and 15th centuries. Such a happy combination of noble design and proportions with entirely practical objects places its author among the very greatest architects of any time. It is one thing to develop patiently step by step from the work of one's fathers in art, quite another to strike out an entirely new form by a new combination of the old elements. In comparison with the works just mentioned the other great Spanish churches of the 15th century are uninteresting. But still their scale is grand, and though their detail is over-elaborated and not beautiful, it is impossible to deny the superb effect of the interior of such churches as those of Seville, Segovia, and Salamanca (new cathedral). They are very similar in their character, their columns are formed by the prolongation of the reedy mouldings of the arches, their window traceries are poorly designed, and their roofs are covered with a complex multitude of lierne ribs. Yet the scale is fine, the admission of light, generally high up and in sparing quantity, is artistic, and much of the furniture is either picturesque or interesting. The *tout ensemble* is generally very striking, even where the architectural purist is apt to grumble at the shortcomings of most of the detail.

The remarks which have been made so far have been confined to the fabrics of the churches of Spain. It would be easy to add largely to them by reference to the furniture which still so often adorns them, unaltered even if uncared for; to the monuments of the mighty dead, in which Spain is a worthy rival of our own country; to the sculpture which frequently adorns the doorways and screens; and to the cloisters, chapter houses, and other dependent buildings, which add so much charm in every way to them. Besides this, there are very numerous castles, often planned on the grandest scale, and some, if not very many, interesting remains of domestic houses and palaces; and most of these, being to some extent flavoured by the neighbourhood of Moorish architects, have more character of their own than has been accorded to the churches. Finally, there are considerable tracts of country in which brick was the only material used; and it is curious that this is almost always more or less Moorish in the character of its detail. The Moors were great brickmakers. Their elaborate reticulated enrichments were easily executed in it, and the example set by them was, of course, more likely to be followed by Spaniards than that of the nearest French brick building district in the region of Toulouse. The brick towers are often very picturesque; several are to be seen at Toledo, others at Saragossa, and, perhaps the most graceful of all, in the old city of Tarazona in Aragon, where the proportions are extremely lofty, the face of the walls everywhere adorned with sunk panels, arcading, or ornamental brickwork, and at the base there is a bold battered slope which gives a great air of strength and stability to the whole. On the whole, it must be concluded that the mediæval architecture of Spain is of less interest than that of most other countries, because its development was hardly ever a national one. The architects were imported at one time from France, at another from the Low Countries, and they brought with them all their own local fashions, and carried them into execution in the strictest manner; and it was not till the end of the 14th century, and even then only in Catalonia, that any buildings which could be called really Spanish in their character was erected.

Gothic Architecture in Italy.

The history of the development of Gothic architecture in Italy brings out, more clearly than anywhere else, of course, the gradual transition from simple Roman work to Romanesque and Byzantine, and thence, finally, to Gothic. But the first portion of the history is, perhaps, the most important, since, owing to various causes, the Gothic architecture of Italy never achieved the same brilliant effects which marked its career in other parts of Europe. Something there was in the climate, something in the constant knowledge of grand works of classic times, and finally, something in the Eastern influence which was so marked in Venice, and in the Greek as well as Moorish or Arab influence which equally affected the whole southern half of the peninsula.

There can be no doubt whatever that the first buildings used for Christian worship in Italy were in no way whatever more suited for its functions than they were for the Pagan rites which had preceded them. The form of architecture used was the Roman art of the day; and to a considerable extent Roman buildings, and particularly basilicas, were converted, from the time of Constantine, into Christian churches. The early Christian policy was not unfrequently one which softened off the transition from the old worship to the new. And when the bishop took his seat in the centre of the apse, with his clergy on either side, and the Christian altar was placed in front of the apse, very much in the position of that which had been used for the Pagan sacrifice, the whole change required to convert the basilica into the church had been made. The basilica was usually a long nave with one or more aisles on either side. These aisles were frequently double in height, a second row or order of columns being placed above the first. At one end was a tribune sometimes square, but usually apsidal in plan, round which a series of steps led to seats formed against the wall. The central seat was that of the principal officer, the others those of his assessors, and the altar stood in front of the tribune. The central nave was either open to the sky, or covered with a wooden roof or with a vaulted ceiling. The basilica at Pompeii, still so perfect as to be quite intelligible, has a single aisle on each side, and a square-ended tribune, and was probably not covered over the centre. This, however, like all the early buildings in Pompeii, is rather Greek than Roman in its character. If we compare such buildings as this and the basilica of Trajan at Rome with the earliest existing churches built on the basilican type, we shall see how very slight the difference was for some hundreds of years. There is still the long unbroken nave with an apsidal head. Over the aisles are sometimes, as in St Agnese and St Lorenzo in Rome, second aisles or galleries opening to the nave. And the principal alteration or adaptation is one entirely of church furniture and screens, ambons and altars under baldachins, which, as if with a scrupulous regard to the old basilican arrangement, are planned independently altogether of the structure, being emphatically nothing but furniture. If we examine San Clemente in its present condition, we shall find a choir having no constructional peculiarities, but formed entirely by low screens built on the floor of the church, with a passage-way between them and the columns, and with ambons or pulpits projecting from their sides. In front of the church was an enclosed court-yard or atrium, from which access was gained to the church. The arrangements of San Clemente are probably not so old as they were once supposed to be. One, if not two, older churches exist beneath it; but, nevertheless, there is every reason for believing that the arrangements now visible are those at latest of the 9th century. The ancient basilica of St Peter was on the same sort of plan, with the addition of a cross nave or transept between the nave and its aisles and the apse, an arrangement which is still to be seen in the famous church of St Paul, without the walls, and in the basilica at Aquileia. At St Paul's the altar stands on the west side of the transept, the bishop's seat is separated from it by the transept, and the whole arrangement is unmeaning and unsatisfactory, but it is probably not old. The number of early churches on the basilican plan is very great, and they are of all sizes. The charming church of Sta Maria in Cosmedin, Rome, is a quite small building, but graceful in its general proportions, and interesting to the architect, like most of the early Roman churches, for the beautiful inlaid work, the Opus Alexandrinum, of its screens, pavements, and pulpits. Out of Rome, also, there are many examples of the same type, but space does not permit the mention here of any but those of Ravenna. The two most remarkable of these are St Apollinare in Classe, two or three miles out of the city, a forlorn and deserted building, and St Apollinare Nuovo, within the walls, a church whose mosaic decorations, being nearly perfect, give an admirable impression of the sumptuous character which the early church knew how to give and loved to give to its temples. Here, however, none of those old ritual arrangements remain, which give so much interest to the basilicas of Rome, Torcello, Toscanella, and Aquileia. The decoration of St Apollinare Nuovo is mainly on the space of wall between the arches opening to the aisles and the clerestory. It is a mosaic picture of an almost endless procession of white-clad saints on a golden ground. Few things in the whole realm of Christian art are more beautiful or more touching. The other St Apollinare, in Classe, has lost almost all its old decorations, and is merely painted in bad taste and in modern times. The Roman love of circular recesses or circular plans was very great. In the baths of Caracalla, for instance, we have them at every turn. The Pantheon is a vast circular building, with recesses in its walls (now used as chapels) alternately square and apsidal in plan; and in the temple of Minerva Medica these apsidal projections round the building are even more distinctly marked. This last example paved the way for the similarly planned church of San Vitale at Ravenna, which even now, overlaid as it is with meretricious decoration, affords us most interesting evidence of the way in which the constructional arrangements of Pagan Rome were copied and utilised by the Christians. But, usually, there was little to admire in the way in which this was done. The architect built up his church with fragments of classic columns, unequal in size or height, married to the wrong capitals and bases, and altogether as rudely put together as was possible. And so little development was there that, in the nave of the basilica of Aquileia, we have this done absolutely in the same way so late as the 14th century, the only difference being that in it the classic columns carry pointed arches and a clerestory of Gothic windows.

From these simple imitations of Roman buildings let us go to the 12th century church of St Ambrogio at Milan, and we shall see how much had by that time been done in the way of modification. The whole building is, of course, round arched. It has a western atrium or courtyard, and it has a nave and aisles, with an eastern apse to its nave. At first sight no alteration seems to have been made, but on further examination it will be found that the columns are alternately piers and clusters (at St Agnese every third column was made into a pier), that the arch orders have a proper connection with the plans of the columns, and that the church is vaulted. Let us now go back for an instant to the introduction of Byzantine plan and details in the church of St Mark at Venice. Here we have brought back again to Italy the product of the developed skill of the succession of artists, who, after constructing the mighty vaults of the Roman buildings, had removed to Constantinople with the empire, and had there grafted their knowledge on the art and practice of the East. It was there that they began to build domes, erected not on circular, but on square bases, the angles being supported on what are technically called pendentives. So fond of this construction were they that their buildings became almost always combinations of domes, instead of the simple nave, ended with a semi-dome, of the Roman architects of the day. This Byzantine style was developed with a skill and delicacy to which the decaying art of Rome was at the time quite a stranger, and it is less wonderful that so beautiful a church as St Mark should have had some influence, than that it should have had so little. But it is to the example of this and other Eastern churches, no doubt, that we owe the raised central lantern or dome which became a feature of so many churches from this time forward. A parallel may well be drawn here between two well-known and typical examples. These are the churches of San Zenone, Verona, and of San Michele, Pavia. In the former we still see the great simple and uniform plan of the wooden roofed basilican church, adorned with much that is Byzantine in feeling and character, but still emphatically a Romanesque building. In San Michele, on the contrary, we see a building which, if it owed something to Rome (as it did), owed at least as much to the East. Its plan was the distinctly cruciform plan, with a central lantern, not the Roman makeshift of a long nave with an Eastern transept, whilst its whole space being covered with vaulted roofs, instead of the Roman wooden ceiling to the nave, marks it as belonging to a different class. Besides this, the whole building is subdivided and constructed in so scientific a way as to show that its architect was in the path of a development leading far away from simple Roman theories of construction and plan. Here one of the most observable features is the fine open gallery under the external eaves of the roof, a device repeated constantly in the Lombard buildings, and transferred from them, with much else, to the valley of the Rhine, where it is the great feature of most of the 11th and 12th century churches, and of some even of the 13th century.

It is impossible here to make any lengthened reference to the buildings of Italy south of Rome. It must suffice to say that Rome herself seems to have had no influence on them during this early period. Their designs and decorations are full of a character which speaks of contact at times with Greece, at other times with the southern coast of the Mediterranean. Their walls are arcaded, and then adorned with square and circular panels, the details of which afford ample evidences of their origin. The arcades are sometimes, as at Foggia, of horse-shoe shape, and the extremely elaborate carving of foliage with which they are adorned is quite Byzantine in character. A comparison of the west fronts of Foggia or Troja, with the arcading of the church at Ani, in Armenia, will show much more similarity than with any Roman work; whilst the front of Sta Maria, Ancona, is planned in just the same fashion as that of the cathedral at Zara in Dalmatia. The one great North Italian church in which there was an attempt to fuse these two fashions of design is the cathedral at Pisa, where all the walls are arcaded and panelled, the mouldings mainly copied from the ancient forms, and the whole trust of the architect put, very much as it was in the South Italian and Byzantine works, in covering the walls with decoration. But these churches did nothing by way of paving the way for Italian Gothic, and need not therefore be further referred to.

Italy is poorer than any other country in examples of the transition from round arched to pointed arched buildings. The use of the pointed arch was accepted at last as a necessity, and cannot be said ever to have been welcomed. The first buildings in which it is seen worked out fully in detail are those of Nicola Pisano, and but few examples exist of good Gothic work earlier than his time. The elaborately arcaded and sculptured west front of Ferrara Cathedral is a screen to an early building. The cathedral and other churches at Genoa are certainly exquisite works, but they appear to owe their internal design rather to the influence of (perhaps) Sicilian taste than North Italian, and the exquisite beauty of the west front owes a good deal, at any rate, to French influence, softened, refined, and decorated by the extreme taste of an Italian architect. The feature which most marks all Italian Gothic is the indifference to the true use of the pointed arch. Everywhere arches were constructed which could not have stood for a day had they not been held together by iron rods. There was none of that sense of the unities of art which made a northerner so jealous to maintain the proper relations of all parts of his structure. In Nicola Pisano's works the arch mould rarely fits the capital on which it rests. The proportions of buttresses to the apparent work to be done by them are bad and clumsy. The window traceries look like bad copies of some northern tracery, only once seen in a hurry by an indifferent workman. There is no life, or development, or progress in the work. If we look at the ground-plans of Italian Gothic churches, we shall find nothing whatever to delight us. The columns are widely spaced, so as to diminish the number of vaulting bays, and to make the proportions of the oblong aisle vaulting bay very ungainly. Clustered shafts are almost unknown, the columns being plain cylinders with poorly sculptured capitals. There are no triforium galleries, and the clerestory is generally very insignificant. In short, a comparison of the best Gothic works in Italy with the most moderate French or English work would show at once how vast its inferiority must be allowed to be. Still there were beauties which ought not to be forgotten or passed over. Such were the beautiful cloisters, whose arcades are carried on delicate coupled shafts. Of these the first examples are in Rome, but they are to be seen all over Italy. Such, again, were the porches and monuments, of which some of the best are in Verona, of almost unsurpassed elegance; such the campaniles, both those of Rome, divided by a number of string-courses into a number of stages, and those of the North, where there are hardly any horizontal divisions, and the whole effort is to give an unbroken vertical effect; or that unequalled campanile, the glory of Florence, of Giotto, of art, the tower of the cathedral at Florence, where one sees in ordered proportion, accurately adjusted, line upon line, and stage upon stage, perhaps the most carefully wrought out work in all Europe. The Italian architects were before all others devoted to the display of colour in their works. St Mark's had led the way in this, but, throughout the peninsula, the bountiful plenty of nature in the provision of materials was only seconded by the zeal of the artist, and on this point a few notes may be added at the conclusion of this summary. They were also distinguished for their use of brick. Just as in parts of Germany, France, Spain, and England, there were large districts in which no stone could be had without the greatest labour and trouble; and here the reality and readiness which always marked the mediæval workman led to his at once availing himself of the natural material, and making a feature of his brickwork. This is a subject which, however, cannot well be treated save at the same time as other developments of brick building in other districts similarly situated. In conclusion, it must be said that the Gothic of Italy has no such grand works to show as more northern countries have. The buildings were seldom thoroughly beautiful as complete works of architecture. Allowance has to be made at every turn for some incompleteness or awkwardness of plan, design, or construction. There is no attempt to emulate the beauties of the best French plans. Milan Cathedral, magnificent as its scale and material make it, is clumsy and awkward both in plan and section, though its vast size makes it impressive internally. San Francesco, Assisi, is only a moderately good early German Gothic church, converted into splendour by its painted decorations. At Orvieto a splendid west front is put, without any proper adjustment, against a church whose merit is mainly that it is large and in parts beautifully coloured. The later Pisan buildings are far finer, the altered baptistery especially being a magnificent work, though words can hardly describe the architectural defects of such work as that of the Campo Santo, where, again, it is the painter, not the architect, who has worked such wonders. The finest Gothic interiors are of the class of which the Frari at Venice and Sta Anastasia at Verona are examples. They are simple vaulted cruciform churches, with aisles and chapels on the east side of the transepts. But even in these the designs of the various parts in detail are poor and meagre, and only redeemed from failure by the picturesque monuments built against their walls, by the work of the painter, and by their furniture. In fine, Gothic art was never really understood in Italy, and, consequently, never reached to perfection.

If the architecture of Italy never fell away so much from the more classic style of imperial Rome as that of the northern nations did, neither did the Italian ever possess that more than equivalent, whose splendid course we have been describing. Whilst the Pointed style was almost exclusively known and practised in Northern Europe, the Italians were but slowly improving in their Gothic style; and the improvement was more evinced in their secular than in their ecclesiastical structures. Florence, Bologna, Vicenza, Udine, Genoa, and, above all, Venice, contain palaces and mansions of the 12th, 13th, 14th, and 15th centuries, which for simplicity, utility, and beauty far excel most of those in the same and other places of the three following centuries. The contemporary churches do not exhibit the same degree of improvement in style that is conspicuous in these domestic works, for there are no works in Europe more worthy of study and admiration than the Ducal Palace at Venice, and some of the older works of the same class, and even of earlier date. The town-halls of Perugia, Piacenza, and Siena, and many houses in these cities, and at Corneto, Amalfi, Asti, Orvieto, and Lucca, the fountains of Perugia and Viterbo, and the monuments at Bologna, Verona, and Arezzo, may be named as evidence of the interest which the national art affords to the architectural student even in Italy, as late as the end of the 14th century; but after this it gradually gave way to, though in some instances its influence may be traced even when it had been overborne by, the new style.

Modern Italian School of Architecture.

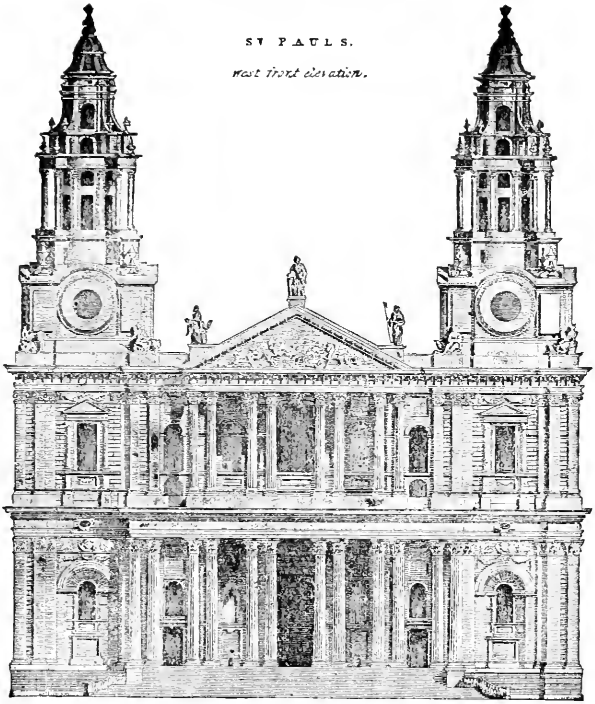
The opening of the Italian school of architecture on the resuscitated dogmas of Vitruvius was coincident with the gradual decay of the Pointed style. Fortunately, however, its effects were a full century in reaching England, and during that period many most elegant structures were erected, and many of those of earlier date which had been commenced before or during the wars of the Roses, and left unfinished, were completed. The first indication we have of the presence of the *Cinquecentist* in England, is in the tomb of Henry VII., which was executed by Torregiano, an Italian artist, who, it would appear, was obliged to have some respect to the style of the edifice in which his work was to rest; but his preconceived ideas of propriety and beauty were too strong to allow him to omit the characteristics of his school, and the result is a strange mixture of the two. From that time the Pointed style rapidly deteriorated, being overborne by the taste of the Renaissance. On the Continent the latter was already predominant, for, during the whole of the 15th century, the current had been setting from Italy over every part of Europe which received its religion from Rome, and this country was only the last to be overwhelmed by it.

The first step taken towards the revolution of architecture was by Filippo Brunelleschi, a Florentine architect, who was employed to finish the cathedral of his native city early in the 15th century; a work which had been commenced more than a century before on the design of Arnolfo, a Florentine also, but which still required the cupola when its completion was intrusted to Brunelleschi. The edifice is in the Italian Gothic style, which his affectation of superior taste and talent induced him to attempt to supersede, so as to bring the world back to the classic style of ancient Rome. The construction of the cupola gained him great reputation and the confidence of the public, which he employed to advance his favourite scheme. To use the words of an Italian writer on the subject, "On the example of so wise and skilled a man, other architects afterwards devoted themselves to free architecture from the monstrosities introduced by barbarism and excessive licence, and to restore it to its primitive simplicity and dignity." But to what did they have recourse to effect this? Did they examine and study the remains of antiquity in Greece and Rome, in Italy and elsewhere? No! they referred to the writings of an obscure Latin author, who professed to give the principles and practice of architecture among the Greeks and Romans, but paid no more attention to the existing architectural works of these nations than if they had never been, although one could hardly walk the streets of any of the old cities in the south of Italy without seeing Roman edifices, whilst Rome and its vicinity was, as it still is, full of them. All the use, however, that these self-called "restorers" of architecture made of the works of the

ARCHITECTURE.

St PAULS.

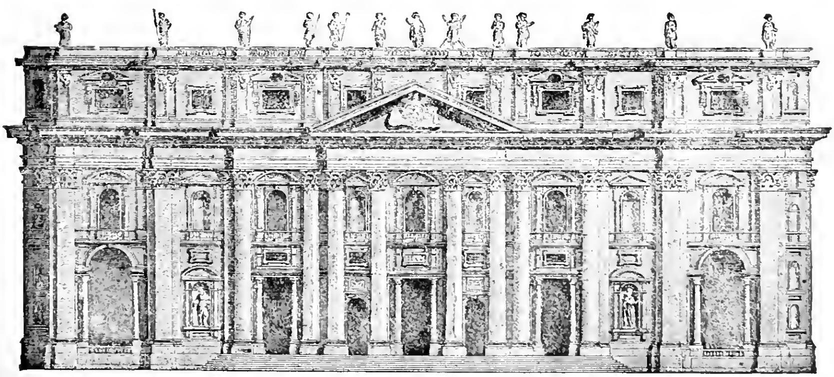
West front elevation.



SCALE

10 5 0 10 20 30 40 50 60 70 80 90 100 Feet.

St PETERS.



east front elevation.

ancients, was to use them as lay-figures, or framework, to model on, according to the proportions and directions given by Vitruvius; and the effect was formality and mannerism in those who adhered to the dogmas of the school, and wild grotesqueness in those who allowed themselves to wander from them, whilst simplicity, and its consequence good taste, were effectually banished from the works of them all.

It may be necessary to remark here that the works of Vitruvius are of value mainly as records of the architectural practice and the opinions and acquirements of an architect of a distant age. His fables about the origin of building, the invention of the orders, and the arrangements which grew out of certain modes of construction, prove his total ignorance not only of the architectural works of the more ancient Eastern nations, but of those of Greece itself, which he professes to describe. His classical taste, in consequence of his knowledge of antiquity, is vaunted by Perrault, one of his commentators, and given by him as a reason why Vitruvius was not much employed by the whimsical Romans, who loved variety, to which he would not administer. But the extent to which his knowledge of antiquity, that is, of the works of the Greeks, extended, may be readily determined by comparing the designs of Greek structures, made by Perrault and others, according to the directions of Vitruvius, with the Greek structures themselves as they exist even at the present time. Not a single example of Greek architecture will bear out any of the rules which Vitruvius lays down, professedly on its authority; and not an existing edifice, or fragment of an edifice, is in form or proportion in perfect accordance with any law of that author, nor indeed are they generally in harmony with the principles he enunciates.

The Five Orders.

The adoption of the Vitruvian laws by the Italian architects of the 15th century led to the formation of the so-called "Five Orders." In speaking of the course of Greek and Roman architecture, mention has been made of the Doric, Ionic, and Corinthian styles. Vitruvius describes, in addition to these, another, which he calls Tuscan—possibly a style of columnar arrangement peculiar to Italy, and most likely of Etrurian origin; but, in the absence of delineations, the *Cinquecentists* could only apply the proportions he laid down for it to what appeared to approximate them in the ancient remains; and hence arose a fourth, or "the Tuscan Order." It is, however, a mere modification of the Roman debasement of the Doric, and may be considered, in its present form, as of purely modern Italian origin. The same "Revivers," on looking among the ruins of ancient Rome for the forms of their Vitruvian orders, found specimens of a foliated ordinance, which the bad taste of the Romans had compounded of the foliated and voluted styles of the Greeks. This was seized upon as a fifth style, subjected to certain rules and proportions, and called "the Composite Order." The very poor Roman specimens of Doric and Ionic fitted themselves without much difficulty to the Vitruvian laws; but the examples Rome afforded of the Corinthian were less tractable, and being as various in detail as they are generally beautiful, they were all passed over, and their places supplied by a mere changeling—an epitome of the Vitruvian theory. Thus we have the "Five Orders" of the Italo-Vitruvian school, viz.:—*first*, the Tuscan, of which there is no recognised example of antiquity, but which owes its form to the descriptions of Vitruvius and the fancies of the revivers; *second*, the Doric, a poor and tasteless arrangement of the general features of the style on a Roman model; *third*, the Ionic, which is almost as great a debasement of the Grecian originals, and was produced in the same manner as the last-mentioned; *fourth*, the Corinthian, a something totally unlike the ancient examples of both Greece and Rome in beauty and spirit; and, *fifth*, the Composite, an inelegant variety of the Corinthian, or a hybrid mixture of the horned or angular-Ionic volutes, with a deep necking of the foliage of the preceding order. The first to publish this system was Leon Battista Alberti, a pupil of Brunelleschi. He has been followed by many others, the most distinguished of whom are Palladio, Vignola, Scamozzi, Serlio, and De Lorme, architects, and Barbaro, a Venetian prelate, and an esteemed translator of, and commentator on, Vitruvius. None of these, it must be understood, agreed with any other of them, but each took his own view of the meaning of their common preceptor; and yet none of their productions evince the slightest approach to the elegance of form and beauty of proportion which distinguish the classic models of the columnar architecture of antiquity. Palladio and Serlio were the first to publish delineations and admeasurements of the Roman architectural remains in Italy; but the total absence of verisimilitude to the originals, and, in many cases, the absolute misrepresentations, in both works, prove how incompetent the authors were to appreciate their merits; and the exaggeration of their defects proves with equal clearness the general bad taste of the school in which they are masters. The worst qualities of the Roman school of architecture were embraced and perpetuated by the Cinquecento artists. The inharmonious and unpleasing combinations which arose out of the collocation of arches with columnar ordinances became the characteristics of the Italian; unequal intercolumniations, broken entablatures and stylobates, enter alike into the productions of the best and of the worst of the Cinquecento architects. The style of this school is marked, too, by the constant attachment of columns and their accessories to the fronts or elevations of buildings; by the infrequency of their use in insulated (their natural) positions to form porticoes and colonnades; by the thinness or want of breadth in the smaller members of their entablatures, and the bad proportions of the larger parts, into which they are divided; by the general want of that degree of enrichment which fluting imparts to columns; by the too great projection of pilasters, and the inconsistent practice of diminishing, and sometimes fluting them; by the use of circular and twisted pediments, and the habit of making breaks in them to suit the broken ordinance they may crown; and by various other inconsistencies and deformities, which will be rendered more evident when we come to treat of the style in detail. The merit of the Italian school consists in the adaptation and collocation of the prolate hemispheroidal cupola, which appears to have grown out of its opposite in the Roman works during the Gothic ages, as we find it in the early cathedrals; though it is highly probable that the idea was brought from the East, in the forms exhibited by the cupolas of St Mark's at Venice, and of Pisa Cathedral. A very imposing style of palatial architecture also was practised by many of the Italian architects. It consists of the use of a grand crowning cornice, running in one unbroken line, unsurmounted by an attic or anything of the kind, superimposing a broad, lofty, and generally well-proportioned front, made into graceful compartments, but not storied, by massive blocking courses or otherwise. Not unfrequently, however, the faults of the school interfere to injure a composition of this kind; for, to produce variety in the decorations of the windows, some of them have been made like doors, with distyle arrangements of columns, surmounted by alternations of circular and angular pediments, and sometimes with all the vagaries which deform the front of an Italian church. It is indeed the ecclesiastical architecture of the school in which its faults are most rife and its merits most rare. An Italian Renaissance church possesses nothing of the stern simplicity and imposing grandeur of an Egyptian sacred structure—nothing of the harmonious beauty and classic dignity of a Grecian fane—nothing of the ornate and attractive elegance of a Roman temple—and nothing truly of the glittering grace and captivating harmony of a Pointed cathedral. No other style of architecture presents so great a contrast, in any two species of its productions, as the Italian does, in one of its ordinary church fronts, with the front of a nobleman's mansion or palazzo, in the manner already referred to; and in no city of Italy is the contrast so strong, by the egregiousness of the examples it contains of both, as Rome. The stately portico is hardly known in Italian architecture; and in the rare cases in which insulated columns are found, they are for the most part so meagre in themselves, and so widely set, according to the Vitruvian laws, that the effect produced by them is poor and wretched in the extreme. This applies most particularly to Italy itself: in some other countries, and especially in this, those architects who have been of the Italian school have generally preferred the proportions and arrangements which they found in the Roman examples of antiquity, to those laid down by their Italian masters. Still, Italian church architecture of this period availed itself largely of the cupola,—certainly its redeeming feature; and the architects of Italy must have full credit for the use they have made of it, both internally and externally. Perhaps no two edifices display more, and in a greater degree, both the merits and defects of the school which produced them, than the Farnese palace and the basilica of St Peter in Rome. The principal front of the former edifice is noble in its proportions, but frittered in its details. It has an immense crowning cornice, whose general effect is certainly grand; but the mouldings are too much projected, and its vertical parts want the breadth which the blocking courses possess. The lowest of its three tiers of windows is characterised by extreme simplicity and good taste in almost every particular; but the other two are crowded with sins against both those qualities, in the dressings of the windows. The cortile and back front, though very differently arranged from the front and from each other, are filled with contrarieties, and the same may be said of the structure throughout. The front of St Peter's is not more distinguished by its magnitude than by its littleness and deformity. It contains the materials of a noble octaprostyle, and consists of an attached tetrastyle. It is divided into three unequal stories, within the height of the columns, whose entablature is surmounted by a windowed attic. In length it is frittered into a multitude of compartments, between which not the slightest harmony is maintained, while tawdriness and poverty are the distinguishing characteristics of its detail. A total absence of everything which produces grandeur and beauty in architecture, marks, indeed, the whole of the exterior of the edifice, except the cupola, than which, if its bad connection with the building out of which it grows is overlooked, architecture seldom produced a more magnificent object. Internally, the structure is open to similar praise and similar dispraise. Gorgeousness in matter and meanness in manner characterise the interior of St Peter's, except the sublime concave which is formed by its redeeming feature without. It must be said also that, probably, no building was ever erected in which the eye is so successfully deceived as to the actual dimensions. Its architect raised enormous walls, arches, and vaults, but gave every one the impression that they were on a very moderate scale. The tawdry and inappropriate sculptured decorations of the Renaissance school can nowhere be criticised with more advantage than in St Peter's. It is not too much to say that, throughout the interior, there is scarcely an ornament which is not offensive; whilst not one of them has the slightest natural connection with, or use in, a sacred building. Perhaps sculpture never reached so profound a bathos as in the hideous cherubs which are stuck, like petrified acrobats, against all the piers of St Peter's; and when we hear of such a building being treated as a model for our guidance in the completion of St Paul's, we are driven devoutly to hope that St Paul's may never in that sense be completed at all. Few people ever seem to trouble themselves to look at any part of St Peter's except the entrance front and the dome. If they would examine the rest of the exterior they would find it to be a building without one other redeeming feature, or a single grace of outline or detail, and so absolutely unscientific in its constructional arrangements as to be beneath contempt as a complete work of architecture.

St Peter's, Rome.

Cinque-cento architects.

The Cinquecento architects of Italy were extreme mannerists; but besides the manner of the school, each had his own peculiarities; so that there exists in their works what may almost be called monotonous variety. Brunelleschi's designs are distinguished by a degree of simplicity and comparative good taste, which causes regret that he had not referred more to the remains of antiquity in Italy, and sought out those of Greece, and attended less to the dogmas of Vitruvius; for then his works would have been more elegant and the school he founded would have done him much more honour. The works of Bramante possess a more classical character than those of any other architect of the school. Bramante's design for St Peter's was preferred by Pope Julius II. to a great many others by the most celebrated men of the time. He it was who suggested the cupola; but, unfortunately, after his death men of less taste and ability were allowed to alter the design, and the edifice is very different from what it would have been had Bramante been adhered to. This we judge from his works generally, and not from any positive knowledge of the design, which indeed does not exist. The elder Sangallo was far inferior to his contemporary and rival Bramante, and his works are full of the faults of the school. Michel Angelo Buonarroti was a man of great genius, but of coarse taste in architecture; and to him may be attributed many of the coarser qualities of the Italian style. His principal works are the buildings of the Capitol and the College della Sapienza in Rome, and the Laurentian Library at Florence; and these are all distinguished for their singular want of architectural beauty and propriety in every particular. Raffaelle, too, had a very bad style in architecture, and so indeed had almost all the painters after Giotto, who professed to be architects also. They generally carried to extremes all the faults of the school. Sansovino and Sanmicheli were men of considerable talent; their works display more originality and less servility than those of most of their contemporaries. Peruzzi was less employed than many who had not half his merit; his productions are with reason considered among the most classical of the Italian school. Vignola had a more correct taste than perhaps any other Italian architect of the 16th century; his works are indeed distinguishable by their superiority in harmony of composition and in general beauty of detail. Palladio very much affected the study of the antique, but his works do not indicate any appreciation of its beauties. He appears to have been very well qualified by nature for an architect, but spoiled by education. He did not look at the remains of antiquity with his own eyes, but with those of Vitruvius and Alberti, and he seems to have been too much influenced by the admired works of some of his predecessors. Palladio made greater use of insulated columns than the Italian architects generally, but his ordinances are deficient in every quality that produces beauty; his porticoes may be Vitruvian, but they certainly are not classic; and all his works show that he studied the Colosseum, the theatre of Marcellus, and the triumphal arches, more than the columns of Jupiter Stator and Mars Ultor, the temple of Antoninus and

Faustina, the Pantheon, the portico at Assisi, and the other classic models, which he drew, but clearly did not appreciate. His columns upon columns, his attached and clustered columns, his stilted post-like columns, his broken entablatures, his numberless pilasters, straggling and unequal intercolumniations, inappropriate and inelegant ornaments, circular pediments, and the like, are blemishes too numerous and too great to be passed over because of occasional elegance of proportion and beauty of detail. Scamozzi did not improve on the style of his master, which, however, he very much affected. Indeed, the term *Palladian* was long used as synonymous with beautiful and excellent architecture, so that it cannot be wondered at that Palladio's pupils and successors should have imitated him; nor is it surprising that they did not surpass, or even equal him, for they were taught to look to his works as the *ne plus ultra* of excellence. Giacomo della Porta, a contemporary of Palladio, followed Michel Angelo in several of his works, and imbibed much of his manner, on which he certainly improved; but still his own is far from being good. Della Porta was much employed in Rome; and it fell to him, in conjunction with Domenico Fontana, to put the cupola on St Peter's. Fontana's style of architecture is not particularly distinguished for its good or bad qualities: he obtained more reputation as an engineer than as an architect, having been engaged in removing and setting up most of the obelisks which give so much interest to the architectural scenery of Rome. The Lunghi, father, son, and grandson, the Rainaldi, Maderno, Borromini, Bernini, Carlo Fontana, Fuga, Vanvitelli, and many others in the course of the 17th and 18th centuries, carried the peculiarities of the Italian school to the greatest extremes. Of those enumerated, Bernini was perhaps the least offensive, and Borromini the most extravagant; but throughout that period, except in extreme cases, individual manner is less distinguishable, and that of the school more strongly marked.

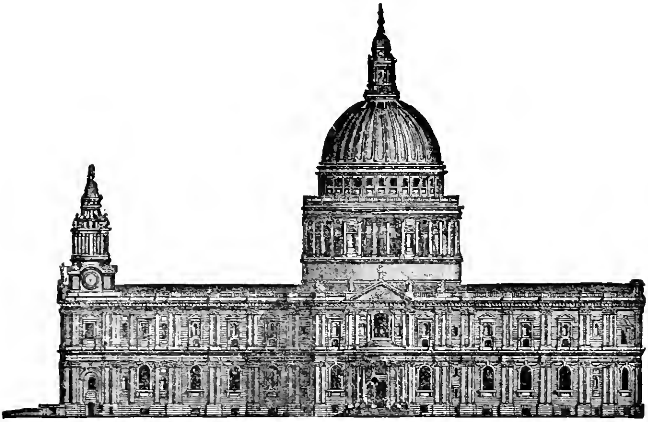
It may be gathered from the preceding remarks, that the secular architecture of the Italian school is generally preferable to the ecclesiastical, and that the architects of the 15th and 16th centuries were generally superior to those who followed them. In Italy the school has not yet ceased to exist, nor indeed has its style ceased to be studied. Designs are still made by the students of the various academies in the manner of the Cinquecento, and on the models with which the country abounds. The precepts of Vitruvius are yet inculcated, and the men whose names have just been mentioned are looked up to as masters of architecture in the country which contains the Roman Pantheon and the Greek temple of Neptune at Pæstum, and has access to the more exquisite works of Greece herself.

As has been already stated, Italian architecture, though professedly a revival of the classical styles of Greece and Rome, was formed without reference to the existing specimens of either, but on the dogmas of an obscure Roman author, and the glosses of the "revivers" on his text. Vitruvius described four classes or orders of columnar composition; and on the principles which governed him in subjecting to fixed laws all the varieties with which he appears to have been acquainted, they formed a fifth, of a medley of two of his, thus completing the Italian orders of architecture. The school which was founded on the Vitruvian theories has systematised everything to an absurd extent, and laid down laws for collocating and proportioning all the matter it furnishes for architectural composition and decoration. It teaches that columns are modelled from the human figure; that the Tuscan column is like a sturdy labourer—a rustic; the Doric is somewhat trimmer though equally masculine—a gentleman, perhaps; the Ionic is a sedate matron; the Corinthian a lascivious courtesan; and the Composite an amalgam of the last two! In a composition which admits any two or more of them, the rustic must take the lowest place; on his head stands the stately Doric, who in his turn bears the comely matron, on whose head is placed the wanton, and the wanton again is made to support the lady of doubtful character! Without commenting on this, we proceed at once to point out the general features of the Italian style, premising only, that according to the practice of the school everything is confined to an exclusive use and appropriation; such columns may be fluted, and such must not; such a moulding may be used here, but not there; and so on. The proportions and arrangements of an order, of any part of one, or of anything that may come within an architectural composition, are fixed and unchangeable, whatever may be the purpose or situation for which it is required, whether, for instance, an order be attached or insulated, the column must have exactly the same number of modules and minutes in height. It is true that the masters of the school are not agreed among themselves as to those things in which they are not bound by Vitruvius; but every one not the less contends for the principle, each, of course, prescribing his own doctrine as orthodox and final on these unsettled points.

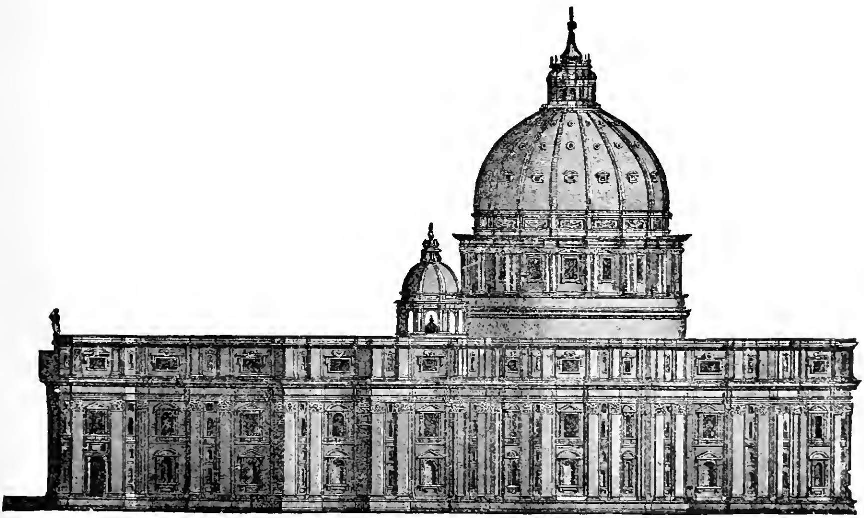
Mouldings are considered by these authorities as constituent parts of an order, and are limited to eight in number, strangely enough including the fillet. They are the cyma-recta, the cyma-reversa (or ogive or ogee), the ovolo, the torus, the astragal or bead, the cavetto, the scotia, and the fillet. They are gathered from the Roman remains, but reduced to regular lines or curves, which unlike all good artistic work may be drawn with a rule or struck with a pair of compasses. By their arrangement according to certain proportions, with flat surfaces, modillions, and dentils, a profile is formed; no two conjoined mouldings may be enriched, but their ornaments, as well as the modillions and dentils, must be disposed so as to fall regularly under one another, and, when columns occur, above the middle of them.

An order is said to be composed of two principal parts, the column and the entablature; these are divided into base, shaft, and capital in the one, and architrave, frieze, and cornice in the other, and are variously subdivided in the different orders. The Tuscan column must be made seven diameters in height, the Doric eight, the Ionic nine, and the Corinthian and Composite ten. The height of the entablature, according to some authorities, should be one-fourth the height of the column, and, according to others, two of its diameters. The parts of the entablature of all but the Doric may be divided into ten equal parts, four of which are given to the cornice, three to the frieze, and three to the architrave; and in the Doric, the entablature being divided into eight parts, three must be given to the cornice, three to the frieze, and the remaining two to the architrave. For the minor divisions a diameter of the column is made into a scale of sixty minutes, by which they are arranged; but this is obviously irrelevant if the whole height of the entablature is determined by the height of the column, and not by its diameter; in this case, therefore, they must be proportioned from the general divisions already ascertained. Columns must be diminished, according to Vitruvius, more or less as their altitude is less or greater,—those of about fifteen feet high being made one-sixth less at their superior than at their inferior diameter, while that proportion is lessened gradually, so that columns fifty feet high shall be diminished one-eighth only. On this subject, however, many of his disciples controvert the authority of their master; and some of them have fixed the diminution at one-sixth of a diameter for columns of all sizes in all the orders. The entasis of columns is disputed also, some authorities making it consist in preserving the cylinder perfect one-quarter or one-third the height of the shaft from below, diminishing thence in a right line to the top; while others, following Vitruvius, make the column increase in bulk in a curved line from the base to three-sevenths of its height, and then diminish in the same manner for the remaining four-sevenths, thus making the greatest diameter near the middle.

It being difficult to determine among the masters of the Italo-Vitruvian school whose designs of the various orders are to be preferred, we have selected those of Palladio, certainly not for any superior merit they possess, but because he is more generally esteemed than any other, and because he the most strictly adhered to the precepts of Vitruvius, as far as he could understand them. It should be remarked however, that although Palladio recommended fluting all but the shaft of the Tuscan column, he very seldom fluted columns in his own practice; and indeed it was the custom of the Italian school not to flute, whatever their doctrine may be to the contrary; for fluted columns in Italian architecture are exceptions to the general practice. Swelled or pillowed friezes are not peculiar to Palladio; they are more or less common to the works of most of the masters of the same school. Prostyles being almost unknown in Italian architecture, antæ are not often required; but when they are, the meanest succedaneum imaginable is recurred to. Of this Palladio's Villa Capra near Vicenza and Lord Burlington's Palladian villa at Chiswick afford striking examples. Pilasters, however, are very common, so common, indeed, that they may be called pro-columns, as they are often used as an apology for applying an entablature. They are described as differing from columns in their plan only, the latter being round, and the former square; for they are composed with bases and capitals, are made to support entablatures according to the order to which they belong, and are fluted and diminished with or without entasis, just as columns of the same style would be. When they are fluted, the flutes are limited to seven in number on the face, which, it is said, makes them nearly correspond with the flutes of columns; and their projection must be one-eighth of their diameter or width when the returns are not fluted; but if they are, a fillet must come against the wall. Pedestals are not considered by the Italo-Vitruvian school as belonging to the orders, but they may be employed with them all, and have bases and surbases or cornices to correspond with the order with which they may be associated. The dado of a pedestal must be a square whose side shall be equal to that of the plinth of the column or pilaster which rests on it, or a parallelogram a sixth or even a fourth of a diameter taller. The intercolumniations of columns are called pycnostyle, systyle, eustyle, diastyle, and aræostyle, and are strictly adhered to in Italian architecture when columns are insulated, which is not very often; when they are attached, the interspaces are not limited, except when a peculiar arrangement called aræostyle is adopted. This consists of two systyle intercolumniations, the column that should stand in the mid-distance between two others being placed within half a diameter of one of them, making, in fact, coupled columns or pilasters. It is applied to insulated columns as well as to those which are attached. Following Vitruvius, the Italian school makes the central intercolumniation of a portico wider than any of the others. The height of arched openings, in arcades or elsewhere, is generally about twice their width; if, however, they are arranged with a columnar ordinance, having columns against the piers, they are made to partake of the order to which the columns belong, being lower in proportion to their width with the Tuscan than with the Doric, and so on; and the piers are allowed to vary in the same manner, from two-fifths to one-half of the opening. With columnar arrangements, moulded imposts and archivolts are used; the former being made rather more than a semi-diameter of the engaged columns in height, and the latter exactly that proportion. Variously moulded keystones are used, too, projecting so that they give an appearance of support to the superimposed entablature. Smaller columns with their entablature are sometimes made to do the duty of imposts, and sometimes single columns are similarly applied; at other times, columns in couples are allowed to stand for piers to carry arches. In plain arcades the masonry is generally rusticated, without any other projection than a plain blocking course for an impost, and a blocking course or cornice crowning the ordinance. Niches and other recesses are at times introduced in the plain piers, which are in that case considerably wider than usual, or in the spandrels over wide piers. Very considerable variety is allowed in these combinations. Doors and windows, whether arched or square, follow nearly the same proportions, being made, in rustic stories, generally rather less than twice their width in height, and in others either exactly of that proportion, or an eighth or a tenth more. If they have columned or pilastered frontispieces, these are sometimes pedimented; and, except in rustic stories, whether with or without columns, a plain or moulded lining called an architrave is applied to the head and sides of a door or window. This architrave is made from one-sixth to one-eighth the width of the opening it bounds, and it rests on a blocking course or other sill, as the case may be. In the absence of columns or pilasters in the frontispiece, their place is frequently supplied by consols or trusses of various form and arrangement, backed out by a narrow pilaster, which may be considered as the return of the frieze of the entablature, and which supports the cornice. It is not uncommon for the architrave lining to project knees at the upper angles, and this is sometimes done even with consols and their pilasters. With columned frontispieces to gateways, doors, and windows, arose the custom, so frequent in Italian architecture, of rusticating columns, by making them alternately square and cylindrical, according to the heights of the courses of rustic masonry to which they are generally attached, and with which they are less offensive than in other collocations. The practice of the Cinquecento school of piling columns on columns with their accessories is warranted by the doctrine of its master; but his precepts not being practicable, recourse has been had to the inferior works of the Romans, which present examples of it. The difficulty of preserving anything like a rational arrangement is acknowledged on all hands to be great, if not insurmountable; for if the first or lowest order be at an intercolumniation fitting its proportions, the second or next above it, though diminished ever so little, is already deranged, for it has the same distance from column to column that the inferior order has whilst the columns themselves are smaller in diameter, and their entablature consequently shallower. This derangement must, of course, increase with every succeeding ordinance, rendering it indeed impossible to make such a composition consistent. The most approved practice in arranging order above order appears to be, that the upper column shall take for its diameter the superior diameter of the one below it; that when the columns are detached their axes shall be in the same perpendicular line; but when attached or engaged, the plinth of the pedestal of the upper shall impend the top of the shaft of the lower column. The most rational mode, however, for diminishing, if reason can be applied to such compositions, is to carry the diminution through, the outlines of the columns of the lowest order being drawn up in the same direction, and so the columns of every story would take up their place and



St. PAUL'S
(South Flank Elevation.)



St. PETERS
(North Flank Elevation.)
SCALE

be diminished in regular gradation. When columns are attached, or pilasters are used, in Italian architecture, the almost invariable custom is to break the entablature over every column or pilaster, or over every two when they are in couples. Because of the great length of the intercolumniation, this would appear to have been done at first; but it has frequently been done by some of the most distinguished practitioners of the school, even without that excuse, so that it may be held as approved by them. A basement is either a low stereobate or a lofty story, according as it is intended to support a single ordinance the whole height of the main body of the structure, or indeed the lowest of two or more orders; or as it occupies the ground story of a building, and supports an ordinance, or the appearance of one, above. In either case much is necessarily left to the discretion of the architect; but in the latter the height of the order it is to support is the generally prescribed height of the basement. A basement may be rusticated or plain; if it be low, and is not arranged like a continued pedestal, it must have neither cornice nor blocking course; but if lofty, a deep bold blocking course is indispensable. An attic may vary in height from one-quarter to one-third the height of the order it surmounts; attics are arranged with a base, dado, and coping cornice, like pedestals, and generally have pilasters broken over the columns below. The rule for the form, composition, and application of pediments in Italian architecture, if it may be gathered from the practice of the school, appears to be to set good taste at defiance in them all. We find pediments of every shape, composed of cornices, busts, scrolls, festoons, and what not, and applied in every situation, and even one within another, to the number of three or four, and each of these of different form and various composition. The proportion laid down for the height of a pediment is from one-fourth to one-fifth the length of its base, or the cornice on which it is to rest. Balustrades are used in various situations, but their most common application is in attics, or as parapets on the summits of buildings, before windows, in otherwise close continued stereobates, to flank flights of steps, to front terraces, or to flank bridges. Their shapes and proportions are even more diversified than their application; that of most frequent use is shaped like an Italian Doric column, compressed to a dwarfish height, and consequently swollen in the shaft to an inordinate bulk in the lower part, and having its capital, to the hypotrachelium, reversed to form a base to receive its grotesque form. The base and coping cornice of a balustrade are those of an ordinary attic, or of a pedestal whose dado may be pierced into balusters. The general external proportions of an edifice, when they are not determined by single columnar ordinances, appear to be unsettled. The grand front of the Farnese Palace in Rome is in two squares, its length being twice its height; the length of each front of Vignola's celebrated pentagonal palace of Caprarola is two and a quarter times its height above the bastions. In Palladio's works we find the proportions of fronts to vary so considerably as to make it evident that he did not consider himself bound by any rule on that point. In some cases we find the length to be one and a sixth times the height, in others one and a fourth, one and a half, two, two and a sixth, and even three and a sixth; and elevations by other masters of the school are found to vary to the same extent. The proportions of rooms, again, range from a cube to the ratio of one to two, though it is preferred that the height should be a sixth, or even a fifth, less than a side when the plan is a square; but the sesquialteral form, with the height equal to the breadth, and the length one-half more, is considered the most perfect proportion for a room. There is considerable variety and beauty in the foliate and other enrichments of an architectural character in many structures in Italy, but very little ornament enters into the columnar composition of Italian architecture. Friezes, instead of being sculptured, are swollen; the shafts of columns, it has been already remarked, are very seldom fluted, and their capitals are generally poor in the extreme; mouldings are indeed sometimes carved, but not often; rustic masonry, ill-formed festoons, and gouty balustrades, for the most part supply the place of chaste and classic enrichment. This refers more particularly to the more *classic* works of the school; in many of the earlier structures of Italy, and especially on monuments of various kinds, we find what may be called a graceful profusion of ornament, of the most tasteful and elegant kind; few carved mouldings however, and very few well-profiled cornices, are to be met with in Italian compositions of any kind. In many of the later architectural works of that country we find again a profusion of ornament of the most tasteless and inelegant description, chiefly in the gross and vulgar style, which is distinguished as that of Louis XIV. of France.

In the 15th century such was the reverence of men for the revived works of ancient literature and science, that the pretence of the Italians, that they had restored ancient classical architecture on the precepts of an architect of the Augustan age, was sufficient to open the way for them all over civilised Europe. In the course of that and the following century Italian architecture was adopted and Italian architects employed in France, Spain, Germany, Great Britain, and their respective dependencies; and now, in the 19th century, Vitruvius and Palladio are as predominant on the shores of the Baltic as on those of the Mediterranean; though in England and in some parts of the Continent their influence is considerably diminished since the time of Inigo Jones and Claude Perrault. It has been already remarked, too, that the Cinquecento was later in gaining a footing in Britain than on the Continent, in consequence of the love of the beautiful national style of architecture, which our ancestors do not appear to have been induced to resign to the barbarian innovators of the South, as readily as most other nations were to give up theirs. The French, though they received the Vitruvian architecture from the Italians, were patriotic enough, as soon as they had acquired its principles, to confine the practice of it almost entirely to native architects, in whose hands it assumed a different character from that which it possessed in Italy, and became what may be called the French style of Cinquecento. Its ecclesiastical structures are less faulty than are those of the corresponding period in Italy, but its secular edifices are as far inferior to those of that country. The grand palatial style, which is exemplified in the Farnese Palace in Rome, never found its way into France; but instead, there arose that monstrous and peculiarly French manner, of which the well-known palaces of the Tuileries and Luxembourg are egregious examples. In the age of Louis XIV. the French appear to have reverted to the Italian manner in a certain degree; for the palace of Versailles includes almost all the extravagances of that school in its worst period, and contains, moreover, architectural deformities which Italy never equalled till it imitated them. They consist in the style of enrichment which is distinguished by the name, and is due in part to the gross taste, of the monarch in whose reign it had its origin. The same period produced one of the most classical architects of the French school—its Palladio or Inigo Jones—Perrault, whose design for the buildings of the Louvre was preferred to that of Bernini, though, indeed, the preference was no compliment to the one nor discredit to the other, considering to whom the decision was of necessity referred. The Hotel des Invalides is of the same age: it exhibits the graces of the Italian cupola, surmounting a composition which includes more than all the faults of St Peter's in

Rome. The church of Sainte Genevieve, or the Pantheon, a work of the following reign, was intended to be in the ancient Roman style, and of Roman magnificence; but it is rather papally than imperially so. Ancient Rome was regarded in the columnar ordinance, but modern Rome in the architectural composition. In it the ecclesiastical style of the Cinquecento is commingled with the simple beauties of Roman architecture, almost, indeed, to the destruction of the latter, and it is crowned by a too lofty cupola. More recently the works of the ancients have been studied by the architects of France, greatly to the amelioration of their style, although many of them still appear to disregard the peculiarities of real Greek architecture, and to retain their devotion to Vitruvius and the 15th century. Spain received but soon modified the Italo-Vitruvian architecture, and has never recovered from the architectural excesses into which her architects plunged when the wealth of their countrymen in the 16th and 17th centuries enabled them to accomplish such enormous works. Of these, the man of the greatest fame out of his own country is Herrera, the architect of the Escorial, a vast palace built upon the ingeniously rural plan of a gridiron. It is a vast but bare, cold, and repulsive building. Not less is the cathedral at Valladolid a grand failure, though Herrera must be credited with much more self-restraint and reserve in the use of ornament than the Italian architects of his own time, and some of his contemporaries and successors in Spain. One of the most famous of these, Churriguerra, gave his name to a fashionable style which was neither more nor less than the most *rococo* travesty of Italian Renaissance that could be invented; and another school of architects, imitating the delicate chasing of silversmiths' work, produced another variation of the style, which was christened "Plateresque." If this is less cold than Herrera's work, and less offensive than Churriguerra's, it contains at the same time none of the elements of a really great and lasting style of architecture, and is only interesting as a local variety of style. The Italian revival was the means of extinguishing the Pointed style of architecture in Germany, and certainly without affording it an equivalent. Italian architects were employed in Germany, and Germans acquired their manner; but they did not improve it, nor did they make it productive of so many good effects as the Italians themselves did. The change in religion which followed the change in architecture in so large a part of Germany may have tended to prevent the latter from acquiring that degree of exuberance there which it reached in Italy; but even in Catholic Germany the splendid Pointed cathedrals have never given way to modifications of the pseudo-classic St Peter's. In the use of Cinquecento architecture for secular structures, it may be truly said that the Germans have not excelled the Italians, nor, on the other hand, have they equalled them in the absurdities and extravagances which are so frequently observable in the works of some of the latter. The Germans also have turned their attention to the works of the ancients, and the fruit of this is evident in many parts of the country, particularly in Prussia; still, however, they have yet to show that it is possible to apply the Greek models to modern uses, and to exhibit a proper sense of the exquisite perfection of their detail, as well as to emancipate themselves from the trammels of the Vitruvian school. The northern Continental nations have been dependent for their architecture on Germany, France, or Italy, and can produce nothing that gives them a claim to consideration in such a review as the present. St Petersburg is exclusively the work of architects of the nations just enumerated, and presents a mass of the merest common-places of Italian architecture, in structures calculated by their extent only, like Versailles, the Escorial, and St Peter's, to impose on the vulgar eye.

Modern English Architecture.

We have already more than once had occasion to refer incidentally to the introduction of Cinquecento architecture into Britain; and in noticing it more particularly, and tracing its course, we are saved the trouble of keeping up a distinction between the different parts of our triple nation, because at the time it actually crossed the Channel the union of the kingdoms had taken place.

When the Pointed style received its deathblow in England, in the reign of Henry VIII., it did not immediately cease to exist; nor was it immediately succeeded by the Italian when it became extinct. It was gradually declining through all the 16th century, during the latter part of which period what has been called the Elizabethan style became somewhat permanent. It consists of a singular admixture of the Italian orders with many peculiarities of the Pointed style, and in many examples the latter appears predominant. With such difficulty, indeed, did that fascinating manner give up its hold on the minds of men in this country, that the Cinquecentists appear to have relinquished the hope of effecting its destruction, unfortunately, however, not until the injury was done; and for some time we were left without a style of any kind, unless that may be called by the name which marks the edifices of the reign of James I., and of which the oldest parts of St James's Palace are a specimen.

The destruction of the Pointed style has been referred by some to the change in religion which took place under the Tudor line of English monarchs, but certainly without sufficient reason. It was the "Reformation" of architecture in Italy, and not that of religion in Great Britain, that effected it; and it may be doubted whether the change would not have taken place sooner in this country if its connection with Italy had not been so materially affected by the moral change here; for it was Germany and France that supplied us with architectural reformers during the reigns of Henry VIII. and his children, and not Italy, whose professors might possibly have obtained more credit than their disciples did.

So dilatory were we, indeed, in the cultivation of the Italian style, that the first professor of it who was actually employed on edifices in this country came to it from Denmark! It is true he was an Englishman; but so little hope did he appear to have of success at home, that he accepted an invitation from the king of that country. He had gone to Venice to study painting; but becoming enamoured of architecture, as he saw it in the works of Palladio, he had made that his study instead, and had already acquired considerable reputation in that city when Christian IV. of Denmark invited him to his court to occupy the post of his first architect. A train of circumstances brought him to England a few years after James I. came to the English crown, and he was appointed architect at first to the queen, and subsequently to Henry prince of Wales. But this does not appear to have then obtained employment for him, since after the death of the prince he went again to Italy, where he remained till the office of surveyor-general, which had been promised him in reversion, fell vacant. This was the celebrated Inigo Jones, who has been called the English Palladio; and, indeed, he succeeded so well in acquiring the peculiar manner of that architect, that he richly deserves whatever credit the appellation conveys. It is unfortunate, however, for his own reputation, that he had not looked beyond Palladio and their common preceptor Vitruvius to the models the latter pretends to describe; in which case he might have been the means of solving the question whether the truly classical architecture of the ancients could ever be introduced here with any advantage. But instead of that he brought nothing home but Italian rules and Italian prejudices. Jones commenced the truly Gothic custom of thrusting Cinquecento fittings into our Pointed cathedrals, by putting up an Italian screen in that of Winchester; and he barbarised the ancient cathedral of St Paul in London, by repairing it according to his notions of Pointed architecture, whilst at the same he defaced its exterior by affixing to it an Italian front. Of the Palladian style, however, he was a complete master. He designed a royal palace, which was to have been built at Whitehall, in a manner as far superior to those of Versailles and the Escorial as the works of Palladio are to those of Borromini. The only part of Jones's design ever executed is the structure called the Banqueting House, whose exterior is an epitome of many of the faults, and most of the beauties of the Palladian school. It rises boldly from the ground with a broad, simple, and nearly continuous basement, or stereobate, and the various compartments of its principal front are beautifully proportioned; but though the circular pediments to the windows, the attached unfluted columns, with broken entablatures and stylobates, the attic and balustrade, be the materials of Palladian, it may be confidently denied that they are consistent with classical, architecture. Another well-known work of this architect is the Italo-Vitruvian Tuscan church of St Paul, Covent Garden, whose eastern portico is well-proportioned in general, but grossly deformed in detail, and whose interior was left to take care of itself, having absolutely no charm either of proportion or detail.

Architecture was in abeyance in this country, again, from the troublous times of Charles I. till the restoration of the monarchy in the person of his son, whose French taste would have completely Gallicised the architecture of the nation, if the genius of Sir Christopher Wren had not been present to avert the infliction, or rather to modify it; for it cannot be denied that the influence of the French manner had an effect on the architecture of this country from that period down to the middle of the last century. Indeed, Wren himself knew the stylo he practised mainly from books and the structures of France; and, in consequence of his visit to France, the peculiarities of the French style are obvious in many of his less esteemed works. Fortunately, however, he was proof against the grosser peculiarities of the Cinquecento, whether in the books of the Italians or in the edifices of the French; and his own productions show that he had imbibed much of the spirit of the antique monuments of Italy, which he could have known only from engravings, and those very imperfect ones. The field that was opened to his genius by the great fire of London in 1666, and its result, are equally well known. It is true that the general absence of taste and feeling with regard to the Pointed style extended even to him. Wren was guilty of many offences in that respect, besides giving authority to the opprobrious term Gothic; and in no case more so than in the construction of the towers added to Westminster Abbey, which are a lasting proof of his ignorance of its most obvious principles. Nevertheless, to the influence of our beautiful native style on his mind the architecture of his period is indebted for some of its best works. If Wren had not been accustomed to contemplate the graceful and elegant pyramids or spires of his native country, he would never have originated the tapering steeple, in the composition of which with the materials of Italian architecture he still stands as unrivalled as he was original. Witness the steeples of Bow Church and St Bride's in London, the former of which is hardly surpassed in grace and elegance by the pointed spires themselves. It must remain a constant subject of curious speculation, what effect would have been produced on this great head of the English school of Cinquecento architecture if he had known the remains of ancient Greece and Rome from personal observation. With his splendid genius and fine taste, if he had not been imposed on by the specious pretence of the Italo-Vitruvian school, his works might have been models for imitation and study, as they are objects of admiration; as it was, he avoided many of the faults of that school, and improved on many of its beauties. Although he did not know the Greek style at all, and knew the Roman only through imperfect mediums, and, indeed, had never seen an example of either, whenever he has varied from the Italian practice it has been towards the proportions and peculiarities of the Greek! The great west front of St Paul's, though it is said to be imitated from that of St Peter's in Rome, or rather from what it was proposed to be, with the two towers to form its wings, is a much finer, a more imposing, and more classical specimen of architecture than its prototype; for the advantage the latter should have in being of columns in one height is lost entirely in their poverty, and in the miserable arrangement of the whole front, whereas that of St Paul's is in two noble pseudo-prostyle and recessed porticoes, with the columns fluted, and generally conceived and executed in much better taste than those of St Peter's. The entablatures, though massive, are finely proportioned, and sufficiently ornate to be elegant; they are, too, quite continuous, and the upper one is surmounted by a noble pediment, whose pyramidal form gives at the same time dignity and a finished appearance to the whole front. The coupling of the columns, however, and the putting of one columnar ordinance over another, can only be defended by the practice of the Italian school; though, in the present case, both are rendered less offensive by the judicious management of the architect. Nothing shows more strikingly the superiority of St Paul's to St Peter's as an architectural composition, than a parallel of their flanks. The great magnitude of the latter may strike the vulgar eye with admiration in the contrast; but the rudest taste must appreciate the surpassing merit of the former in the form and arrangement of the cupola, and the noble peristyle, with its unbroken entablature and stylobate, out of which it rises, when compared with the sharper form and depressed substructure of that of St Peter's. The superiority of St Paul's in the composition of the main body of the edifice is not less in degree, though, perhaps, less obvious, than in the superstructure. In the one it is broken and frittered, and in the other almost perfectly continuous, in broad, bold, and effective masses.

The history of the works of Sir Christopher Wren is the history of the architecture of the period in this country; and as it must be admitted that he was not so successful in the composition of the architecture of secular structures as of ecclesiastical, it will follow that our secular edifices of that time are of inferior merit. If it were not indeed an historical fact, it would hardly be credited that Chelsea College, the old College of Physicians in London, and the halls of some of the city companies, are by the architect of Bow Church and St Paul's.

The style introduced by Sir John Vanbrugh, who may be said to have succeeded Sir Christopher Wren in the direction of architecture in England, was distinguished by massiveness unsuited to the style in which he built, which was, of course, Italian. It was, however, free from the extravagances which characterise that style generally in other countries at the same period, but was certainly more suited to the soberer character of ecclesiastical than of secular structures, whereas his principal works were noblemen's mansions. Vanbrugh's faults were generally those of Michel Angelo; he was a painter architect, and did not understand beauty of proportion and detail so well as the pictorial arrangement of lights and shadows,—to produce which in the Cinquecento it is almost necessary to part with all the higher beauties of architecture. Hawksmoor added to the style of his master that noble ornament in which Italian works are so very deficient—a prostyle portico. His compositions are marked by severe simplicity, and only want to be absolved from a few faults and enriched with a few elegances to be among the best of modern times. Not the least distinguished architect of the same age (the first half of the 18th century) was the earl of Burlington, who was a passionate admirer of the style of Palladio and Inigo Jones. Many of the edifices erected by Kent are asserted to be from the designs of that nobleman, who, with considerable talent, was, however, a somewhat bigoted devotee to Vitruvius and the Cinquecento generally, as well as to Palladio in particular; for he frequently used columns representing half-barked trees in conformity with the silly tales of Vitruvius, and the sillier whims of his disciples. The portal of his own house in Piccadilly, and that of the King's Mews, were special examples of this bad taste, and of other faults of the school besides. Lord Burlington built for himself at Chiswick a villa on the model of the Villa Capra, or Rotonda, near Vicenza—a structure which has been called the master-piece of Palladio. In form and proportion it is certainly elegant, but its details strongly exhibit the poverty of Italian columnar architecture, when unaided by the frittering which is its bane, and almost its only element of effect. Gibbs, a contemporary, had, like Hawksmoor, imbibed a taste for the classic prostyle portico, which he evinced in St Martin's Church in London; but that he also was in the trammels of the Italian school is no less evident, in the same structure, to a considerable extent, and still more so in the church of St Mary in the Strand, which is a mediocre specimen of architecture, though a favourable one of its style. During the following half-century (the latter half of the 18th) Sir William Chambers and Sir Robert Taylor were the most distinguished architects of this country. They were both men of genius and skill, who had availed themselves of the remains of Roman antiquity to good purpose (for as yet those of Greece were either unknown or unappreciated), and the former has left us, in the Strand front of Somerset House in London, perhaps the best specimen of its style in existence. Other parts of the same edifice, however, are far from deserving the same degree of praise; indeed, as an architectural composition, the river front is altogether inferior in merit to the other, though of much greater pretence. The inner fronts to the great quadrangle, though exhibiting good parts, are, as a whole, not above mediocrity. An air of littleness pervades them; and the general effect of the fronts themselves is made still worse by the little clock towers and cupolas by which they are surmounted; and to this may be added the infinity of ill-arranged chimneys, which impart an air of meanness and confusion that nothing can excuse. While Sir William Chambers and a few others were applying the best qualities of Italian architecture, indeed, improving its general character, and, it may be said, making an English style of it, there were many structures raised in various parts of the country in a manner hardly superior to that of the time of James I.,—structures in which all the meanness and poverty of the Cinquecento are put forth, without any of its elegance of proportion, or that degree of effectiveness which men of talent contrived to give it. During the same period, too, the seeds of a revolution were sown, which almost succeeded in ejecting the Italian style and its derivative from this country, without perhaps having furnished a complete equivalent.

In the year 1748 James Stuart and Nicholas Revett, two painters pursuing their studies in Rome, having moreover paid some attention to architecture, issued "Proposals for publishing an accurate description of the Antiquities of Athens, &c." These proposals met with general approbation, and in consequence they determined on prosecuting their plan; but various hindrances prevented their arrival in Athens till March 1751, when they commenced measuring and delineating the architecural monuments of that city and its environs. In this work they were unremittingly employed (as far as their own exertions went, for they were frequently interrupted by the Turks) for several years, so that they did not reach England with the result of their labours until 1755; and, by a series of almost unaccountable delays, the first volume of their work did not appear until the year 1762. Sixteen years more expired before the second issued from the press; and the third was not published until 1794, being nearly fifty years from the time the work was first announced! In the meantime a Frenchman of the name of Le Roy, who was at Rome when our countrymen issued their proposals, had gone to Athens, and collecting in a very short time some loose materials, had published at Paris, in 1758, a work which he called *Les Ruines des plus beaux Monumens de la Grèce, &c.*, in which he makes not the slightest mention of Stuart and Revett, or of their labours or intentions, with all of which he was well acquainted. This work is, moreover, notoriously and grossly incorrect,—so incorrect, indeed, as to make it difficult of belief that its author ever saw the objects of which he professes to give the representations. It was, however, from M. le Roy's work that the public had to judge of the merits and beauties of Greek architecture; for the first volume of Stuart and Revett's *Antiquities* did not appear for several years after it, and that does not contain any pure specimen of the national or Doric style: the second, which does, was not published for twenty years after Le Roy's. Considering, therefore, the source of information on the subject, it can hardly be wondered at that Greek architecture was vituperated on all sides; and by none with greater acrimony than by Sir William Chambers, whose apology must be ignorance and the prejudices of education. He really did not know the style he carped at; and his education in the Italo-Vitruvian school had unfitted him for appreciating its grand, chaste, and simple beauties, even if he had known it. Notwithstanding the misrepresentations of Le Roy, the vituperations of Chambers, the established reputation of Italian architecture, and the trammels which Vitruvius and his disciples had fixed on the public mind, when Stuart and Revett's work actually appeared, the Greek style gradually advanced in esteem, by its intrinsic merits alone—for it has had no factitious aids; and since that period, Greece and all her colonies which possess remains of her unrivalled architecture have been explored, and we now possess correct delineations of almost every Greek structure which has survived, though in ruins, the wreck of time and the desolation of barbarism. To our country and nation, then, is due the honour of opening the temple of Greek architectural art, of drawing away the veil of ignorance which obscured the beauties it contains, and of snatching from destruction, and consequent oblivion, the noble relics of ancient architecture which bear the impress of the Grecian mind. Not only, indeed, were we the first to open the mine, but by us it has been principally worked; for among the numerous treatises on the Hellenic remains which now exist, by far the greatest number, and indisputably the most correct, are by Englishmen, and have been published in England. It required, however, a generation for the effects of ignorance and prejudice in some, and imperfect knowledge in others, to wear away before any effects of the study of the Greek style could be obvious in our structures. The works of the Adams, who were the contemporaries and immediate successors of Sir William Chambers, evince a taste for the beauties of Greek architecture, but a very imperfect knowledge, indeed, of the means of reproducing them. The architects who had the direction of our principal works during the earlier part of this century had the disadvantage of being pupils of those who were themselves, as we have shown, incompetent to appreciate the Greek style; and at a time, too, when the state of Europe prevented all access to the remains of Greece and Rome, so that no great improvement could perhaps be expected from them. Personal study of the monuments they wish to rival is the absolute duty of all architects, and it is possible that study even of the older examples may in all cases teach them some useful lesson. The structures of Egypt may show us how to arrange large masses harmoniously and effectively, those of Greece and Rome how to impart grace and dignity. The structures of Italy show us how far the materials of ancient architecture may be moulded to modern uses, while at the same time they give practical warning of what may result from the abuse of the most obvious principles of the art, and from the neglect of our national style or the requirements of our own country and climate, with which it is almost unnecessary to say it is quite impossible to harmonise the works of so entirely different a climate as that of Greece.

The difference between the representations of the Athenian antiquities by Stuart and his colleague, and the misrepresentations of them by Le Roy, appears to have opened the eyes of the world to those of ancient Rome, to see if they too had not been dealt with unjustly; for much more correct delineations of them had appeared than those of Palladio and Desgodets,—delineations of them as they exist, exhibiting the spirit of the originals, and not warped to the Vitruvian precepts, and thereby stripped of their best quality, truth. The excavation of the ancient cities of Herculaneum and Pompeii has opened to us much interesting and instructive matter, and their ruins have now been correctly delineated.

It is an argument in proof of the classical beauty of the Pointed style, that when the eyes of men were opened to the perfections of Greek architecture, they began to discover its merits also. Pointed architecture, under the opprobrious name Gothic, had long been a subject of discussion among antiquaries,—that is, essays were written by them to prove how the pointed arch originated, but none appreciated its beauties. Our Pointed cathedrals and churches were, after the example of Inigo Jones, ruthlessly barbarised in course of repairing and fitting them up. If an architect were employed to do anything about one of them, he appears to have thought it incumbent on him to convert it to the doctrines of his own faith—to Italianise it. Deans and chapters for the most part entrusted their commissions to country masons and plasterers, who also operated according to the laws of the "five orders." About the middle of the 18th century one Batty Langley endeavoured to draw the attention of the world to Pointed architecture, by reducing it to rules, and dividing it into orders. Fortunately he was only laughed at, and both he and the book he published on the subject were soon forgotten. One of the first men in rank and influence of his time, in matters of taste particularly, Horace Walpole, *patronised* Pointed architecture, but ineffectually. He had himself neither taste nor feeling to appreciate its beauties, as his Strawberry Hill clearly shows. Delineations were indeed put forth from time to time, but generally so rude and imperfect, that they did more harm than good. The Society of Antiquaries, however, at length took up the subject, engaged Mr John Carter, an ardent and judicious admirer of our national architecture, and commenced the publication of a series of splendid volumes, containing engravings of its best specimens, from drawings and admeasurements by him. The *Antiquities of Athens* had already done much to dispossess men of their prejudices, by showing that Greek architecture, though neither Vitruvian nor Palladian, was nevertheless beautiful; and the great work of the Society of Antiquaries did the same for Pointed architecture. Since the death of Mr Carter our national buildings have been studied, catalogued, drawn, and published by an infinity of admirers, who have done their work with zeal which has been thoroughly enthusiastic. The works of the elder Pugin were the first to show how architecture ought to be drawn, whilst the work of Mr Rickman was the first to show how it ought to be studied. From the time of these two pioneers in the work, it would be impossible to catalogue a hundredth of the works which have been devoted to the subject. Nor have they been written by architects only. On the contrary, a large number of them are the work of amateurs, and it may be truly asserted that never since art has been written upon at all have so vast a number of publications, on every branch of it, been given to the world as within the last thirty years have been devoted to the illustration and history of our national Gothic architecture. Germany and France have been equally prolific on the same subject, and the only difficulty now is, out of the mass of materials how to select that which is useful and to the point. In Spain and Italy no such zeal has been shown, and the elucidation of their mediæval antiquities has been left almost entirely to foreign hands.

Saracenic Architecture.

The beautiful forms by which Saracenic or Arabian architecture is best known were wrought into a style, if they were not invented, by the descendants of the wild Arab tribes who accepted Mahomet as their leader and prophet. In estimating their influence upon architecture,

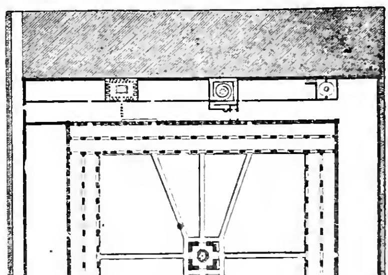


Fig. 46.—Plan of Mosque of Tooloon, Cairo. From Costo's *Architecture Arabe en Caire.*

the first point to be considered is whether the Arabs, as they emerged from their deserts and overran the rich countries of Syria, Persia, and Egypt, brought with them any art of their own, or whether they formed their style after their conquests were secured, when they had become great, and had consequently leisure and power to form it by the aid of foreigners. Now, in the Koran no notices are found that would lead us to suppose that any definite

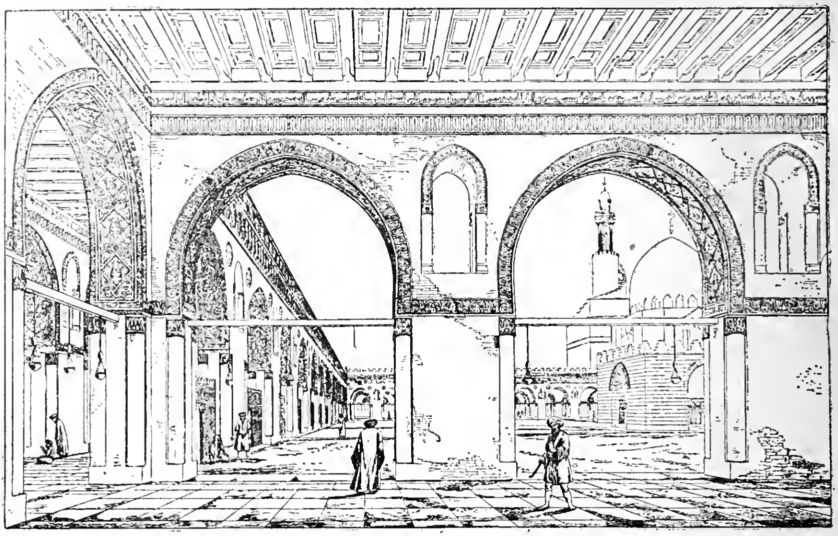


FIG. 47.—Court of the Mosque of Tooloon, Cairo. From Coste.

forms of art were known to the Arabs in early times. We gather also that the minaret, one of the most prominent and beautiful forms of their architecture, could not have been used in early times, since we are told that the call to prayers was then made from the roofs of the mosques.

The earliest example of a mosque in Arabia itself is supposed to have been that at Mecca, 705 A.D. But this was rebuilt in the 15th century, and that of Medina in the 16th, and we have no definite account of the original structures. The earliest of those which still exist are the Mosque of Amrou at Cairo (about 642 A.D.), and that of Damascus (705). Both of these were built of columns, &c., obtained by the destruction of Roman work.

In the Mosque of Tooloon at Cairo we find for the first time anything original. It was constructed about 879, and is said to have been designed by a Christian architect. Indeed, numerous passages in the early history of the Saracens seem to show that their architects and art workers generally were foreigners, attracted from Baghdad, Byzantium, and other places. It was the same throughout their progress in Spain as well as in Egypt; and however that style was eventually formed, which has given to us the beautiful domes and minarets of Cairo, the Alhambra in Spain, and the houses of Algiers, there can be little doubt but that it was based upon the art of Persia and Byzantium.

Ultimately it developed into two very distinct forms,—the Arabic of Cairo and the Moorish of Spain. But these still showed themselves, both in general form and in details, to be members of the same great family which we now call Saracenic. The chief structures in this style are the mosques and tombs. The former are very simple in plan, consisting, usually, of a mere open space with colonnades round and with a prayer niche (*mehrab*) in the side

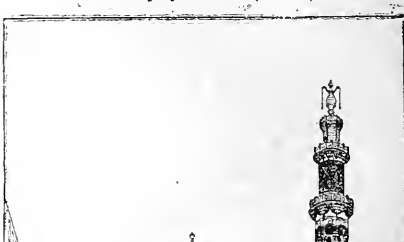


FIG. 48.—Exterior view of Kaid Bey Mosque, Cairo. From Coste.

towards Mecca. Near this was a pulpit (*mimbar*), and as this part of the edifice was of course the most frequented, the colonnades were made of extra depth. In the centre of the court was a fountain, just as in the atrium of the Christian basilicas; and conspicuously, sometimes at each corner of the mosque, was placed a minaret. The size of the whole and the number and richness of the columns might

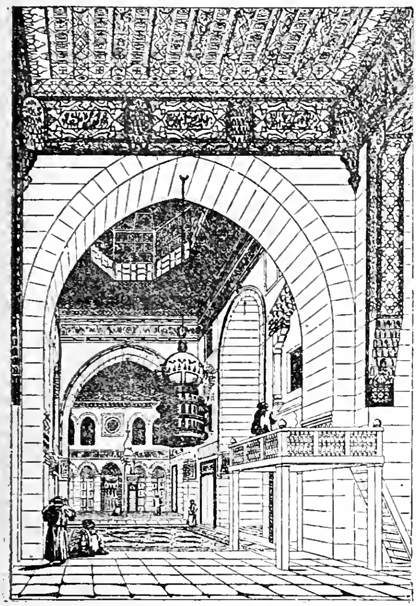


FIG. 49.—Interior view of Kaid Bay Mosque. From Coste.

vary, but the general arrangement was nearly always the same, the really essential parts being the prayer niche, the pulpit, the fountain, some protection against the burning noonday heat, and some elevated place from which the priest could call to prayers. A remarkable exception to the ordinary plan occurs in the celebrated Mosque Soultan Hassan at Cairo, which is in the form of a cross, the four arms being arched over, whilst the centre is left open and contains the usual fountain. Closely connected with the mosque is, often, the tomb of its founder. This is nearly always covered with a dome which, when on a large scale, was almost invariably a sign of a sepulchral edifice.

In these mosques and tombs we meet with general forms and details unknown elsewhere in Western art at the time of their erection. First of all we meet with the pointed arch. Very early in the style, and long before the era of Pointed architecture, this arch was used by the Saracens. But peculiar to their art are the beautiful minarets. Springing from a square base, they were gradually brought to an octagon or a round with a corbelled gallery at every change, and each part ornamented by diaper work of the most elaborate kind. The domes are equally varied and beautiful. They spring from a square base, and are gathered into the usual circular form in the most graceful manner. Quite opposite also to the Western mode, the external surfaces of the domes are sometimes decorated with diaper or other work, beautiful in itself and equally so in its application, and never is the Saracenic dome concealed outside by a conical roof. The want of a crowning cornice to the long lines of the walls was to some extent supplied by a peculiarly bold crest ornament often filled in with rich scroll or other work. A variety of these adorns many of the mediæval palaces of Venice. The ornamentation was almost entirely conventional, as the strict rules of the Koran forbade the copying of any natural objects. That this rule was not always followed may be seen in the Alhambra; but it, nevertheless, was in general attended to, and wonderfully beautiful were the results of this absence of all copying. Intricate scrollwork, flat in appearance on the surface, but really in various planes and intertwining, formed the usual basis. And from the scrolls came a sort of leafwork certainly like nothing in nature, but most graceful and varied in its elegant curves. The whole is utterly conventional—as entirely the creation of the artist's mind as the most conventional work of a Gothic architect. The capitals of the columns were usually some adaptation of the classic. But in Spain, as specially seen in the Alhambra, they were of quite an original type, somewhat like that which we have described as being the germ of the Ionic, but with long leaves under the block, tied together with a band at the top of the shaft.

One of the ornaments peculiar to the Saracens, and constantly used by them, was the honey-comb by which they brought the square base, which they almost always used on plan, into the circular dome or niche-head. It was, in fact, the Saracenic pendentive. In its simplest form it occurs very early in the style, as, *e.g.*, at the Mosque of Tooloon at Cairo, and was composed of a series of small niches, the pointed head of each of which bent forward at the top and formed the springing point of two others. The repetition of a few rows of this produced a pendentive in which it is impossible to detect any harsh point of junction between the square base and the circular finish. Sometimes this honey-comb work was exceedingly intricate, and formed niche-heads, roofs, &c. Good examples of this occurs at the Zisa, Palermo, and at the Alhambra. The entrance doorways were often grandly composed in a very high square recess, but the Saracens were as careful as the Gothic architects not to dwarf the size of the interior of their buildings by making the actual openings large, and thus the recess was brought down in height by elaborate work in the upper part, and the actual doorway thus reduced to just the size required for use. The windows were, of necessity, small, in order to guard against the heat; they were fitted up with thick bars of marble or of plaster, in elaborate diaper patterns,

FIG. 50.—Capital and Springing of Arch, from the Hall of Abencerrages, Alhambra.

these being filled in with pot metal glass, brilliantly coloured. The ceilings, when not domed, were flat, showing the timbers, which, in the finest examples, were richly painted and gilt, the wood being first canvased over, and then covered with a fine thin stucco to receive the decoration. The pavements were of marble mosaic, in some cases lighted up in colour by enamelled earthenware tesseræ. The walls were often lined with still more elaborate mosaic, the outlines being in some cases marked out with mother-of-pearl. Add to this that the pulpits, doors, and other

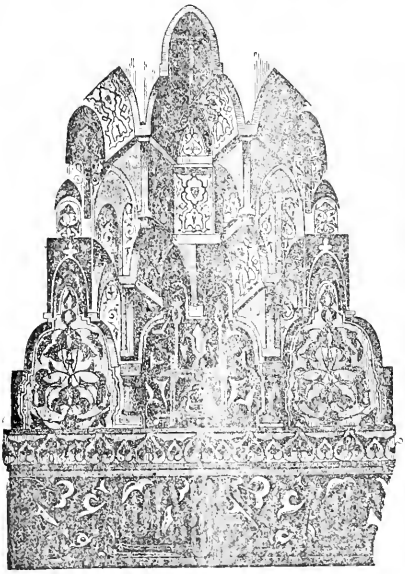


FIG. 51.—Pendentive, from the Court of the Lions, Alhambra.

woodwork were of the most exquisite workmanship, and the bronze hinges, &c., often chased in a manner scarcely to be paralleled in any other style, and we have a combination of outlines and details which could scarcely be surpassed in design or execution in buildings of a size comparatively so small. Admirable descriptions of Saracenic architecture in Spain have been given by the late Mr Owen Jones and M. Coste; of that in Egypt, also by M. Coste, and in India by Mr Fergusson. Of the houses in Egypt the best descriptions, probably, are those given in *The Modern Egyptians*, by Mr Lane, who has illustrated his work by numerous details of the carved wood and other work in which the Arabs excelled. Of the houses in Algiers, a peculiar class, an account is given by Professor Lewis in the *Transactions of the R. Institute of British Architects*, 1868-9.

It remains only to say that the present successors of the Saracens seem now to have lost nearly all claim to individuality in art, and to be unable even to copy or imitate the illuminated MSS., the mosaics, the carving in wood or in ivory, which lend so great a charm to the old work. What is now done is merely a copy, and a bad copy, of the work of their European neighbours.

CHINESE ARCHITECTURE.

The buildings of the Chinese are very inferior in character to those of India; in fact, Mr Fergusson goes so far as to say, "China possesses scarcely anything worthy of the name of architecture." Sir W. Chambers has described one of the Buddhist temples, that at Ho-nang, which is not unlike those of India in arrangement. There is an extensive court, with avenues of trees, leading to a

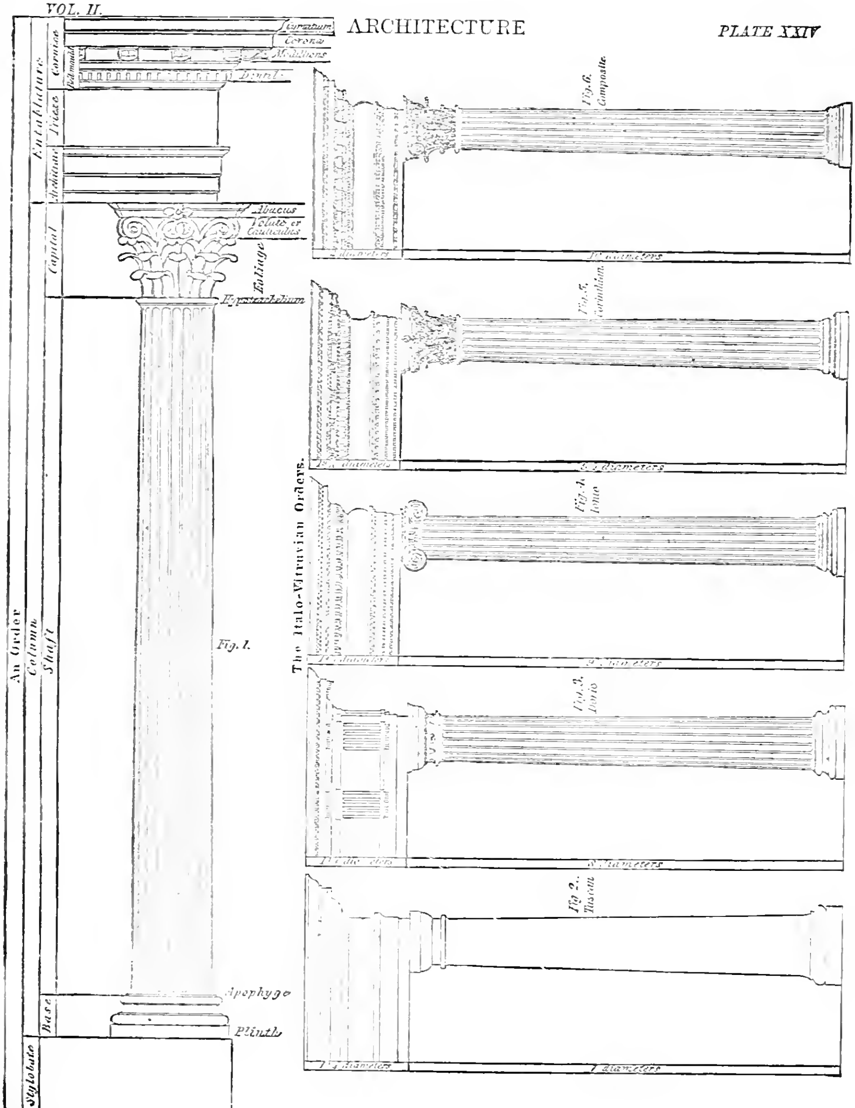
FIG. 52.—Temple of Confucius, Shanghai, China.

flight of steps and portico of four columns. In a second vestibule behind this are four colossal figures bearing various emblems. Beyond this is a very large second court, entirely surrounded by colonnades and small sleeping cells for the priests or *bonzes;* in other words, a huge cloister, much like the Indian viharas. In the same ranges are four pavilions filled with idols, and large rooms for refectories, behind which are the kitchen, courts, &c. At the extreme corners of the grand court are four other pavilions, the dwellings of the higher order of priests. At equal distances behind each other, down the centre of the court, are three larger pavilions, called *tings*, entered on each side by a flight of steps, and a fourth engaged in the cloister itself, and having a front portico and one flight of steps only. The first three are square, two stories in height, the lowest surrounded by fourteen columns, each face or front showing six. They have rude caps, composed of eight brackets, projecting various ways. Sir William Chambers says there are four species of *tings*,—three used for temples and the fourth for gardens; some having a gallery and fretted railing round the first floor on the outside, the upper story being set back. The roofs all have the peculiar hollow dip, which leads one to suppose their prototype was the tent, the sag of the cloth of which would suggest the form. They are frequently surmounted with a sort of cresting and finial, and each angle is turned up sharply, and ornamented with a dragon. Sometimes the columns have a frieze perforated in the form of frets; sometimes the same is also under the eaves of the upper roof. Examples are also given of smaller octagonal *tings*, intended to cover the large vessels in which the Chinese burn gilt paper to their idols.

Mr Simpson has given an interesting account of the temple of Heaven at Peking. It lies in an open space of about one mile square, surrounded by a triple enclosure. In this space were kept the animals destined for sacrifice. The temple proper consisted of several detached structures, the most sacred being to the south, and consisting of a

ARCHITECTURE

PLATE XXIV



raised platform approached by three terraces, and bearing simply an altar unscreened by any building and open to the sky. The northern structure was roofed but not enclosed.

FIG. 53.—Temple of Heaven, Peking.

Four pillars supported the main roof, which was 99 feet high, and lower roofs round the higher one were upheld by 24 columns of less height, all richly sculptured and gilt.

The accompanying illustrations (figs. 52 to 54) represent Chinese temples of different types.

The most striking buildings in China are, however, the tapering towers which they call *taas*, and our old writers pagodas. These are of brick covered with marble, or most generally with glazed tiles; and are built in stories, one over the other, from three, four, or five, to as many as nine in number. Each story is reduced in width, and has a gallery round it. The roofs are hollow or sagging, like those formerly described. They project a great deal, the corners being turned up sharply. On these light bells are suspended, which make a constant ringing when the wind blows. The roofs are covered with glazed tiles of various colours, and the summit ornamented with a species of spire and finial. The most celebrated of these was that known as the porcelain tower at Nanking. It had nine stories, and was about 200 feet high, exclusive of the iron spire. At each angle was a bell, making seventy-two in all; and there were eight chains hanging from the top of the finial to the angles of the spire, and carrying nine bells each, or seventy-two more. This celebrated building was destroyed by the Taepings in 1853. The *taa* is not a pagoda or temple, but a memorial of some event or of some great personage. At Peking is one used as an observatory, and at Nanganfoo one was erected simply to bring good luck.

Buildings called *Toov Tang*, or halls of ancestors, are found in all considerable towns. These much resemble temples, but instead of idols, memorial tablets are placed in the niches to record the transactions and deeds of the "worthies" or celebrated inhabitants of the neighbourhood.

The *Pai Loo*, or *Pai Fang*, is another common object in China. These are monumental memorials, though they have been mistaken for triumphal arches. Quatremère says, the Chinese annals reckon 3636 of these, erected in honour of literary men, philosophers, princes, generals, &c. The smaller are of wood, forming a sort of doorway. The larger have three openings side by side, and over these are several broad panelled fascias for inscriptions and carving, which is often very bold and in high relief, and over all is a projecting cornice carrying a tiled roof. Chambers has given one, the side gateways of which have semicircular arches, with festoons of drapery. The resemblance of these to the famous Sanchi tope is evident, as is also their

FIG. 54.—Temple of Agriculture, Peking.

being adaptations from wooden originals, for the stones are put together with mortices and other joints just as a wooden framework would be. The Chinese gateways are, however, very poor in comparison with those of India.

There is not much variety of design about the houses of the Chinese, as every one must be on a scale corresponding to the rank of the inhabitant. Le Comte mentions a case where a mandarin was obliged to pull down one that he had constructed of a somewhat better quality than those of the others. Chambers has given a plan of a house which he says is of very common design. It is about 260 feet from front to back, and about 65 feet wide. It is entered at the front by a passage nearly 20 feet wide, which goes nearly through the entire building. On each side of this, fronting the street, is a shop, with its back shop. It should be stated, that the divisions on the two sides of the central passage exactly correspond with each other. First we have two studies and two small bedrooms; then two saloons or reception rooms, about 24 feet by 18, looking into open courts or gardens, with fish ponds, fountains, flowers, &c., divided by walls; then two more saloons with bedrooms, and then the great dining-hall, which runs right across the house. This is about 60 feet by 30, and is carried on eight columns. Behind this is the kitchen and other offices. The first floor has two bedrooms, one on each side of a passage, for the shop-keeper; then on each side is a saloon and the bedrooms for the family. Between these last, and also carried on columns, is the hall where the family idol is worshipped. This overlooks the open gardens before mentioned. At the further end of these courts are two more saloons and bedrooms, and then a hall, said to be devoted to the use of strangers or visitors, which is over the ground floor dining-hall, and of the same size. Chambers tells us every house has a number of movable partitions kept ready, to be put up to subdivide the larger rooms.

The tombs are as singular as the rest of the Chinese edifices. The grandest of them, viz., those of the Ming dynasty, which ended in 1628, have been well described by Mr Simpson in the *Transactions of the R. I. B. A.*, 1873–4. One of these tombs is at Nanking, but the chief are about 40 miles north of Peking. The entry is by a grand Pai Loo of five gateways in white marble, and then through several other gateways to a singular dromos, nearly a mile long, of 32 colossal figures (ranged in pairs), some human, others of camels, griffins, elephants, &c. Such a dromos exists also at Shanghai. The tombs, thirteen in number, are ranged round the base of a hill and extend for several miles. Each consists of an earthen mound about half a mile in circuit, having, at its base, a crenellated retaining wall 20 feet high. The mound has no entrance, nor any indication of the exact place of burial. To the south of the tomb is a temple in an open court, about 1200 feet by 500. The plan is just the ordinary one of a palace, and the names, "The House of the living and the House of the dead," seem to show clearly that this resemblance was intended.

The Chinese method of construction is very peculiar. Their roofs are put up first, supported on wooden posts, which are removed as the permanent fabric is built. The walls of the grand edifices are of stone, but the ordinary material is brick, and the work is often executed with beautifully close joints. In palaces and temples the whole was often gorgeously coloured with glazed tiles, or the bricks themselves were coloured and glazed. A magnificent example of this is a temple near the summer palace at Peking, all of which is of bright majolica, except its marble base. As with all structures belonging to the emperor the colour was yellow, it being a capital offence for any other person to use that colour.

The Chinese never use square timber when they can get round trees of a suitable size, probably on account of the lightness, strength, and convenience of the bamboo. The roofs are of very peculiar construction, and all timbers are left visible. The windows are filled in with the lining of the oyster shell, which looks like talc, and is quite as transparent; and the main door is frequently a perfectly round aperture. The old buildings of the Chinese, like those of the Saracens, are fast going to decay, and the streets of even their grand capital, Peking, now exhibit immense ranges of ruined buildings.

Ancient American Architecture.

It was not long before the exhumation by Mr Layard, in Central Asia, of the wonderful remains of fine art entombed in earthen mounds, that Mr J. L. Stephens, when engaged on a mission from his Government—that of the United States of North America—to some of the mutable states

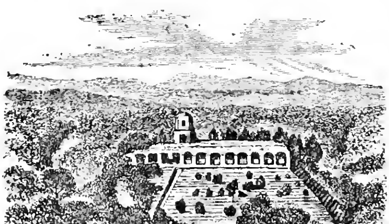


Fig. 55.—Ruins of *Teocalli* or Temple at Palenque.

of Central America, heard of and tracked out in the forests of Yucatan[1] the remains of a bygone time, exhibited in sculptural and architectural monuments of a coarse character, affording a strange counterpart to those which Mr Layard describes as having existed in and about the valleys of the Tigris and Euphrates. The remains of fifty or sixty cities have been discovered, the most interesting being those of Chololu, Palenque, Uxmal, Tescuco, and Mitla. The chief structures were evidently temples (*Teocallis*), raised high above the surrounding buildings on grand basements, square on plan, and rising by huge steps to the summit, so as to have the general outline of a low truncated pyramid. One at Palenque is 280 feet square at the base, and about 60 feet high to the platform, on which stands the temple, the latter being oblong on plan, measuring about 76 feet by 25. It was a low building, with a roof formed by stone gradini, so as to be, in fact, a continuation of the pyramid. Other structures, supposed to be palaces, are described by Mr Stephens, Mr Catherwood, Lord Kingsborough, &c., and copiously illustrated in their works. Many of them are very extensive, but of no great elevation. They are chiefly built on massive stone basements and surmounted by cornices, the friezes of which are adorned with evident imitations of logs of wood in upright rows. The greater part of the roofs were of wood, but among the objects represented in Mr Catherwood's *Views of Ancient Monuments in Central America, Chiapas, and Yucatan*, are several examples of vaults having the arch form, but not being arched vaults,—that is to say, of vaults presenting the appearance internally, or upon the soffit, of arches, but formed by the gathering over of horizontally-coursed masonry, with the inner and lower angles worked away—or cleaned off, as it is technically expressed—to the appearance on the inside which an arched vault would present.

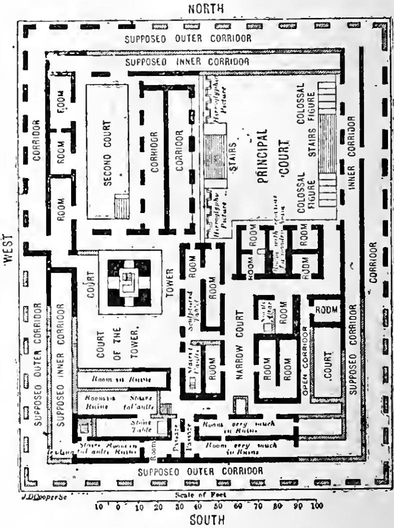


Fig. 56.—Plan of Temple at Palenque.

(See fig. 59.) The circumstance that the arch form presented in the American monuments is produced by the gathering over of horizontally-ranged masonry, and not by means of arch structure, would seem to show clearly that if the builders ever had intercourse with the Old World, it was before the properties of the arch were known and exemplified in it. These remains show an advance on the

[1] Lord Kingsborough's great work, *The Antiquities of Mexico*, contains in some of the later volumes, representations of monuments which would almost appear to be the same as some of those subsequently explored by Mr Stephens.

Pelasgic and Celtic monuments of the Old World, and

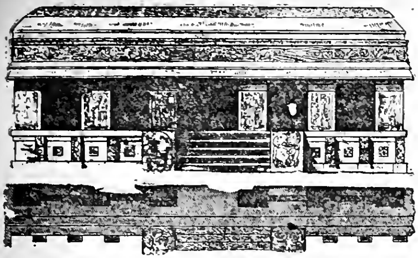


FIG. 57.—Elevation and Plan, from Palenque.

FIG. 58.—Bas-relief, Palenque. From Stephens and Catherwood.

take the general character of the stoneworks of Egypt and India; but like those works, they exhibit the vaulted form by gathering over and not by arching.

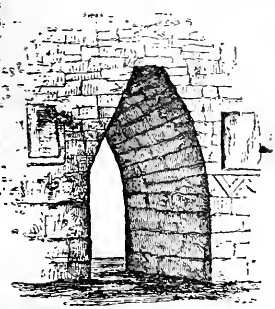


FIG 59.—Horizontally-Coursed Arch.

Mr Catherwood states that he and Mr Stephens concur in the opinion expressed by Mr Prescott, in his *History of the Conquest of Mexico*,—"that though the coincidences are sufficiently strong to authorise a belief that the civilisation of Anahuac (Ancient Mexico) was in some degree influenced by Eastern Asia, yet the discrepancies are so great as to carry back the communication to a very remote period, so remote that this foreign influence has been too feeble to interfere materially with the growth of what may be regarded, in its essential features, as a peculiar and indigenous civilisation;" and this opinion the monuments, as presented by Mr Catherwood, would seem fully to justify. But Mr Catherwood adds to this, as the ground, it would appear, for coinciding with Mr Prescott's opinion, that the results arrived at by Mr Stephens and himself "are briefly, that they (the American monuments) are not of immemorial antiquity, the work of unknown men; but that, as we now see them, they were occupied and probably erected by the Indian tribes in possession of the country at the time of the Spanish conquest, that they are the production of an indigenous school of art, adapted to the natural circumstances of the country, and to the civil and religious polity then prevailing; and that they present but very slight and accidental analogies with the works of any people or country in the Old World."

Less artistic, but more vast and massive, are the structures in Peru, which have been as yet imperfectly explored.

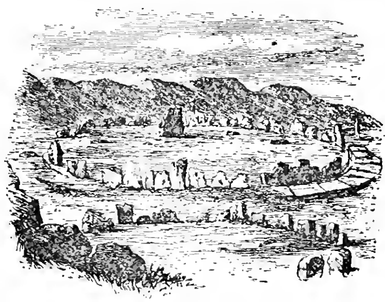


FIG. 60.—Stone Circles (*Intihuatanus*) at Sillustani. From Squier's *Peru*.

Referred by Mr Prescott to the reigns of the Incas, they are now considered to have been the works of a far earlier race,

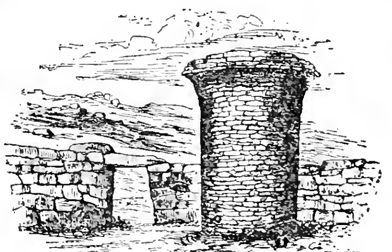


FIG. 61.—*Chulpa* or Burial Tower, Peru. From Squier.

of whom the Incas were the conquerors. The rudest of these early works are sepulchral, and much of the same kind as the cromlechs and stone-circles already referred to (p. 383). One circle at Sillustani is 90 feet diameter, another 150 feet, and they have a massive paved platform all round them outside, which is not found in similar remains in the Old World. The cromlechs are not covered merely by a flat stone, but are rudely domed over by overlapping stones.

A much more artistic class of tombs is built of stones in

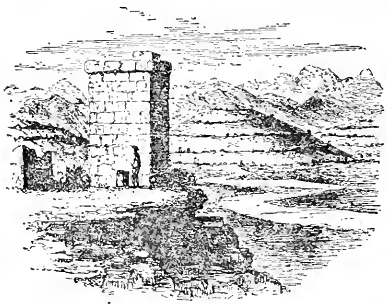


Fig. 62.—Square *Chulpa* or Burial Tower, Bolivia. From Squier.

the form of a tower, but *increasing* in width towards the top, and domed as above described. Most of them are round on plan, but some are square and two stories high, the upper being covered with overlapping stones cut to the arch shape. Many of these are of hard stone, beautifully fitted together, and the chambers are lined with a peculiar stucco still in good preservation.

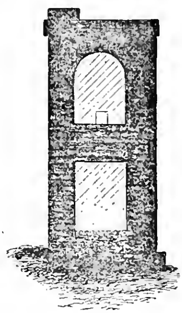


Fig. 63.—Section of Tower, fig. 62.

Some other sepulchral remains are on a much grander scale, being immense mounds held up by huge retaining walls. One of these mounds is 108 feet high, and 276 yards by 75 at the top. None seem to have been as yet explored. Of the fortresses one of the grandest examples is at Cuzco, 760 feet above the level of that city. It has three lines of fortifications in terraces 1800 feet long, the lower terrace having a retaining wall now 25 feet high, the second

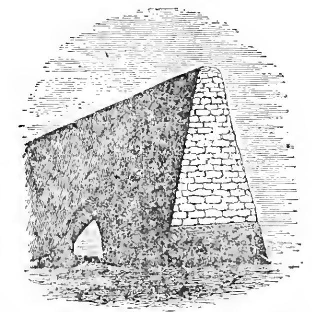


Fig. 64.—Cyclopean Wall at Chanchan. From Hutchinson's *Peru*.

30 feet behind the first) 18 feet, and the third (18 feet behind the second) 14 feet high. The walls are of cyclopean masonry, accurately fitted, one stone being 27 feet by 14 by 12, and many are 15 by 12 by 10 feet. The plan shows considerable skill, as the walls are not straight, but built with recesses and re-entering angles, evidently for giving the garrison command of the ground close to the walls. The most interesting remains in Peru are those called *Huacas;* but whether they were forts, or palaces, or tombs, is not as yet clearly ascertained. They are described as being enclosed by walls (in various examples 100 to 180 yards long, and 60 or 70 yards broad), and divided by cross walls, thus forming enclosures or chambers, many of which are still lined with stucco. In some of these are considerable remains of staircases, but the upper parts are destroyed. The chambers and enclosures are almost invariably filled with clay, which presents great difficulties in their examination. This filling in may, possibly, be accounted for by the construction of the walls, which are immensely thick (some at Chanchan are 15 feet), and usually of sun-dried bricks, either small (*adobes*), viz., about two-thirds the size of ours, or very large (*adobines*), some being 1 to 2 yards long.

Present Position of Architecture.

We have, in conclusion, a few remarks to make upon the present position of architecture. The increase of commerce and of wealth in the United Kingdom of late years, has thrown into the hands of the architect and engineer a vast amount of work, both for public and private edifices. Not only has there been an increase in the number of buildings, but the old parts of very many towns are being rebuilt on a larger and grander scale, and new, wide streets are being formed through their busiest and most densely peopled quarters. In London, in the great manufacturing towns of the north, in the universities, in the seaport towns, north and south, and in the pleasure-seeking cities on the sea-board on every coast, this process is going on at a rapid rate; and we look with interest and anxiety as to what are replacing the old buildings (many of them landmarks in our art) which have been destroyed, or what is to range beside those which are left. And besides these reconstructions, there are rising up, in every part of the country, railway stations, colossal hotels, baths and washhouses, working men's dwellings, and such other edifices as the Crystal and Alexandra Palaces, of a kind entirely unknown to the past generation. In addition to these we have the altogether new towns of Swindon, Wolverton, Crewe, Fleetwood, Barrow-in-Furness, Middlesborough, &c. These last afford, perhaps, the least encouraging view of modern work as contrasted with the old. Our old towns were usually picturesquely placed on the margin of a river for trade, or on a hill for defence; gradually increased round some nucleus of importance—a church or monastery or castle; and comprised the mansions of the rich as well as the shops of the trader and dwellings of the poor. But the modern town is all built at once, on some sudden call, on a site selected, perhaps, simply from its being at the junction of two railways. It shows only long straight streets of small dwellings for artisans, unbroken, except, perhaps, by a church, or an assembly-room, or more forcibly by the long, unpicturesque lines of railway sheds. Neither the architect nor the engineer has had much to do with this, and the result is about as wretchedly uninteresting a series of streets as it is possible to conceive. Horace Walpole's satirical description of London, "a gigantic mass of littleness," would apply well to them.

It has been better with the extension of the old towns. At first this gave us such long, bald lines of streets as Bath shows in stone, and Baker Street, &c., in London, in brick. These led by a natural result to a more ornate class, and we had the Regent's Park, and Regent Street, London, wherein a number of houses are grouped together into one mass, abounding with Roman columns and cornices, and receiving something of the massive appearance and lightness of stone from being covered with stucco, just as most of Palladio's buildings in Italy were. But whilst they were far better in general effect than the class which preceded them, the columns and their long unbroken lines of cornices often sadly interfered with the requirements of the dwellings, and in the new streets and terraces of our towns we see but few imitations of Roman porticoes and pediments, and the speculating builder mostly limits himself to putting a portico to the door, a few mouldings (in stucco) to the windows, and a slight cornice as a finish to the tops.

On the Continent the usual style of living—in flats—enables the builders to produce, with the same number of rooms, a more massive external effect than with us. One large entrance doorway suffices for the whole, and thus four or five separate houses (as they are in reality) have the effect of one large mansion. Still more is this the case when a courtyard, requiring a carriage entrance, occupies the centre of the building.

Of a far higher class than the private dwellings are many of the places of business recently erected in our great towns. In the new banks, exchanges, insurance offices, &c., many of our most noted architects have produced good results; and if we cannot congratulate ourselves upon much that is being done, we can, at least, say that the new work is an improvement upon the old. In no instance, perhaps, is the advance more to be noted than in the club-houses and the great warehouses for storing the lighter class of goods. A façade having long lines of windows, in many stories, each story of considerable height, and with only one main entrance doorway, affords the materials, of course, for forming a massive and pleasing effect much as that of the Continental houses above described. And the opportunity has certainly not been lost. Our plan, too, of letting each owner build to a considerable extent according to his own design, results in a more picturesque arrangement of our streets than those of a Continental town, which usually present lines of uninteresting houses, all of much the same design.

As a still further mark of progress we must mention the town-halls and other civic structures at Bradford, Halifax, Leeds, Liverpool, Manchester, Plymouth, Preston, &c., and the local museums and picture galleries, as at Cambridge, Edinburgh, Exeter, Leeds, Liverpool, Oxford, Salisbury, &c. Not only do these great civic buildings give importance by their magnitude to the towns, but they lead to other works in rivalry or imitation, just as a mediæval building of note did in olden times, and the goodness of their design is therefore a matter of prime importance. The museums are gradually helping to fill up a void most painfully felt by every stranger in our towns, and will help to preserve many local pieces of antiquity which would otherwise have been lost.

Of a higher class still are the colleges at Edinburgh, Glasgow, London, Manchester (Owens), &c., and many of the additions to those of the old universities. In these colleges the number of rooms of varying size, the entrance tower, and the internal quadrangles, allow of picturesque effects, but seldom present any one very grand mass. This has, however, been produced at University College, London, by the central portico (probably the finest in England), which rises high above the rest of the edifice.

In the civic buildings a bolder effect can be produced by their actual requirements, viz., a grand hall of large area and height, with spacious corridors and staircases, and a high clock tower, which seems to furnish the natural complement to such structures. If we have not rivalled Ypres, or Louvain, we have at least improved on the wretched civic buildings of the last century.

Larger and grander than any of the above works are the Houses of Parliament in London. However much of the detail may be open to criticism, it must be readily acknowledged that the architect had in his mind, and steadily carried out, the idea of combining the whole into one grand mass, in place of leaving it as a mere series of fronts, as in the Bank of England or Somerset House; and the variously designed steeples and towers culminating in the one grand tower at the royal entrance form the whole into one of the grandest buildings of the age.

Of a class unknown to the last generation are the railway stations, some of the largest edifices of the time, but usually almost hidden by another new class of buildings, viz., the colossal hotels. The stations themselves are in the main mere great vaults of glass on iron ribs, whose curved outlines are disfigured by the iron ties which the safety of a great extent of such roofing requires, and thus the only beauty, viz., the curved form, is to a large extent obscured. It is a fortunate circumstance that this form is the best adapted to the purpose, and when, as in many notable instances, the skill or good taste of the engineer has allowed of the ties being dispensed with, the vast size and lightness of the vault have a very impressive look. The hotels, which in most cases form the frontage of the stations in our country, are, for the most part, worthy of the striking positions which they occupy; but they are chiefly by living architects, and so beyond the scope of our criticism. No one, however, can study the way in which most of them are attached to the station buildings which they front without wishing most heartily that the engineer of the one and the architect of the other had worked somewhat more in harmony with each other.

Of an entirely novel design and construction was the Crystal Palace, admirably adapted, no doubt, for the purpose for which Paxton designed it, or for any other purpose for which a flood of light without impediment is required. But the manner in which the second, at Sydenham, has been altered is instructive. Where a grand orchestra was required the top was covered as a great sounding board, and when pictures or art works were to be exhibited the sides were closed,—the result showing plainly that the top lights are of the chief value, the side ones being little required except for the prospect through; and even for picture galleries a much smaller amount of light is required than in the Crystal Palace roof. Its curved form is, however, very pleasing, and the brilliancy of the light glass roof will ensure its being adopted in many buildings where a vivid light is required.

We have now passed hurriedly in review most of the forms of modern architecture, and we need scarcely add that it is developed in every conceivable style. If a church is to be built we may, indeed, pretty safely predict that it will be in one of the many pointed styles, but even then it may be English, French, or Italian. But of any other kind of edifice no one could safely predict the style. Probably it might be safe to assert that a theatre would not have (as Covent Garden in London had) a Grecian Doric portico, or an Egyptian pylon be made to do duty (as in Piccadilly, London) for a couple of shops. One might also be tolerably sure that a monument to a distinguished person would not be a granite column with a staircase up the middle, and a statue almost out of sight, with a lightning conductor through the head at top, as at the duke of York's column, London. But short of this, almost any prediction as to the style might come true; and as nearly every building of note throughout the world is brought to the eyes of the public by means of engravings or photographs, there seems little chance of its being otherwise.

In the United States the architects of the public build ings appear to be of much the same feeling as were English architects some years ago. The churches are often Gothic, but the other great edifices are in the main Italian, such as the capitols of Ohio, New York (Albany), and Washington. The last is a building of great size and picturesque outline, depending for its chief effect on the lavish use of porticoes and colonnades.

In Canada very much the same state of things exists as in the United States, the art in each being much the reflex of that in the old country.

The adoption of Greek, Roman, or Italian architectural details, little modified by climate and customs, is, in fact, to be noted in almost every country—any form of art peculiarly national being now abandoned in their favour; and if the houses in Paris were to be transported to Berlin or Cairo, they would simply agree with what has already been done in those cities. And if, further, the Bourse or the Pantheon at Paris, the Museum at Berlin, the Glyptothek at Munich, or the great church of St Isaac at St Petersburg, were to be severally changed to any of the other cities, it would be fairly in harmony with the modern works around it, though the nationality and language of the peoples in those cities are utterly distinct from each other. This abandonment of natural and peculiar styles is now producing another result quite foreign to anything known in art history before. From the earliest period known until the 17th century almost every nation had its own peculiar forms of art, and practised it (modified, perhaps, by the conditions of climate) in every part of the world which it colonised or conquered; and the result was the interesting remains of Roman art, clearly to be identified as such in Europe, Asia, and Africa; of Norman in France, England, Italy, and Sicily; and of Saracenic from Spain to India. This clear identification of a nation by its art works is as valuable to the historian as to the artist. But we can look for this no longer. We ourselves build Greek, Roman, or Italian palaces in our great towns of India, whilst close by, perhaps, is a church or cathedral in our English style of Gothic, and a college in the style of the Saracens, who themselves, centuries back, brought it with them as the art of foreign conquerors from Egypt or Persia. And the French in Algiers, to celebrate the triumph of their religion, erect a splendid church copied from the mosques of the people whom they have conquered, and whose religion they detest.

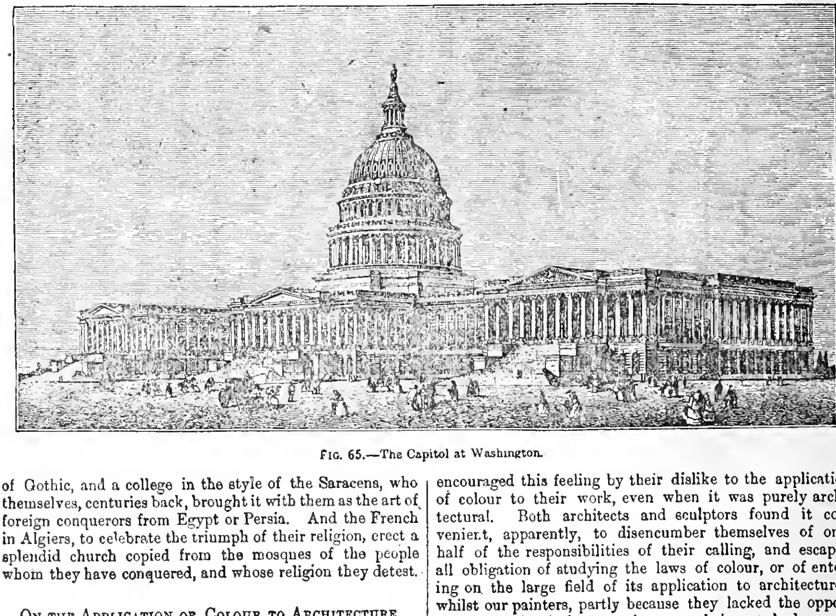


FIG. 65.—The Capitol at Washington.

ON THE APPLICATION OF COLOUR TO ARCHITECTURE.

On none of the subsidiary arts connected with architecture has there been in modern practice so little agreement with all ancient rules or customs as on this. It is only of late years that any one has conceded that the duty of architects is to give the best possible combination of form and colour, and that the completest form of architecture is that which affords examples of such a combination.

For the last three centuries architects have shown almost a contempt for colour, to such a degree, indeed, that the world till lately was taught to believe that purity of style and absence of colour always went together; and that it was only a vulgar and uneducated eye which saw the greatest evidence of good and matured taste in the harmonious application of colour and form. Our sculptors encouraged this feeling by their dislike to the application of colour to their work, even when it was purely architectural. Both architects and sculptors found it convenient, apparently, to disencumber themselves of one-half of the responsibilities of their calling, and escaped all obligation of studying the laws of colour, or of entering on the large field of its application to architecture; whilst our painters, partly because they lacked the opportunity, partly, it is true, because their art had ceased to be exercised for the public benefit in the old sense, had ceased to regard wall-painting as their legitimate work, and had so completely sunk into the habit of treating only small subjects in a small way, that it will take an age to develop in them the power of dealing properly with those large wall spaces which present them with the grandest opportunity of achieving real distinction. It it abundantly clear that those who argue against the application of colour to architecture, do so without the weight which the authority of their ancestors would have given them. Of late years much attention has been devoted to this point; there has been considerable discussion, and in the end, though there has been much difference of opinion as to the *extent* to which colour was applied by the Greeks and Romans, there has been none as to the fact that, at any rate, some introduction of colour was well-nigh invariable in their work. Mr Owen Jones's *Apology for the Colouring of the Greek Court* at the Crystal Palace contains, in a small compass, quite sufficient evidence to show how strong is the ground of those who maintain the necessity of colour in classic buildings; and equally valuable is the report, drawn up by the Committee of the Institute of British architects, on the colouring of the Elgin marbles, with Professor Faraday's analyses of portions of the coatings of marbles brought from several ancient buildings in Athens, upon all of which he makes it perfectly clear that colour was extensively and generally applied. Professor Semper of Berlin, in treating of the origin of architectural polychromy, proves that the Syrians, Persians, Egyptians, Chinese, Indians, Jews, Phœnicians, and Greeks all used colour in their architecture and sculpture, and we may safely conclude, therefore, that there is no country which has been in any way remarkable for its architectural monuments in which the necessity of the combination has been ignored or forgotten. This statement is sufficient on the subject so far as it affects all ancient schools of art.

If we turn to later times we shall discover in all the schools of mediæval artists a still greater and more pronounced adhesion to the same principle. It seems, indeed, almost superfluous to say that there are most abundant evidences of the fact that the architects of the Middle Ages were seldom satisfied until they had covered their walls with colour; in one place with that in which nature has been so lavish in marble and precious stones; in another with the artificial tints of tiles and bricks; in another with the bright stencilling of gay diapers over entire walls; or, lastly, in the teaching of Scripture story, or legend or history, by the aid of the greatest painters of the day.

If we look for an instant to Italy we shall see what a lesson these artists have left us there. There is, for instance, the Arena chapel at Padua, designed by Giotto, and then painted by him with his own hands in such fashion that, to the present day, this simple little room—some 20 feet by 40 in its dimensions—is one of the greatest pilgrimage places in Europe for all lovers of Christian art; and again, in that far grander work—the noble church so finely stationed on the steep slopes of the Apennines at Assisi—we see how Cimabue, Simone Memmi, Giotto, and many others, helped to cover with pictures, conceived in a really divine spirit, the walls which would otherwise, no doubt, have been resplendent with the less artistic, but still most effective labours of the patient stenciller. The same lesson is taught if we look at the Campo Santo of Pisa, and see how Andrea Orcagna, that great architect, painter, sculptor, and poet, and beside him a succession of artists, among whom we count Buffalmacco, Simone Memmi, Giotto, and Benozzo Gozzoli, helped each in their turn in this illumination of architecture; or at the church and refectory of Sta Croce, and the church and chapter-house of Sta Maria Novella, and the crypt of San Miniato, Florence; or at that masterpiece of decorative art—St Mark's at Venice—where precious marbles and mosaics rich in gold and bright colour almost dazzle the eye with their magnificence, but combine to make an interior in which none can fail to admit that the effect of the mere architecture of the building has been extraordinarily enhanced.

Nor was such practice as this peculiar to mediæval artists; for the earlier Renaissance men had the same feeling in some degree, and Benozzo Gozzoli has shown us in his exquisite paintings in the chapel of the Riccardi Palace at Florence, and Perugino and Raffaelle in the Stanze of the Vatican, how their work might be best adorned.

But it was not only in Italy—the land *par excellence* of colour—that men had a true appreciation of its value. It need hardly be told how St Louis, in the palmiest days of the French kingdom, covered the walls of the Sainte Chapelle of Paris with gold and colour and mosaic, and filled its windows with stained glass of the richest hues, so that to the present day it is an example of the most gorgeous colouring it is possible to conceive; or how, in England, when our monarchs wished to rival the zeal and enthusiasm of St Louis, they gave, in St Stephen's Chapel at Westminster, an example equally sumptuous and rich in colour: whilst at the same time, not only in our cathedrals, but in almost every parish church throughout our country, traces of more or less colouring are found to have existed over nearly the whole surface of the walls. Taking for granted, therefore, that every one will allow that it was, at any rate, the intention of all architects, as far as possible, to combine colour with form, it remains to be seen how this was accomplished.

There were two great and distinct orders of architectural colourists, the constructional and the decorative. The first were those who built their walls partially or altogether with coloured materials; the second those who so built them that colour might afterwards be added, and with an especial view to its introduction. It is of the works of the former of these two classes that it is right to speak first, because the way in which they did their work was, on the whole, a more thoroughly enduring and proper way than that of the other school. It was also more definitely the work of architects.

The works of the constructional school of architectural colourists must be subdivided into two classes:—1st, Those in which the coloured materials were part of the substance of the walls, and necessary for the stability of the whole fabric; and 2dly, Those in which the walls were covered with decoration, such as mosaic, or tiles, or thin veneers of marble, which had nothing whatever to do with their structural requirements.

The first class was that which was, on the whole, both the best and the most frequently adopted. The few examples which we see in this country, and, indeed, generally throughout the north of Europe, belong to it. The poverty of England in coloured stones or marbles will account sufficiently for the comparative rarity of the examples we can adduce. Among them are many of the Northamptonshire churches,—as Irchester, Strixton, and St Peter's, Northampton,—which are built with horizontal bands or courses of dark red and light stones used alternately; in other districts we find courses of stones and flint alternated, as in the church at Penton Mewsey, near Andover, and in a gateway at Rochester. In others flint and stone are used, but with inferior effect, in a regular chequer-work over the whole surface of the wall. In the church standing close to the north side of Rochester Cathedral, a course of chequer-work in flint and stone is introduced under one string-course, and two courses of flint separated by one of stone under another. The churches of Essex, Suffolk, and Norfolk abound in examples of tracery, and other devices formed by cutting out patterns in the stone, and filling them in with carefully-cut and faced flints of very dark colour, so as to produce a very elaborate system of decoration in two tints. In the cloisters of Westminster Abbey the groining is executed in chalk, with occasional lines of dark stone at regular intervals. Our red brick buildings are constantly diapered with patterns in black. The interiors of our churches, when not painted, were usually left with the natural colour of all the stone work—whether wrought or not—visible on the interior, an arrangement which, though rough and rugged in character, certainly gives a great amount of natural colour in a low key, but infinitely more agreeable to the eye than the cold expanse of plaster generally visible in new public buildings. Finally, throughout the 13th century the use of polished marble columns, of a colour much darker than that of the materials of the wall, is one of the most marked features in all the best English work, and cannot properly be omitted in any catalogue of modes of coloured construction. Every one of these arrangements is noticeable as having been introduced intentionally, and with a sole view to variety of colour. In France examples are much more numerous than in England, and the very interesting church at Vézelay is an early instance of the alternated use of dark and light stones in the interior as well as the exterior. Sta Maria in Capitolio, at Cologne, has some good remains of the same kind; and St Anne's Kloster, at Lübeck, is built with alternate courses of red brick and stone. It is in Italy, however, that we find the most plentiful store of examples of this kind of work, of which a few may be mentioned. The cathedral, baptistery, and the buildings generally in Pisa and Lucca are built, both inside and out, with white stone courses, with thin courses of black marble occurring at about every fourth course. This is a very delicate and effective mode of dividing the wall space. The baptistery and campanile of the cathedral at Pistoia, and the campanile of Siena, are built in almost equal courses of black and white. In Genoa we find the same equal division of the courses in the façades of the cathedral, and of the churches of San Matteo and San Stefano. At Bergamo the porch of Sta Maria Maggiore is executed in red, white, and grey marble. It is of three divisions in height, the highest stage being entirely of grey marble; the middle stage has all the moulded parts of red, and the arches and their spandrils of grey marble; the space at the back of the porch and over its main arch are built in equal courses of red and white marble; the groining is in black, red, and white marble, fitted to diamond-shaped panels, and all the shafts are of red marble. The whole design depends for effect almost entirely upon the arrangement and counter-changing of the three primary colours, the white becoming by age sufficiently yellow to take its place very well as one of them. Similar to this in the colours of its marbles is the 13th century front of the Broletto or town-hall at Como; but here the courses are very irregular in their height, and not arranged upon any symmetrical rule. The campanile of the cathedral at Florence is the last example of this class that need be mentioned, and it is the very finest of all; here the component colours are red marble of Perugia, green serpentine, and white marble (the two latter have the effect at a slight distance of being black and yellow), but these colours are further varied by the introduction of very elaborate patterns inlaid in delicate marble mosaic on almost every available space, whilst glass mosaic is introduced behind sculpture in the stages near the ground, in order to make the figures as distinct as possible. It is important to observe that, in this unsurpassed work, Giotto showed not only his sense of the value of colour, but equally his feeling for true architectural proportion. No building was ever more carefully designed in this way; and the result is so great a success in outline, in detail, and in colour, as to make it one of the most worthy of study of any work in Europe. Here it may be observed, that in the doorways of St Mark's, Venice, we have examples of exquisite beauty, of sculpture of foliage and figures in marble set off by a ground filled in entirely with mosaic, similar in idea to the way in which figures are set upon a mosaic ground in Giotto's work at Florence.

In the great church of San Petronio at Bologna, the flat space between the two stone moulded plinths is of red marble, and above the plinths the walls are all of red brick. This coloured plinth is very fine in its effect, and dignifies the whole building. The upper part of the Ducal Palace and the house called the Ca' d'Oro, at Venice, are examples of a coloured chequer-work over the whole surface of the wall. In the Ducal Palace this is arranged so as to form a regular diaper divided by lines of white and grey marble. The monument of Can Signorio, one of the Scaliger family, in the churchyard of Sta Maria l'Antica at Verona, is a good example of the successful application of coloured materials to works of delicate detail. It is a lofty erection, composed of a great canopied monument in the centre, with a number of smaller canopied niches rising out of it, or standing upon shafts around it. The base is all of red marble, the niches have red marble columns, white gables, and red pyramids above them. The central mass is mainly of a yellowish tint, with white marble niches and pinnacles of red marble, and, owing to the extent to which the colours are counterchanged, the effect is very good. The west doorway of Sta Anastasia, and the north doorway of San Fermo Maggiore, both at Verona, are beautiful examples of the simple alternation of white, red, and grey marbles in the jamb and arches; and in both these cases the extreme beauty of the effect appears to be owing to the delicacy and harmony of the tints of the marble employed, and to the absence of the very violent contrasts of colour which are sometimes seen.

There are other examples of buildings decorated with inlaid ornaments which belong to this class; such are some of the French churches, as, *e.g.*, those throughout the Puy de Dome, of which we may select as a typical example Nôtre Dame-du-Port, Clermont Ferrand. Here the lower part of the walls is of uniform colour, the windows have alternate voussoirs of light and dark stone, and the wall above them is entirely covered with a mosaic diaper; the walls are crowned by a heavy cornice supported on corbels, between each of which the space is filled in with a star in mosaic. Similar examples occur at S. Etienne, Nevers, in Poitou, on the banks of the Loire, and frequently in volcanic districts where dark and light materials, tufa and scoriæ, abound, and suggest the treatment which has been adopted. Some of the churches at Pisa are very beautifully and delicately enriched with inlaying. The little church of San Matteo has round all its arches inlaid chevrons, diamonds, or triangles, and a line of inlaying under the moulded eaves cornice of the aisle. The front of San Michele, also in Pisa, is covered with inlaid patterns filling in the spandrils, or following all the architectural lines of the arcading with which the whole upper portion is covered; similar inlaid patterns are to be seen between corbels under the tympanum of the south door of San Paolo, Pistoia. An inlaid pattern is carried along under the string-course below the aisle windows of the Cathedral of Lucca, and here, as in the other examples which have been given, the inlaid material is dark, on the white ground of the stone wall, and the object of its introduction was, no doubt, to give as much emphasis as possible to important features. In the case of the windows at Lucca the label is of dark marble, whilst the rest of the head of the window is white. In the church of San Domenico, Perugia, a window arch is built of grey stone, with occasional voussoirs of red, and on these, in order to make them as conspicuous as possible, small rosettes are carved. Another window in the same church has alternate voussoirs of red and white stone, and a red shaft for a monial. In the Palazzo Publico of Perugia the cornices and strings have ranges of corbels, the spaces between which are filled in with red marble to make the shadow deeper and more effective; in the windows, the shafts are of red marble; and in the doorway the tympanum is of red marble, with figures in white in front of it. The west front of Lucca Cathedral is inlaid in the most elaborate manner, the upper part with illustrations of field sports, and the lower part with geometrical patterns. Here, too, and in Giotto's campanile at Florence, the shafts themselves are inlaid in the same way as the rest of the work.

In the arcades outside the walls of San Fermo Maggiore, and in the windows of the little church opposite the cathedral, at Verona, great effect is produced by the ingenious combination of brick and stone; and throughout the north of Italy examples of this sort of arrangement of colour occur, and there is none more easy of imitation or reproduction with good effect at the present day and in our own country. In Sant' Antonio, at Padua, an arcade of brick and stone in the west front has all its spandrils filled in with red marble; and the case of the east end of the church at Murano will be remembered by all who have read Mr Ruskin's *Stones of Venice*. Here the substance of the walls is red brick for a few feet from the ground, and above that a rather coarse yellow brick; red brick is used in place of labels, &c., to define the arches; the shafts are of various marbles; and courses of marble, cut in triangles and alternately coloured and carved, are also introduced. The examples here given are enough to show, at any rate, the general prevalence of a love of colour in the Middle Ages throughout Europe.

It would be somewhat beyond the scope of the examination of such a subject from its architectural side to go at any length into the mode of decorative painting, which was almost universally adopted at the same time. In this application of colour all countries agree, and there is hardly room to doubt the beauty and expediency of the practice. The passage to the chapter-house at Salisbury, the early church of St Mary at Guildford, the chapels at the east end of Winchester Cathedral, are interesting English examples of early work. The Norfolk screens and roofs are still more interesting and beautiful works of the richest description, and so numerous were these that at one time no church seems to have been thought furnished which had none of this kind of decoration. These had every portion of their moulded surfaces adorned in the richest way with gold and colours, whilst their solid panels were covered with pictures of single figures or subjects. English roofs were decorated in the same fashion, and of these the finest examples are in Peterborough Cathedral and St Alban's Abbey. If we turn to the pages of illuminated manuscripts we shall find views of towns in which whole houses are decorated with masses of colour on the outside to distinguish them from their neighbours. And in rather later times, as we see in Florence, in Brescia, at Augsburg, at Meran, and often elsewhere, most brilliant effects were produced by painting subjects on the external walls of palaces and houses. But, generally speaking, beautiful as this sort of decoration was, it erred rather in ignoring to a considerable extent the architecture which it adorned,—unlike the earlier works, where the effort of the colourist was usually and rightly to make all the mouldings or members of the work decorated more distinct and intelligible than they can be in the absence of colour. Without coloured illustrations of an elaborate description it would be impossible to explain any or all the features of architectural polychrome. But enough has been said to show that the subject is one not only of interest to architects, but of importance to all who care for architecture, for it is hardly possible that works such as those which have here been shortly referred to should be passed over by the student or amateur of architecture as though they had no interest for us, and it may be confidently asserted that modern schools of architecture cannot with safety ignore so interesting a development of the art. (T. H. L.—G. E. S.)

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GLOSSARY OF ARCHITECTURAL TERMS (ESPECIALLY CLASSICAL AND MEDIÆVAL).

Abaciscus, diminutive of Abacus, applied to the chequers or squares of a tessellated pavement.

Abacus, from the Gr. ἄβαξ, a tray, or flat board, Ital. *abaco*, Fr. *tailloir*, the upper part of the capital of a column, pier, &c. (See separate article, and Capital.)

Abated, a term for such work in mediæval masonry as is worked down or sunk.

Abbey (Fr. *abbaye*, Ital. *abbadia*, or contracted, *badia*, Ger. *Abtei*, *Kloster*), a term for the church and other buildings used by conventual bodies presided over by an abbot or abbess, in contradistinction to *cathedral*, which is presided over by a bishop, and *priory*, the head of which was a prior or prioress. (See separate article.)

Acroterium (Gr. ἀκρωτήριον, the summit or vertex), a statue or ornament of any kind placed on the apex of a pediment. The term is often restricted to the plinth, which forms the podium merely for the acroterium.

Aisle, sometimes written Isle, Yle, and Alley (Lat. and Ital. *ala*, Fr. *aile*, *bas-coté*, Ger. *Seitenschiff*, *Seitenchor*), in its primary sense the wing of a house, but generally used to describe the alleys or passages at the sides of the naves and choirs of churches. (See separate article.)

Alcove, a recess in a room usually screened off by pillars, balustrade, or drapery.

Alien-Houses, religious houses in England belonging to foreign ecclesiastics, or under their control. They generally were built where property had been left by the donors to foreign orders to pray for their souls. They were frequently regular *priories*, but sometimes only *cells*, and even *granges*, with small chapels attached. Some, particularly in cities, seem to have been a sort of mission-houses. There were more than 100 in England. Many alien-houses were suppressed by Henry V., and the rest by Henry VIII.

Alley, also called Ambulatory (Lat *deambulatorium*), the covered passages round a cloister. (See also Alure.)

Almery, also Aumery, Aumbrie, and Ambry (Fr. *armoire*, Ital. *armario*), a recess in the wall of a church, sometimes square-headed, and sometimes arched over, and closed with a door like a cupboard—used to contain the chalices, basins, cruets, &c., for the use of the priest; many of them have stone shelves. They are sometimes near the piscina, but more often on the opposite side. The word also seems in mediæval times to be used commonly for any closed cupboard, and even bookcase.

Almonry (Lat. *eleemosinarium*, Fr. *aumonerie*, Ger. *Almosenhaus*), the place or chamber where alms were distributed to the poor in churches, or other ecclesiastical buildings. At Bishopstone Church, Wiltshire, it is a sort of covered porch attached to the south transept, but not communicating with the interior of the church. At Worcester Cathedral the alms are said to have been distributed on stone tables, on each side, within the great porch. In large monastic establishments, as at Westminster, it seems to have been a separate building of some importance, either joining the gatehouse or near it, that the establishment might be disturbed as little as possible.

Almshouses, small buildings for the residence of the aged poor, generally endowed with some yearly stipend. The greater portion were built after the Reformation. Two interesting early examples are—that at St Cross, near Winchester, and that near the Preaching Cross of the Black Friars at Hereford.

Altar, anciently written Auter, or Awter (Lat. and Ital. *altare*, Fr. *autel*), the elevated table devoted to the celebration of the Eucharist. (See separate article.)

Alure (Lat. *alura*—*allorium*, probably from *alatorium*), an alley, passage, the water way or flat gutter behind a parapet, the galleries of a clerestory, sometimes even the aisle itself of a church. The term is sometimes written *valure*, or *valoring*.

Amphiprostyle (Gr. ἀμφί, around or about, and *prostyle*, *q.v.*) A temple with a portico at each end is said to be amphiprostylar.

Angel-Lights, the outer upper lights in a perpendicular window, next to the springing; probably a corruption of the word angle-lights, as they are nearly triangular.

Annulet (Lat. *annulus*, a ring), a term applied to the small fillets or bands which encircle the lower part of the Doric capital immediately above the neck or trachelium.

Antæ (probably from the Gr. ἀντίος, or some other derivative of the preposition ἀντί, opposite to), the pier-formed ends of the walls of a building, as in the portico of a Greek temple. A portico is said to be *in antis* when columns stand between antæ, as in the temple of Theseus, supposing the peristyle or surrounding columns removed.

Ante-Chapel, a small chapel forming the entrance to another. There are examples at the Cathedral and at Merton College, Oxford, and at King's College, Cambridge, besides several others. The ante-chapel to the Lady chapel in cathedrals is generally called the Presbytery.

Ante-Choir, the part under the rood loft, between the doors of the choir and the outer entrance of the screen, forming a sort of lobby. It is also called the Fore-Choir.

Antefixæ (Lat. *ante*, before, and *fixus*, fixed), upright blocks with an ornamented face placed at regular intervals on a cornice. Antefixæ were originally adapted to close and hide the lower ends of the joints of the covering tiles on the roof of a temple.

Apophyge (Gr. ἀποφυγή, a flying off), the lowest part of the shaft of an Ionic or Corinthian column, or the highest member of its base if the column be considered as a whole. The apophyge is the inverted cavetto or concave sweep, on the upper edge of which the diminishing shaft rests.

Apse (Gr. ἁψίς, Lat. *absis*, *tribuna*, *concha*, Fr *abside*, *rond-point*, Ital. *apside*, *tribuna*, Ger. *Ablauf*), the semicircular or polygonal termination to the chancel of a church. (See separate article.)

Apteral (Gr. *a* priv., and πτερόν, a wing), a temple without columns on the flanks or sides.

Aræostyle (Gr. ἀραιός, rare or weak, and στῦλος, a column), a wide intercolumniation. (See Eustyle.) The space assigned to this term by Vitruvius is uncertain; the moderns assign to it four diameters.

Aræosystyle (compounded of *aræostyle* and *systyle*, *q.v.*) expresses the arrangement attendant on coupled columns, as in the western front of St Paul's Cathedral.

Arcade (Fr. *arcade*, *arcature*, Ital. *arcata*, Ger. *Bogengang*), a range of arches, supported either on columns or on piers, and detached or attached to the wall. (See separate article.)

Architrave (Gr. ἀρχή, chief, and Lat. *trabs*, a beam), the chief, beam—that part of the entablature which rests immediately on the heads of the columns and is surmounted by the frieze; it is also called the epistylium or epistyle. The moulded enrichment on the sides and head of a door or window is called an architrave.

ARCHIVOLT, a contraction of the Italian *architrave voltato*, is applied to the architrave moulding on the face of an arch, and following its contour.

ARMATURE, the French term for the iron stays by which the lead lights are secured in windows. (See STANCHIONS and SADDLE BARS.)

ARRIS, the sharp edge or angle in which two sides or surfaces meet.

ASHLAR, also written Ashler, Ashelere, &c., (probably from the Lat. *assella*), squared stones, generally applied to those used for facing walls. In a contract of date 1398 we read—"Murus erit exterius de pure lapide vocato *achilar*, plane incisso, interius vero de lapide fracto vocato *roghwall*." "Clene hewen" ashler often occurs in mediæval documents; this no doubt means tooled or finely scappled, in contradistinction to rough-axed, faces.

ASHLER PIECES, upright pieces of wood going from the common rafters so as to cut off the lower angle of the roof in the attic story.

ASTRAGAL (Gr. ἀστράγαλος, a bone of the ancle), a convex moulding. This term is generally applied to small mouldings, torus to large ones of the same form. (See TORUS.)

ATTIC, a low story above an entablature, or above a cornice which limits the height of the main part of an elevation. Although the term is evidently derived from Ἀττικός, we find nothing exactly answering to it in Greek architecture; but it is very common in both Roman and Italian practice. What are otherwise called tholobates in St Peter's and St Paul's Cathedrals are frequently termed attics.

BACK-CHOIR, a place behind the altar in the principal choir, in which there is, or was, a small altar standing back to back with the former.

BAHUT, the French term for a wall of plain masonry on which there is some superstructure.

BAILEY, said to be a corruption of *Ballium* by some, and derived by others from the French "baille," a corruption of "bataille," because there the soldiers were drilled in battle array; the open space between the inner and outer lines of a fortification. Sometimes there were more than one, as the Inner and Outer Bailey; we have the Old Bailey at London and at York, and the Upper and Nether Baileys at Colchester.

BALDAQUIN, BALDACCHINO. See CIBORIUM.

BALL-FLOWER, an ornament in the form of a ball inserted in the cup of a flower, which came into use in the latter part of the 13th, and was in great vogue in the early part of the 14th century. It is generally placed in rows at equal distances in the hollow of a moulding, frequently by the sides of mullions. The earliest known is said to be in the west part of Salisbury, where it is mixed with the tooth ornament. It seems to have been used more and more frequently, till at Gloucester Cathedral, in the south side, it is in profusion.

BALUSTER, a small column or pier supporting the coping in a pierced parapet: the parapet itself when pierced is hence called a *Balustrade*.

BALUSTER SHAFT, the shaft dividing a window in Saxon architecture. At St Alban's are some of these shafts, evidently out of the old Saxon church, which have been fixed up with Norman capitals.

BAND, a sort of flat frieze or fascia running horizontally round a tower or other parts of a building, particularly the base tables in perpendicular work, commonly used with the long shafts characteristic of the 13th century. It generally has a bold, projecting moulding above and below, and is carved sometimes with foliages, but in general with cusped circles, or quatrefoils, in which frequently are shields of arms.

BAND OF A COLUMN (Fr. *bague*), a series of annulets and hollows going round the middle of the shafts of columns, and sometimes of the entire pier. They are often beautifully carved with foliages, &c., as at Amiens. In several cathedrals there are rings of bronze apparently covering the junction of the frusta of the columns. At Worcester and Westminster they appear to have been gilt; they are there more properly called Shaft Rings.

BAPTISTERY, a separate building to contain the font, for the rite of baptism. They are frequent on the Continent—that at Rome near St John Lateran, and those at Florence, Pisa, Pavia, &c., are all well-known examples. The only examples in England are at Cranbrook and Canterbury—the latter, however, is supposed to have been originally part of the treasury.

BARBICAN, an outwork for the defence of a gate or drawbridge; also a sort of pent-house or construction of timber to shelter warders or sentries from arrows or other missiles.

BARGE BOARD. See VERGE BOARD.

BARTIZAN, supposed to be derived from the Ger. *Bartizene* (Fr. *échauguette*), a small turret, corbelled out at the angle of a wall or tower to protect a warder and enable him to see around him. They generally are furnished with oylets or arrow-slits.

BASE (Gr. Βάσις, Lat. *spira*, *basis*, Fr. and Ital. *base*, Ger. *Fuss*), that part of a column on which the shaft stands. The only base used by the Egyptians was a mere square plinth. The Assyrians evidently understood the value of a base as an architectural accessory, and some bases shown on the bas-reliefs are strongly moulded. But all actually remaining are like the one recently placed in the British Museum, which consists merely of a large torus. The Persian bases were finely moulded, elegant in outline, and more richly ornamented than in any other style. The chief mouldings are a torus, and a large reversed cyma. In pure Greek work a base is never used in the Doric, but always in the Ionic and Corinthian. The plainer sort is that well known as the Attic, consisting mainly of a hollow between two tori; but the tori are, in other instances, deeply channelled, so as to have a very complicated appearance. The Romans had bases to all their orders, the more usual form being like the Attic. The Romanesque and Norman bases were evidently copies, for the most part, from classic forms; but were often adorned with leaves at the angles of the square plinths, thereby leading them into the round in a very pleasing way. This was done still more elegantly in the Early English style, whose most characteristic base was much like the Attic, but with the hollow prolonged upwards in a deep water-holding section. The Perpendicular were mostly very high, formed with two or more plinths and bold mouldings, chiefly reversed ogees.

BASE COURT (Fr. *basse cour*, *i.e.*, the lower court), the first open space within the gates of a castle. It was used for exercising cavalry, and keeping live stock during a siege. (See ENCEINTE.)

BASE OF A WALL, or GROUND TABLE, mouldings round a building just above ground; they mostly consist of similar members to those above described (BASE), and run round the buttresses. The flat band between the plinth and upper mouldings is frequently panelled and carved with shields, as in Henry VII. Chapel at Westminster.

BASEMENT. A basement story is a story placed wholly or partly below the level of the ground on the outside of and about the building. Basement, applied specially, as architects apply it, means the compartment in the elevation of a building upon which any columnar pilastered or arcaded ordinance may rest; as in the Strand front of Somerset House, of which the basement begins at the level of the floor of the vestibule, being about that of the street pavement, and extends upwards to half the height of the adjoining building east and west.

BASILICA (Gr. βασιλική, *i.e.*, the royal house), a term given by the Greeks and Romans to the public buildings devoted to judicial purposes. (See separate article.)

BATEMENT LIGHTS, the lights in the upper part of a perpendicular window, abated, or only half the width of those below.

BATTER (Fr. *battre*, to beat). Building over in projecting courses like inverted steps is termed battering, gathering, or corbelling over. The term is often applied to the converse operation of throwing back, as in a revêtement or retaining wall.

BATTLEMENT (Fr. *bretesse*, Ital. *merlo*, Ger. *Zinne*), a parapet with a series of notches in it, from which arrows may be shot, or other instruments of defence hurled on besiegers. The raised portions are called *merlons*, and the notches *embrasures*, or *crenelles*. The former were intended to cover the soldier while discharging his weapon through the latter. Their use is of great antiquity; they are found in the sculptures of Nineveh, in the tombs of Egypt, and on the famous François vase, where there is a delineation of the siege of Troy. In ecclesiastical architecture the early battlements have small shallow embrasures at some distance apart. In the Decorated period they are closer together, and deeper, and the mouldings on the top of the merlon and bottom of the embrasure are richer. During this period, and the earlier part of the Perpendicular, the sides or cheeks of the embrasures are perfectly square and plain. In later times the mouldings were continued round the sides, as well as at top and bottom, mitring at the angles, as over the doorway of Magdalene College, Oxford. The battlements of the Decorated and later periods are often richly ornamented by panelling, as in the last example. In castellated work the merlons are often pierced by narrow arrow-slits. (See OYLET.) In South Italy some battlements are found strongly resembling those of old Rome and Pompeii; in foreign ecclesiastical architecture the parapets are very rarely embattled.

BAY (Fr. *travée*, Ital. *compartimento*, Ger. *Abtheilung*), any division or compartment of an arcade, roof, &c. Thus each space from pillar to pillar, in a cathedral, is called a bay, or severey.

BAY WINDOW, any window projecting outwards from the wall of a building, either square or polygonal on plan, and commencing from the ground. If they are carried on projecting corbels, they are called Oriel windows. Their use seems to have been confined to the later periods. In the Tudor and Elizabethan styles they are often semicircular on plan, in which case some think it more correct to call them Bow Windows. For those in mediæval halls, see DAIS, HALL.

Bead, a small cylindrical moulding of frequent use.

Bed-Mould, the congeries of mouldings which is under the projecting part of almost every cornice, of which, indeed, it is a part.

Belfry (Fr. *clocher*—if applied to a church, *beffroi*—if to the tower of a hotel de ville; Ital. *campanile*, Ger. *Glockenthurm*), properly speaking, a detached tower or campanile containing bells, as at Evesham, but more generally applied to the ringing room or loft of the tower of a church. (See Tower.)

Bell of a Capital. In Early English and Decorated work, immediately above the necking is a deep, hollow curve; this is called the bell of a capital. It is often enriched with foliages.

Bell-Cot, Bell-Gable, or **Bell-Turret.** The place where one or more bells are hung in chapels, or small churches which have no towers. Bell-cots are sometimes double, as at Northborough and Coxwell; a very common form in France and Switzerland admits of three bells. In these countries also they are frequently of wood, and attached to the ridge. Those which stand on the gable, dividing the nave from the chancel, are generally called Sanctus Bells. A very curious, and it is believed unique, example at Cleves Abbey juts out from the wall. In later times bell turrets were much ornamented these are often called Flèches.

Bema (Gr. βῆμα, Lat. *tribunal*), the semicircular recess or hexedra, in the basilica, where the judges sat, and where in after times the altar was placed. It generally is roofed with a half dome or *concha*. The seats, θρόνοι, of the priests were against the wall, looking into the body of the church, that of the bishop being in the centre. The bema is generally ascended by steps, and railed off by Cancelli.

Bench Table, the stone seat which runs round the walls of large churches, and sometimes round the piers; it very generally is placed in the porches.

Bezantée, a name given to an ornamented moulding much used in the Norman period, resembling bezants, coins struck in Byzantium.

Billet (Fr. *billette*), a species of ornamented moulding much used in Norman, and sometimes in Early English work, like short pieces of stick cut off and arranged alternately.

Blocking-Course, a deep but slightly projecting course in an elevation, to act as cornice to an arcade, or to separate a basement from a superior story. (See String-Course.)

Boss (Fr. *clef de voûte*, Ital. *bozza*, Ger. *Buckel*), an ornament, generally carved, forming the key-stone at the intersection of the ribs of a groined vault. Early Norman vaults have no bosses. The carving is generally foliage, and resembles that of the period in capitals, &c. Sometimes they have human heads, as at Nôtre Dame at Paris, and sometimes grotesque figures. In later vaulting there are bosses at every intersection.

Bowtell (supposed to be akin to *Bottle*), the mediæval term for a round moulding or torus. When it follows a curve, as round a bench end, it is called a Roving Bowtell, *q.v.*

Brace Mould, two ressaunts or ogees united together like a brace in printing, sometimes with a small bead between them.

Bracket (Fr. *corbeau*, *cul-de-lampe*, Ital. *mensola*, Ger. *Kragstein*), a projecting ornament carrying a cornice. Those which support vaulting shafts or cross springers of a roof are more generally called Corbels.

Brattishing or **Brandishing**, is no doubt derived from the French *breteche*, a sort of crest ridge on a parapet, or species of embattlement. The term, however, is generally employed to describe the ranges of flowers which form the crests of so many parapets in the Tudor period.

Broach (from *broche*, a spit), now used to designate a particular form of spire, the sides of which, with the angles of the tower, finish with a sort of haunching. (See Spire.)

Buttress, anciently written Botrasse, or Boterasse (Ital. *puntello*, Fr. *contrefort*, Ger. *Strebepfeiler*), masonry projecting from a wall, and intended to strengthen the same against the thrust of a roof or vault. Buttresses are no doubt derived from the classic pilasters which serve to strengthen walls where there is a pressure of a girder or roof timber. In very early work they have little projection, and in fact are "strip-pilasters." In Norman work they are wider, with very little projection, and generally stop under a cornice or corbel table. Early English buttresses project considerably, sometimes with deep sloping weatherings in several stages, and sometimes with gabled heads, as at Beverley. Sometimes they are chamfered, and sometimes the angles have jamb shafts, as in the last example. At Wells and Salisbury they are richly ornamented with canopies and statues. In the Decorated period they became richly panelled in stages, and often finish with niches and statues and elegantly carved and crocketted gablets, as at York. In the Perpendicular period the weatherings became waved, and they frequently terminate with niches and pinnacles.

Buttress, Flying (Fr. *arc-boutant*, Ital. *puntello arcuato*, Ger. *Strebebogen*), a detached buttress or pier of masonry at some distance from a wall, and connected therewith by an arch or portion of an arch, so as to discharge the thrust of a roof or vault on some strong point.

Buttress Shafts, slender columns at the angle of buttresses, chiefly used in the Early English period.

Cabling. The flutes of columns are said to be cabled when they are partly occupied by solid convex masses, or appear to be refilled with cylinders after they had been formed.

Caisson. See Cassoon.

Campanile, a name given in Italy to the bell tower of a town hall or church. In that country this is almost always detached from the latter. (See Belfry.)

Canopy, the upper part or cover of a niche, or the projecting ornament over an altar or seat or tomb. The word is supposed to be derived from *conopæum*, the gauze covering over a bed to keep off the gnats (κώνωψ), a mosquito curtain. Early English canopies are generally simple, with trefoiled or cinquefoiled heads; but in the later styles they are very rich, and divided into compartments with pendants, knots, pinnacles, &c. The triangular arrangement over an Early English and Decorated doorway is often called a canopy. The triangular canopies in the north of Italy are peculiar. Those in England are generally part of the arrangement of the arch mouldings of the door, and form, as it were, the hood-moulds to them as at York. The former are above and independent of the door mouldings, and frequently support an arch with a tympanum, above which is a triangular canopy, as in the Duomo at Florence. Sometimes the canopy and arch project from the wall, and are carried on small jamb shafts, as at San Pietro Martire at Verona. An extremely curious canopy, being a sort of horse-shoe arch, surmounting and breaking into a circular arch, from Tournay is given. Similar canopies are often over windows, as at York Minster over the great west window, and lower tiers in the towers. These are triangular, while the upper windows in the towers have ogee canopies.

Cant. When the corner of a square is cut off octagonally, it is said to be *canted*. Thus a bay window with octagonal corners is called a canted bay.

Capital (Gr. κεφάλαιον, Lat. *capitulum*, Ital. *capitello*, Sp. *chapitel*, Ger. *Knauff*, *Kapital*, Fr. *chapiteau*), the upper part of a column, pilaster, pier, &c. Capitals have been used in every style down to the present time. That mostly used by the Egyptians was bell-shaped, with or without ornaments. The Persians used the double-headed bell, forming a kind of bracket capital. The Assyrians apparently made use of the Ionic and Corinthian, which were developed by the Greeks, Romans, and Italians, into their present well-known forms. The Doric was apparently an invention or adaptation by the Greeks, and was altered by the Romans and Italians. But in all these examples, both ancient and modern, the capitals of an order are all of the same form throughout the same building, so that if one be seen the form of all the others is known. The Romanesque architects altered all this, and in the carving of their capitals often introduced such figures and emblems as helped to tell the story of their building. Another form was introduced by them in the curtain capital, rude at first, but afterwards highly decorated. It evidently took its origin from the cutting off of the lower angles of a square block, and then rounding them off. The process may be distinctly seen, in its several stages, in Mayence Cathedral. But this form of capital was more fully developed by the Normans, with whom it became a marked feature. In the Early English capitals a peculiar flower of three or more lobes was used, spreading from the necking upwards in most graceful forms. In Decorated and Perpendicular this was abandoned in favour of more realistic forms of crumpled leaves, enclosing the bell like a wreath. In each style bold abacus mouldings were always used, whether with or without foliage.

Carrels (Lat. *carola*), small chapels or oratories enclosed by screens; also sometimes the rails of the screens themselves; and sometimes the separate seats or pews for monks near the windows. It was at one time supposed that the scrolls on which inscriptions of texts, &c., are formed were called carrels, but this seems a mistake.

Caryatides, human female figures used as piers, columns, or supports. *Caryatic* is applied to the human figure generally when used in the manner of Caryatides.

Casement, a deep hollow moulding, sometimes filled with foliage, and then called a Vignette; also the frame which holds the lead lights of a quarrel-glazed window.

Cassoon, or **Caisson**, a deep panel or coffer in a soffit or ceiling. This term is sometimes written in the French form, *caisson*, sometimes derived directly from the Italian *cassone*, the augmentative of *cassa*, a chest or coffer.

Cathedral (Ital. *duomo*, *cattedrale*, Fr. *cathédrale*, Ger. *Domkirche*), the principal church where the bishop has his seat (*cathedra*) as diocesan. (See separate article.)

Cathetus (Gr. κάθετος, a perpendicular line). The eye of the volute is so termed because its position is determined, in an Ionic or voluted capital, by a line let down from the point in which the volute generates.

Cauliculus (Lat. a stalk or stem), the inner scroll of the Corinthian capital. It is not uncommon, however, to apply this term to the larger scrolls or volutes also.

Cavetto (Ital. *cavare*, to dig out), a moulding whose form is a simple concave, impending.

Ceiling (Ital. *soffito, soppalcho*, Fr. *plafond, lambris*, Ger. *Stubendecke*), that covering of a room which hides the joists of the floor above, or the rafters of the roof. Most churches have either open roofs, or are groined in stone. At Peterborough and St Albans there are very old flat ceilings of boards curiously painted. In later times the boarded ceilings, and, in fact, some of those of plaster, have moulded ribs, locked with bosses at the intersection, and are sometimes elaborately carved. In the cloisters at Lincoln, the nave and choir at York, the side aisles of the choir at Winchester, the church at Warmington, and several other places, there are ceilings formed of oak ribs, filled in at the spandrils with narrow thin pieces of board, in exact imitation of stone groining. In the Elizabethan and subsequent periods, the ceilings are enriched with most elaborate ornaments in stucco. (See Groined Vaulting.)

Cells, small monastic houses, generally in the country, belonging to large conventual buildings, and intended for change of air for the monks, as well as places to reside in to look after the lands, vassals, &c. Thus Tynemouth was a cell to St Albans; Ashwell, Herts, to Westminster Abbey. (See Grange.) Also the small sleeping apartments of the monks; also a small apartment used by the anchorite or hermit.

Chamfer, Champfer, or Chaumfer. When the edge or arris of any work is cut off at an angle of 45° in a small degree, it is said to be chamfered; if to a large scale, it is said to be a canted corner. (See Cant.) The chamfer is much used in mediæval work, and is sometimes plain, sometimes hollowed out, and sometimes moulded.

Chamfer Stop. Chamfers sometimes simply run into the arris by a plane face; more commonly they are first stopped by some ornament, as by a head; they are sometimes terminated by trefoils, or cinquefoils, double or single, and in general form very pleasing features in mediæval architecture.

Chancel, a place separated from the rest of a church by a screen (*cancellus*). The word is now generally used to signify the choir of a small church.

Chantry (Lat. *cantuaria*, Fr. *chantrerie*, Ger. *Kantorei*), a small chapel generally built out from a church. They generally contain a founder's tomb, and are often endowed places where masses might be said for his soul. The officiator, or mass priest, being often unconnected with the parochial clergy, the chantry has generally an entrance from the outside.

Chapel (Lat. and Ital. *capella*, Fr. *chapelle*, Ger *Kapelle*), a small, detached building used as a substitute for a church in a large parish; an apartment in any large building, a palace, a nobleman's house, an hospital or prison, used for public worship; or an attached building running out of and forming part of a large church, generally dedicated to different saints, each having its own altar, piscina, &c., and screened off from the body of the building.

Chapiter, the old English name for a Capital.

Chapter House (Lat. *capitolium*, Ital. *capitolo*, Fr. *chapitre*, Ger. *Kapitelhaus*), the chamber in which the chapter or heads of the monastic bodies assembled to transact business. They are of various forms; some are oblong apartments, as Canterbury, Exeter, Chester, Gloucester, &c.; some octagonal, as Salisbury, Westminster, Wells, Lincoln, York, &c. That at Lincoln has ten sides, and that at Worcester is circular; most are groined over, and some, as Salisbury, Wells, Lincoln, Worcester, &c., depend on a single slight vaulting shaft for the support of the massive vaulting. This picturesque plan is almost exclusively English.

Charnel House (Med. Lat. *carnarium*, Fr. *ossuaire*), a place for depositing the bones which might be thrown up in digging graves. Sometimes, as at Gloucester, Hythe, and Ripon, it was a portion of the crypt; sometimes, as at Old St Paul's and Worcester (both now destroyed), it was a separate building in the church-yard; sometimes chantry chapels were attached to these buildings. M. Viollet-le-Duc has given two very curious examples of *ossuaires*,—one from Fleurance, the other from Faouet.

Choir (Lat. *chorus*, Ital. *coro*, Fr. *chœur*, Ger. *Chor*, Old English, *quire, quere*), that part of a church or monastery where the breviary services or "horæ" are chanted.

Ciborium (Fr. *baldaquin*, Ital. *baldacchino*), a tabernacle or vaulted canopy supported on shafts standing over the high altar. Gervase of Canterbury calls every bay of the quire there a ciborium, probably because the groining rose and formed a sort of canopy over each bay.

Cinquefoil, a sinking or perforation like a flower of five points or leaves, as a quatrefoil is of four. The points are sometimes in a circle, as in the lower windows at Lincoln, and sometimes form the cusping of a head.

Cleithral (Gr. κλεῖθρον, an enclosed or shut-up place), is applied to a covered Greek temple, in contradistinction to *Hypæthral*, which designates one that is uncovered; the roof of a cleithral temple completely covers or encloses it.

Clerestory, Clearstory (Ital. *chiaro piano*, Fr. *clairevoie, claire étage*, Ger. *Lichtgaden*). When the middle of the nave of a church rises above the aisles and is pierced with windows, the upper story is thus called. Sometimes these windows are very small, being mere quatrefoils, or spherical triangles. In large buildings, however, they are important objects, both for beauty and utility. The window of the clerestories of Norman work, even in large churches, are of less importance than in the later styles. In Early English they became larger; and in the Decorated they are more important still, being lengthened as the triforium diminishes. In Perpendicular work the latter often disappears altogether, and in many later churches, as at Taunton, and many churches in Norfolk and Suffolk, the clerestories are close ranges of windows.

Cloister (Lat. *claustrum*, Ital. *chiostro*, Fr. *cloître*, Ger. *Kloster*), an enclosed square, like the atrium of a Roman house, with a walk or ambulatory round, sheltered by a roof generally groined, and by tracery windows, which were more or less glazed. (See separate article.)

Close, the precinct of a cathedral or abbey. Sometimes the walls are traceable, but now generally the boundary is only known by tradition.

Coffer, a deep panel in a ceiling.

Column (Lat. *columna*), a tapering cylindrical mass, placed vertically on a level stylobate, in some cases with a spreading congeries of mouldings called a base, and having always at its upper and smaller end a dilating mass called a capital. Columns are either insulated or attached. They are said to be attached or engaged when they form part of a wall, projecting one half or more, but not the whole, of their substance. For the columns of different styles and orders of architecture, see the general article, *supra*.

Consol or Console, a bracket or truss, generally with scrolls or volutes at the two ends, of unequal size and contrasted, but connected by a flowing line from the back of the upper one to the inner convolving face of the lower.

Coping (Ital. *coperto, corona*, Fr. *chaperon*), the capping (whence the name is probably derived) or covering of a wall. This is of stone, weathered to throw off the wet. In Norman times, as far as can be judged from the little there is left, it was generally plain and flat, and projected over the wall with a throating to form a drip. Afterwards it assumed a torus or bowtell at the top, and became deeper, and in the Decorated period there were generally several sets-off. The copings in the late Perpendicular period assumed something of the wavy section of the buttress caps, and mitred round the sides of the embrasure, as well as the top and bottom.

Corbel (from the low Latin *corbeyus*, a basket, Ital. *mensola*, Fr. *corbeau, cul-de-lampe*, Ger. *Kragstein*), the name in mediæval architecture for a piece of stone jutting out of a wall to carry any superincumbent weight. A piece of timber projecting in the same way was called a tassel or a bragger. Thus the carved ornaments from which the vaulting shafts spring at Lincoln are corbels. Norman corbels are generally plain. In the Early English period they are sometimes elaborately carved, as at Lincoln above cited, and sometimes more simply so, as at Stone. They sometimes end with a point apparently growing into the wall, or forming a knot, as at Winchester, and often are supported by angels and other figures. In the later periods the foliage or ornaments resemble those in the capitals. (See Capital.)

Corbel Table, a projecting cornice or parapet, supported by a range of corbels a short distance apart, which carry a moulding, above which is a plain piece of projecting wall forming a parapet, and covered by a coping. Sometimes small arches are thrown across from corbel to corbel, to carry the projection.

Corbie Steps, a Scottish term for the steps formed up the sides of the gable by breaking the coping into short horizontal pieces.

Cornice (Fr. *corniche*, Ger. *Kranz*), the projection at the top of a wall finished by a blocking-course, common in classic architecture. In Norman times, the wall finished with a corbel table, which carried a portion of plain projecting work, which was finished by a coping, and the whole formed a Parapet. In Early English times the parapet was much the same, but the work was executed in a much better way, especially the small arches connecting the corbels. In the Decorated period the corbel table was nearly abandoned, and a large hollow, with one or two subordinate mouldings, substituted; this was sometimes filled with the ball flowers, and sometimes with running foliages. In the Perpendicular style, the parapet frequently did not project beyond the wall-line below; the moulding then became a string (though often improperly called a cornice), and was ornamented by a quatrefoil or small rosettes set at equal intervals immediately under the battlements. In many French examples the moulded string is very bold, and enriched with foliage ornaments.

CORONA, a term applied to the deep vertical face of the projected part of the cornice between the bed-mould and the covering mouldings.

COVE—COVING. The moulding called the cavetto,—or the scotia inverted,—on a large scale, and not as a mere moulding in the composition of a cornice, is called a cove or a coving.

CRENELLE, a word generally considered to mean an embrasure of a battlement, but latterly proved to apply to the whole system of defence by battlements. In mediæval times no one could "crenellate" a building without special licence from his supreme lord. (See BATTLEMENT, EMBRASURE.)

CRESTING, an ornamental finish in the wall or ridge of a building, which is common on the Continent. An example occurs at Exeter Cathedral, the ridge of which is ornamented with a range of small *fleurs-de-lis* in lead.

CROCKET (Ital. *uncinetto*, Fr. *crochet*, *crosse*, Ger. *Häklein*, *Knollen*), an ornament running up the sides of gablets, hood-moulds, pinnacles, spires; generally a winding stem like a creeping plant, with flowers or leaves projecting at intervals, and terminating in a finial.

CROP (Ang.-Sax. *crop*), the top of anything. A word anciently used for a FINIAL, which see.

CROSS. This religious symbol is almost always placed on the ends of gables, the summit of spires, and other conspicuous places of old churches. In early times it was generally very plain, often a simple cross in a circle, as at Beverley. Sometimes they take the form of a light cross crosslet, or a cross in a square. In the Decorated and later styles they became richly floriated, and assumed an endless variety of forms. Of *memorial* crosses the finest examples are the Eleanor crosses, erected by Edward I. Of these a few yet remain, one of which has recently been re-erected at Charing Cross. *Preaching* crosses were often set up by the wayside as stations for preaching; the most noted is that in front of St Paul's. The finest remaining *sepulchral* crosses are the old elaborately-carved examples found in Ireland.

CROSS-AISLE, an old name for a transept.

CROSS-SPRINGER, the transverse ribs of a vault.

CROW-STEPS. See CORBIE STEPS.

CROW STONE, the upper stone of a gable; see also as last.

CRYPT (Lat. *crypta*, Ital. *volto sotterraneo*, Fr. *crypte*, Ger. *Gruft*), a vaulted apartment of greater or less size, usually under the choir. (See separate article.)

CUPOLA (Ital. *cupo*, concave, profound), a spherical or spheroidal covering to a building, or to any part of it.

CUSP (Fr. *feuille*, Ital. *cuspide*, Ger. *Knopf*), the point where the foliations of tracery intersect. The earliest example of a plain cusp is probably that at Pythagoras School, at Cambridge,—of an ornamented cusp at Ely Cathedral, where a small roll, with a rosette at the end, is formed at the termination of a cusp. In the later styles the terminations of the cusps were more richly decorated; they also sometimes terminate not only in leaves or foliages, but in rosettes, heads, and other fanciful ornaments.

CYCLOSTYLE (Gr. κύκλος, a circle, and στῦλος, a column). A structure composed of a circular range of columns without a core is cyclostylar; with a core the range would be a peristyle. This is the species of edifice called by Vitruvius Monopteral. (See MONOPTEROS.)

CYMA (Gr. κῦμα, a wave), the name of a moulding of very frequent use. It is a simple, waved line, concave at one end and convex at the other, like an Italic *f*. When the concave part is uppermost it is called a cyma-recta; but if the convexity appear above, and the concavity below, it is then a cyma-reversa.

CYMATIUM. When the crowning moulding of an entablature is of the cyma form, it is termed the Cymatium.

CYRTO-PROSTYLE. An alternation of CYRTOSTYLE (*q.v.*), but indicating more clearly than Cyrtostyle does an external projection.

CYRTOSTYLE (Gr. κυρτός, convex, and στῦλος, a column), a circular projecting portico. Such are those of the transept entrances to St Paul's Cathedral.

DADO or DIE, the vertical face of an insulated pedestal between the base and cornice or surbase. It is extended also to the similar part of all stereobates which are arranged like pedestals in Roman and Italian architecture.

DAIS (Fr. *dais*, *estrade*, Ital. *predella*), a part of the floor at the end of a mediæval hall, raised a step above the rest of the building. On this the lord of the mansion dined with his friends at the great table, apart from the retainers and servants. In mediæval halls there was generally a deep recessed bay window at one or at each end of the dais, supposed to be for retirement, or greater privacy than the open hall could afford. In France the word is understood as a canopy or hanging over a seat; probably the name was given from the fact that the seats of great men were then surmounted by such an ornament.

DECASTYLE (Gr. δέκα, ten, and στῦλος, a column), a portico of ten columns in front.

DENTIL (Lat. *dens*, a tooth). The cogged or toothed member, common in the bed-mould of a Corinthian entablature, is said to be dentilled, and each cog or tooth is called a dentil.

DEPRESSED ARCHES or DROP ARCHES, those of less pitch than the equilateral.

DESIGN. The plans, elevations, sections, and whatever other drawings may be necessary for an edifice, exhibit the design, the term *plan* having a restricted application to a technical portion of the design. (See PLAN.)

DETAIL. As used by architects, detail means the smaller parts into which a composition may be divided. It is applied generally to mouldings and other enrichments, and again to their minutiæ.

DIAMETERS. The diameters of the lower and upper ends of the shaft of a column are called its inferior and superior diameters respectively; the former is the greatest, the latter the least diameter of the shaft.

DIAPER (Ital. *diaspro*, Fr. *diaspré*, Ger. *Geblumte*), a method of decorating a wall, panel, stained glass, or any plain surface, by covering it with a continuous design of flowers, rosettes, &c., either in squares or lozenges, or some geometrical form resembling the pattern of a diapered table-cloth, from which, in fact (drap d'Ypres), the name is supposed by some to have been derived.

DIASTYLE (Gr. διά, through, and στῦλος, a column), a spacious intercolumniation, to which three diameters are assigned. (See EUSTYLE.)

DIPTEROS (Gr. δίς, twice, and πτερόν, a wing), a double-winged temple. The Greeks are said to have constructed temples with two ranges of columns all round, which were called dipteroi. A portico projecting two columns and their interspaces is of dipteral or pseudo-dipteral arrangement.

DISCHARGING ARCH, an arch over the opening of a door or window, to discharge or relieve the superincumbent weight from pressing on the freestone.

DISTEMPER. See FRESCO.

DISTYLE (Gr. δίς, twice, and στῦλος, a column), a portico of two columns. This term is not generally applied to the mere porch with two columns, but to describe a portico with two columns *in antis*.

DITRIGLYPH, an intercolumniation in the Doric order, of two triglyphs. (See TRIGLYPH.)

DODECASTYLE (Gr. δώδεκα, twelve, and στῦλος, a column), a portico of twelve columns in front. The lower one of the west front of St Paul's Cathedral is of twelve columns, but they are coupled, making the arrangement pseudo-dodecastyle. The Chamber of Deputies in Paris has a true dodecastyle.

DOG-TOOTH, a favourite enrichment used from the latter part of the Norman period to the early part of the Decorated. It is in the form of a four-leaved flower, the centre of which projects, and probably was named from its resemblance to the dog-toothed violet.

DOME (Gr. δῶμα, a structure of any kind, Lat. *domus*, a house or temple), a cupola or inverted cup on a building. The application of this term to its generally-received purpose is from the Italian custom of calling an archiepiscopal church, by way of eminence, *Il duomo*, the temple; for to one of that rank, the cathedral of Florence, the cupola was first applied in modern practice. The Italians themselves never call a cupola a dome: it is on this side of the Alps the application has arisen, from the circumstance, it would appear, that the Italians use the term with reference to those structures whose most distinguishing feature is the cupola, tholus, or (as we now call it) dome. (See CUPOLA.)

DONJON, the principal tower of a castle. (See KEEP.)

DORMER BEAM or DORMANT BEAM, said to be a tie-beam, but more probably, as its name imports, a sleeper.

DORMER WINDOW (Fr. *lucarne*, Ital. *abbaino*, Ger. *Dachfenster*), a window belonging to a room in a roof, which consequently projects from it with a valley gutter on each side. They are said not to be earlier than the 14th century. In Germany there are often several rows of dormers, one above the other. In Italian Gothic they are very rare; in fact, the former have an unusually steep roof, while in the latter country, where the Italian tile is used, the roofs are rather flat.

DORMITORY (Fr. *dortoir*, Ital. *dormitorio*, Ger. *Schlafgemach*), the place where the monks slept at night. It was sometimes one long room like a barrack, and sometimes divided into a succession of small chambers or cells. The dormitory was generally on the first floor, and connected with the church, so that it was not necessary to go out of doors to attend the nocturnal services. In the large houses of the late Perpendicular period, and also in some of the Elizabethan, the entire upper story in the roof formed one large apartment, said to have been a place for exercise in wet weather, and also for a dormitory for the retainers of the household, or those of visitors.

DOSSEL or DORSAL. See REREDOS

DRIPSTONE, the moulding or cornice which acts as a canopy to doors and windows. Horizontal running mouldings, are sometimes called tablets, and sometimes dripstones.

DROP ARCHES. See DEPRESSED ARCHES.

Dungeon, the prison in a castle keep, so called because the Norman name for the latter is donjon, and the dungeons or prisons are generally in its lowest story. (See Keep.)

Echauguette. See Bartizan.

Echinus (Gr. ἐχῖνος, an egg), a moulding of eccentric curve, generally cut (when it is carved) into the forms of eggs and anchors alternating, whence the moulding is called by the name of the more conspicuous. It is the same as Ovolo, *q.v.*

Element, the outline of the design of a Decorated window, on which the centres for the tracery are formed. These centres will all be found to fall on points which, in some way or other, will be equimultiples of parts of the openings. Before any one can draw tracery well, or understand even the principles of its composition, he must give much attention to the study of the element. (See Tracery.)

Elevation, the front *façade*, as the French term it, of a structure, a geometrical drawing of the external upright parts of a building.

Embrasure, the opening in a battlement between the two raised solid portions or merlons, sometimes called a crenelle. (See Battlement, Crenelle.)

Enceinte, a French term for the close or precinct of a cathedral, abbey, castle, &c.

Entablature, or **Intablature** (Lat. *in*, upon, and *tabula*, a tablet), the superimposed horizontal mass in a columnar ordinance, which rests upon the tablet or abacus of a column. It is conventionally composed of three parts, architrave, frieze, and cornice.

Entail, Entayle, sculptured ornaments, generally of rich design, most probably derived from the Italian *intaglio*.

Entasis, the swelling of a column, &c. In mediæval architecture, some spires, particularly those called "broach spires," have a slight swelling in the sides, but no more than to make them look straight; for, from a particular "deceptio visus," that which is quite straight, when viewed at a height, looks hollow.

Épi, the French term for a light finial, generally of metal, but sometimes of terra cotta, forming the termination of a pointed roof or spire.

Epistylium, or **Epistyle** (Gr. ἐπί, upon, and στῦλος, a column). This term may with propriety be applied to the whole entablature, with which it is synonymous; but it is restricted in use to the architrave or lowest member of the entablature.

Escape, an equivalent for the term Apophyge, *q.v.*

Escutcheon (Lat. *scutum*, Ital. *scudo*, Fr. *écusson*, Ger. *Wappenschild*), a term for the shields used on tombs in the spandrils of doors or in string-courses. Also the ornamented plates from the centre of which door-rings, knockers, &c., are suspended, or which protect the wood of the key-hole from the wear of the key. In mediæval times these were often worked in a very beautiful manner.

Estrade, a French term for a raised platform. (See Dais.)

Eustyle (Gr. εὖ, well, and στῦλος, a column), a species of intercolumniation, to which a proportion of two diameters and a quarter is assigned. This term, together with the others of similar import—pycnostyle, systyle, diastyle, and aræostyle—referring to the distances of columns from one another in composition, is from Vitruvius, who assigns to each the space it is to express. It will be seen, however, by reference to them individually, that the words themselves, though perhaps sufficiently applicable, convey no idea of an exactly defined space, and by reference to the columnar structures of the ancients, that no attention was paid by them to such limitations. It follows, then, that the proportions assigned to each are purely conventional, and may or may not be attended to without vitiating the power of applying the terms. Eustyle means the best or most beautiful arrangement; but as the effect of a columnar composition depends on many things besides the diameter of the columns, the same proportioned intercolumniation would look well or ill according to those other circumstances, so that the limitation of eustyle to two diameters and a quarter is absurd.

Façade. See Elevation.

Faite, the French term for the ridge of a roof.

Faitière, the ornament running along the ridge of a building (See Crestino.)

Fan Tracery. See Groined Vaulting.

Fascia (Lat. a band.) The narrow vertical bands or broad fillets into which the architraves of Corinthian and Ionic entablatures are divided are called fasciæ; and the term is generally applied to any similar member in architecture.

Feathering. See Cusp.

Femerell, properly **Fumerell**, a sort of lantern in the ridge of a hall (when the fire was in the middle of the floor and not in a chimney) for the purpose of letting out the smoke.

Fenestral, a frame or "chassis," on which oiled paper or thin cloth was strained to keep out wind and rain when the windows were not glazed.

Feretory, a sort of parclose which enclosed the feretrum, shrine, or tomb, as in Henry VII.'s chapel.

Fillet (Fr. *filet*, *listel*, Ital. *listello*, Ger. *Binde*), a narrow vertical band or listel, of frequent use in congeries of mouldings, to separate and combine them, and also to give breadth and firmness to the upper edge of a crowning cyma or cavetto, as in an external cornice. The narrow slips or breadths between the flutes of Corinthian and Ionic columns are also called fillets. In mediæval work, the fillet is a small, flat, projecting square, chiefly used to separate hollows and rounds, and often found in the outer parts of shafts and bowtells. In this situation the centre fillet has been termed a keel, and the two side ones wings; but apparently this is not an ancient usage.

Finial (Fr. *fleuron*), the flower or bunch of flowers with which a spire, pinnacle, gablet, canopy, &c., generally terminates. Where there are crockets, the finial generally bears as close a resemblance as possible to them in point of design. They are found in early work where there are no crockets. The simplest form more resembles a bud about to burst than an open flower. They soon became more elaborate, as at Lincoln, and still more, as at Westminster and the Hotel Cluny at Paris. Many Perpendicular finials are like four crockets bound together. Almost every known example of a finial has a sort of necking separating it from the parts below. (See Épi.)

Flamboyant, a name applied to the Third Pointed style in France (*ogive tertiale*), which seems to have been developed from the Second, as our Perpendicular was from the Decorated. The great characteristic is, that the element of the tracery flows upwards in long wavy divisions like flames of fire. In most cases, also, every division has only one cusp on each side, however long the division may be. The mouldings seem to be as much inferior to those of the preceding period, as our Perpendicular mouldings were to the Early English, a fact which seems to show that the decadence of Gothic architecture was not confined to one country.

Flèche (Ital. *aguglia*), a general term in French architecture for a spire, but more particularly used for the small slender erection rising from the intersection of the nave and transepts in cathedrals and large churches, and carrying the sanctus bell.

Flute, a concave channel. Columns whose shafts are channelled are said to be fluted, and the flutes are collectively called flutings.

Foliation. See Cusp.

Font, the vessel used in the rite of baptism. The earliest extant is supposed to be that in which Constantine is said to have been baptised; this is a porphyry *labrum* from a Roman bath. Those in the baptisteries in Italy are all large, and were intended for immersion; as time went on, they seem to have become smaller. What they were in Saxon times is uncertain, though it is not improbable that some of the plain examples, called Norman, may have been of earlier date. Norman fonts are sometimes mere plain, hollow cylinders, generally a little smaller below than above; others are massive squares, supported on a thick stem, round which sometimes there are smaller shafts. In the Early English this form is still pursued, and the shafts are detached; sometimes, however, they are hexagonal and octagonal, and in this and the later styles assume the form of a vessel on a stem. Norman fonts have frequently curious carvings on them, approaching the grotesque; in later times the foliages, &c., partook absolutely of the character of those used in other architectural details of their respective periods. The font is usually placed close to a pillar near the entrance, generally that nearest but one to the tower in the south arcade, or, in large buildings, in the middle of the nave, opposite the entrance porch, and sometimes in a separate building. (See Baptistery.)

Foot-Stall, a word supposed to be a literal translation of *piédestal*, or pedestal, the lower part of a pier. (See Base, Patin.)

Formeret, the half ribs against the walls in a groined-ceiling.

Fratery, Frater House, supposed to be the hall where the friars met for dinner or other purposes; the same as *refectory* among the monks.

Free-stone (Fr. *pierre de taille*, Ital. *pietra molle*), stone used for mouldings, tracery, and other work required to be executed with the chisel. The oolitic stones are generally so called, although in some countries the soft sandstones are so used, and in some churches an indurated chalk called clunch is employed for internal lining and for carving.

Fresco, the method of painting on a wall while the plastering is wet. The colour penetrates through the material, which therefore will bear rubbing or cleaning to almost any extent. The transparency, the chiaroscuro, and lucidity, as well as force, which can be obtained by this method, cannot be conceived unless the frescoes of Fra Angelico or Raffaelle are studied. The word, however, is often applied improperly to mediæval delineations in ancient churches, which are only painted on the surface in distemper or body colour, mixed with size or white of egg, which gives them an opaque effect.

Frieze (Ital. *fregio*, from the Lat. *Phrygionius*, enriched or embroidered), that portion of an entablature between the cornice above and the architrave below. It derives its name from being the recipient of the sculptured enrichments either of foliage or figures which may be relevant to the object of the structure. The frieze is also called the ZOÖPHORUS, *q.v.*

FRONTISPIECE, the front or principal elevation of a structure. This term, however, is generally restricted in application to a Decorated entrance.

FUMEREL. See FEMERELL.

GABLE, sometimes *Gavil* (Fr. *pignon*, Ital. *colma*, Ger. *Giebel*). When a roof is not hipped or returned on itself at the ends, its ends are stopped by carrying up the walls under them in the triangular form of the roof itself. This is called the gable, or, in the case of the ornamental and ornamented gable, the pediment. Of course gables follow the angles of the slope of the roof, and differ in the various styles. In Norman work they are generally about half pitch; in Early English, seldom less than equilateral, and often more. In Decorated work they become lower, and still more so in the Perpendicular style. In all important buildings they are finished with copings or parapets. In early times the copings were nearly flat. In the later styles gables are often surmounted with battlements, or enriched with crockets; they are also often panelled or perforated, sometimes very richly. The gables in ecclesiastical buildings are mostly terminated with a cross; in others, by a finial or pinnacle. In later times the parapets or copings were broken into a sort of steps, called *corbie steps*. In buildings of less pretension, the tiles or other roof covering passed over the front of the wall, which then, of course, had no coping. In this case the outer pair of rafters were concealed by moulded or carved verge boards. (See BATTLEMENT, COPING, CORBIE STEPS, PARAPET, VERGE BOARD, &c.)

GABLE WINDOW, a term sometimes applied to the large window under a gable, but more properly to the windows in the gable itself.

GABLED TOWERS, those which are finished with gables instead of parapets, as at Sompting. Many of the German Romanesque towers are gabled.

GABLETS, triangular terminations to buttresses, much in use in the Early English and Decorated periods, after which the buttresses generally terminate in pinnacles. The Early English gablets are generally plain, and very sharp in pitch. In the Decorated period they are often enriched with panelling and crockets. They are sometimes finished with small crosses, but oftener with finials.

GALILEE. This name is said to be derived from the Scriptural expression, "Galilee of the Gentiles." Galilees are supposed to have been used sometimes as courts of law, but chiefly for penitents not yet admitted to the body of the church. At Durham the galilee is a chapel at the main entrance into the nave.

GALLERY, any long passage looking down into another part of a building, or into the court outside. In like manner, any stage erected to carry a rood or an organ, or to receive spectators, was latterly called a gallery, though originally a loft. In later times the name was given to any very long rooms, particularly those intended for purposes of state. (See LOFT, TRIFORIUM.)

GARGOYLE or GURGOYLE (Fr. *gargouille*, *canon*, *lanceur*, Ital. *doccia di gronda*, Ger. *Ausguss*), the carved termination to a spout which conveyed away the water from the gutters, supposed to be called so from the gurgling noise made by the water passing through it. Gargoyles are mostly grotesque figures.

GARRETTING, properly GALLETTING, from gallet, a small piece of stone chipped off by the chisel. A method of protecting the mortar joints in rough walls by sticking in chips of stone while the mortar is wet.

GATE-HOUSE, a building forming the entrance to a town, the door of an abbey, or the enceinte of a castle or other important edifice. They generally had a large gateway protected by a gate, and also a portcullis, over which were battlemented parapets with holes (machicolations) for throwing down darts, melted lead, or hot sand, on the besiegers. Gatehouses always had a lodge, with apartments for the porter, and guard-rooms for the soldiers; and generally rooms over for the officers, and often places for prisoners beneath. They are sometimes open in the rear, as at Cooling Castle, and often have doors with portcullises, &c., on both sides, in case the enemy should scale the walls, and attack them both in front and rear. In this case, the space between, on the ground floor, was generally groined over, with holes for missile weapons.

GLYPH, a vertical channel in a frieze. (See TRIGLYPH.)

GRADINO (Ital. dim. of *gradus*, a step). Architects frequently apply the plural of this term, *gradini*, to such series of great steps as are found at the mausoleum at Halicarnassus.

GRANGE, a word derived from the French, signifying a large barn or granary. They were usually long buildings with high wooden roofs, sometimes divided by posts or columns into a sort of nave and aisles, and with walls strongly buttressed. In England the term is applied not only to the barns, but to the whole of the buildings which formed the detached farms belonging to the monasteries; in most cases there was a chapel either included among these or standing apart as a separate edifice.

GRIFFE, a French term for an ornament at the angles of the base of early pillars, for which we have no proper equivalent. It first consisted of a single leaf, which became more elaborate, and was, no doubt, the origin of the foliated bases.

GRILLE, the iron work forming the enclosure screen to a chapel, or the protecting railing to a tomb or shrine; more commonly found in France than in England. Our best example, perhaps, is that round the tomb of Queen Eleanor in Westminster Abbey. They are of wrought iron, ornamented by the swage and punch, and put together either by rivets or clips.

GROIN, by some described as the line of intersection of two vaults where they cross each other, which others call *the groin point;* by others the curved section or spandril of such vaulting is called a groin, and by others the whole system of vaulting is so named.

GROIN ARCH (Fr. *arc doubleau*), the cross rib in the later styles of groining, passing at right angles from wall to wall, and dividing the vault into bays or *travées*.

GROIN CEILING, a ceiling to a building composed of oak ribs, the spandrils of which are filled in with narrow, thin slips of wood. There are several in England; one at the Early English church at Warmington, and one at Winchester Cathedral, exactly resembling those of stone.

GROIN CENTERING. In groining without ribs, the whole surface is supported by centering during the erection of the vaulting. In ribbed work the stone ribs only are supported by timber ribs during the progress of the work, any light stuff being used while filling in the spandrils.

GROIN POINT, the name give by workmen to the arris or line of intersection of one vault with another where there are no ribs.

GROIN RIB (Fr. *nerf d'arête*, Ital. *costola*, Ger. *Rippe*), the rib which conceals the groin point or joints, where the spandrils intersect.

GROINED VAULTING (Lat. *fornix*, *testudo*, Fr. *voûte d'arête*, Ital. *fornice*), the system of covering a building with stone vaults which cross and intersect each other, as opposed to the barrel vaulting (*voûte de berceau*), or series of arches placed side by side. The earliest groins are plain, without any ribs, except occasionally a sort of wide band from wall to wall, to strengthen the construction. In later Norman times ribs were added on the line of intersection of the spandrils, crossing each other, and having a boss as a key common to both; these ribs the French authors call *nerfs en ogive*. Their introduction, however, caused an entire change in the system of vaulting; instead of arches of uniform thickness and great weight, these ribs were first put up as the main construction, and spandrils (*remplissage*) of the lightest and thinnest possible material placed upon them, the haunches only being loaded sufficiently to counterbalance the pressure from the crown. Shortly after, half ribs against the walls (*formerets*) were introduced to carry the spandrils without cutting into the walling, and to add to the appearance. The work was now not treated as continued vaulting, but as divided into days (*travees*), and it was formed by keeping up the ogive or intersecting ribs and their bosses; a sort of construction having some affinity to the dome was formed, which added much to the strength of the groining. Of course the top of the soffit or ridge of the vault was not horizontal, but rose from the level of the top of the formeret-rib to the boss and fell again; but this could not be perceived from below. As this system of construction got more into use, and as the vaults were required to be of greater span and of higher pitch, the spandrils became larger, and wanted more support. To give this another set of ribs was introduced, passing from the springers of the ogive ribs, and going to about half-way between these and the ogive, and meeting on the ridge of the vault; these intermediate ribs are called by the French *tiercerons*, and began to come into use in the transition from Early English to Decorated. About the same period a system of vaulting came into use called *hexpartite*, from the fact that every bay is divided into six compartments instead of four. It was invented to cover the naves of churches of unusual width. The filling of the spandrils in this style is very peculiar; and, where the different compartments meet at the ridge, some pieces of harder stone have been used, which have rather a pleasing effect. The arches against the wall being of smaller span than the main arches, cause the centre springers to be perpendicular and parallel for some height, and the spandrils themselves are very hollow. As styles progressed, and the desire for greater richness increased, another series of ribs called *liernes*, was introduced; these passed cross-ways from the *ogives* to the *tiercerons*, and thence to the *doubleaux*, dividing the spandrils nearly horizontally. These various systems increased in the Perpendicular period, so that the vaults were quite a network of ribs, and led at last to the Tudor, or, as it is called by many, *fan tracery* vaulting. In this system the ribs are no part of the real construction, but are merely carved upon the voussoirs, which form the actual vaulting. Fan Tracery is so called because the ribs radiate from the springers, and spread out like the sticks of a fan. These later methods are not strictly groins, for the pendentives are not square on plan, but circular, and there is therefore no arris intersection or GROIN POINT (which see)

GROINS, WELSH, or UNDERPITCH. When the main longitudinal vault of any groining is higher than the cross or transverse vaults which run from the windows, the system of vaulting is called underpitch groining, or, as termed by the workmen, Welsh groining. A very fine example is at St George's Chapel, Windsor.

GROUND TABLE. See BASE OF A WALL.

GUILLOCHE or GUILLOCHOS (Gr. γυῖον, a member, and λόχος, a snare), an interlaced ornament like network, used most frequently to enrich the torus.

GUTTÆ (Lat. drops). The small cylindrical drops used to enrich the mutules and regulæ of the Doric entablature are so called.

GUTTER, the channel for carrying off rain-water. The mediæval gutters differed little from others, except that they are often hollows sunk in the top of stone cornices, in which case they are generally called *channels* in English, and *chéneaux* in French.

HAGIOSCOPE, a term derived from the Greek, improperly used to describe certain oblique openings in the mediæval buildings for the purpose of seeing the altar. (See SQUINT.)

HALL (Fr. *salle*, *salon*, Ital. *sala*, *salone*, Ger. *Saal*), the principal apartment in the large dwellings of the Middle Ages used for the purposes of receptions, feasts, &c. In the Norman castle the hall was generally in the keep above the ground floor, where the retainers lived, the basement being devoted to stores and dungeons for confining prisoners. Later halls, indeed some Norman halls (not in castles), are generally on the ground floor, as at Westminster, approached by a porch either at the end, as in this last example, or at the side, as at Guildhall, London, having at one end a raised DAIS (which see) or Estrade. The roofs are generally open, and more or less ornamented. In the middle of these was an opening to let out the smoke (see LOUVRE, FEMERELL), though in later times the halls have large chimney places with funnels or chimney shafts for this purpose. At this period there were usually two deeply recessed bay windows at each end of the dais, and doors leading into the withdrawing-rooms or the ladies' apartments; they are also generally wainscoted with oak, in small panels, to the height of five or six feet, the panels often being enriched. Westminster Hall was originally divided into three parts, like a nave and side aisles, as are some on the Continent.

HELIX (Gr. ἕλιξ, a wreath or ringlet), used synonymously with CAULICULUS, *q.v.* Its plural is Helices.

HERRING-BONE WORK, bricks or other materials arranged diagonally in building.

HEXASTYLE (Gr. ἕξ, six, and στῦλος, a column). A portico of six columns in front is of this description. Most of the churches in London which have porticoes have hexaprostyles.

HIGH ALTAR, the principal altar in a cathedral or church. Where there is a second, it is generally at the end of the choir or chancel, not in the Lady Chapel. At St Albans it stood at the end of the nave, close to the choir screen.

HIP-KNOB, the finial on the hip of a roof, or between the barge boards of a gable.

HOOD-MOULD, a word used to signify the drip-stone or label over a window or door opening, whether inside or out; but it seems more properly to be applied to the mouldings at the arris of the arch at the inner side of such opening. Sometimes these assume the form of a label, and have jamb-shafts. Frequently the soffit is slightly hollowed and finishes with an arris. (See DRIPSTONE, LABEL.)

HOTEL DE VILLE (Ital. *broletto*, *palazzo*, *communale*), the town-hall or guild-hall, in France, Germany, and Northern Italy. The building in general serves for the administration of justice, the receipt of town dues, the regulation of markets, the residence of magistrates, barracks for police, prisons, and all other fiscal purposes. As may be imagined, they differ very much in different towns, but they have almost invariably attached to them, or closely adjacent, a large clock-tower (*beffroi*), containing one or more bells, for calling the people together on special occasions.

HOTEL DIEU (Fr. *maison dieu*, Ital. *ospedale*, *lo spedale*), the name for an hospital in mediæval times. In England there are but few remains of these buildings, one of which is at Dover; abroad there are many. The most celebrated is the one at Angers, described by Parker. They do not seem to differ much in arrangement of plan from those in modern days—the accommodation for the chaplain, medicine, nurses, stores, &c., being much the same in all ages, except that in some of the earlier, instead of the sick being placed in long wards like galleries, as is now done, they occupied large buildings, with naves and side aisles like churches. The reader is referred to the works of Parker, Viollet-le-Duc, and Verdier and Cattois, for further details.

HYPÆTHROS (Gr. ὑπό, under, and αἰθήρ, the air), a temple open to the air, or uncovered. The term may be the more easily understood by supposing the roof removed from over the nave of a church in which columns or piers go up from the floor to the ceiling, leaving the aisles still covered.

HYPOGEA (Gr. ὑπο, under, and γῆ, the earth), constructions under the surface of the earth, or in the sides of a hill or mountain.

HYPOTRACHELIUM (Gr. ὑπό, under, and τράχηλος, the neck), the moulding or the groove at the junction of the shaft with the capital of a column. In some styles the hypotrachelium is a projecting fillet or moulding, and in others, as the Doric, it is composed of a channel or groove, and sometimes of more than one.

ICHNOGRAPHY (Gr. ἴχνος, a footstep or track, and γραφή, a description or representation), the drawing of a plan, or representation of the site of an object on a horizontal plane.

IMPOST, a term in classic architecture for the horizontal mouldings of piers or pilasters, from the top of which the archivolts or mouldings which go round the arch spring. The word is scarcely applicable to mediæval architecture, as the mouldings in general spring from the capital of a shaft, or from a corbel; or they continue without breaking down to the base, or till they are stopped by a chamfer or a regular base moulding, or they die into a plain shaft, or at any rate one of different section.

INTERCOLUMNIATION, the distance from column to column, the clear space between columns.

INTERLACED ARCHES, arches where one passes over two openings, and they consequently cut or intersect each other.

IRON WORK, in mediæval architecture, as an ornament is chiefly confined to the hinges, &c., of doors and of church chests, &c. Specimens of Norman iron work are very rare. Early English specimens are numerous, and very elaborate. In some instances not only do the hinges become a mass of scroll work, but the surface of the doors is covered by similar ornaments. In both these periods the design evidently partakes of the feeling exhibited in the stone or wood carving. In the Decorated period the scroll work is more graceful, and, like the foliage of the time, more natural. As styles progressed, there was a greater desire that the framing of the doors should be richer, and the ledges were chamfered or raised, then panelled, and at last the doors became a mass of scroll panelling. This, of course, interfered with the design of the hinges, the ornamentation of which gradually became unusual. In almost all styles the smaller and less important doors had merely plain strap hinges, terminating in a few bent scrolls, and latterly in *fleurs-de-lis*. Escutcheon and ring handles, and the other furniture, partook more or less of the character of the time. On the Continent the knockers are very elaborate. At all periods doors have been ornamented with nails having projecting heads, sometimes square, sometimes polygonal, and sometimes ornamented with roses, &c. The iron work of windows is generally plain, and the ornament confined to simple *fleur-de-lis* heads to the stancheons. The iron work of screens enclosing tombs and chapels is noticed under GRILLE, *q.v.*

JAMB, the side-post or lining of a doorway or other aperture. The jambs of a window outside the frame are called Reveals.

JAMB-SHAFT. Small shafts to doors and windows with caps and bases; when in the inside arris of the jamb of a window they are sometimes called Esconsons.

JAMBETTE, a French term for the upright ashlar piece between the inside of the plate and the rafters.

JUBE, one of the names of the ambo or reading desk in the early Christian church. In later times, a term especially applied to the rood-loft or gallery over the screen, whence the words "Jube, Domine, benedicere," &c., were read.

KEEL-MOULDING, a round on which there is a small fillet, somewhat like the keel of a ship. It is common in the Early English and Decorated styles.

KEEP (Fr. *donjon*), the inmost and strongest part of a mediæval castle, answering to the citadel of modern times. The arrangement is said to have originated with Gundulf, the celebrated bishop of Rochester. The Norman keep is generally a very massive square tower, the basement or stories partly below ground being used for stores and prisons. The main story is generally a great deal above ground level, with a projecting entrance, approached by a flight of steps and drawbridge. This floor is generally supposed to have been the guard-room or place for the soldiery; above this was the hall, which generally extended over the whole area of the building, and is sometime separated by columns; above this are other apartments for the residents. There are winding staircases in the angles of the buildings, and passages and small chambers in the thickness of the walls. The keep was intended for the last refuge, in case the outworks were scaled and the other buildings stormed. There is generally a well in a mediæval keep, ingeniously concealed in the thickness of a wall, or in a pillar. The most celebrated of Norman times are the White Tower in London, the castles at Rochester, Arundel, and Newcastle, Castle Hedingham, &c. The keep was often circular, as at Conisborough and Windsor.

KEY-STONE, in classic architecture, the centre voussoir of an arch, often ornamented with carving. In Pointed architecture there is often no key-stone. For those to groined arches, see BOSS.

KNOB, KNOT, the bunch of flowers carved on a Corbel, or on a Boss.

LABEL, the outer projecting moulding over doors, windows, arches, &c., sometimes called *Dripstone* or *Weather Moulding*, or *Hood-Mould*. The former terms seem scarcely applicable, as this moulding is often found inside a building where no rain could come, and consequently there is no drip. The latter term is described under HOOD-MOULD. In Norman times the label frequently did not project at all, and when it did it was very little, and formed part of the series of arch mouldings. In the Early English styles they were not very large, sometimes slightly undercut, sometimes deeply, sometimes a quarter round with chamfer, and very frequently a "roll" or "scroll moulding," so called because it resembles the part of a scroll where the edge laps over the body of the roll. Labels generally resemble the string-courses of the periods, and, in fact, often return horizontally and form strings. They are less common in Continental architecture than in English. (See DRIPSTONE, HOOD-MOULD, STRING-COURSES.)

LABEL TERMINATIONS, carvings on which the labels terminated near the springing of the windows. In Norman times these were frequently grotesque heads of fish, birds, &c., and sometimes stiff foliage, as at Shoreham. In the Early English and Decorated periods they are often elegant knots of flowers, or heads of kings, queens, bishops, and other persons supposed to be the founders of churches. In the Perpendicular period they often finished with a short, square mitred return or knee, and the foliages are generally leaves of square or octagonal form.

LACUNAR (Lat.), a panelled or coffered ceiling or soffit. The panels or cassoons of a ceiling are by Vitruvius called *lacunaria*.

LANTERN (Lat. *laterna*), a turret raised above a roof or tower, and very much pierced, the better to transmit light. In modern practice this term is generally applied to any raised part in a roof or ceiling containing vertical windows, but covered in horizontally. The name was also often applied to the *louvre* or *femerell* on a roof to carry off the smoke; sometimes, too, to the open constructions at the top of towers, as at Ely Cathedral, Boston in Lincolnshire, probably because lights were placed in them at night to serve as beacons.

LANTERNS OF THE DEAD, curious small slender towers, found chiefly in the centre and west of France, having apertures at the top, where a light was exhibited at night to mark the place of a cemetery. Some have supposed that the round towers in Ireland may have served for this purpose.

LAVABO (Fr. *lavoir*, Ital. *lavatoio*), the lavatory for washing hands, generally erected in the cloisters of monasteries. Those at Gloucester, Norwich, and Lincoln are best known. A very curious one at Fontenay, surrounding a pillar, is given by Viollet-le-Duc. In general it is a sort of trough, and in some places has an almery for towels, &c.

LICH GATE, a covered gate at the entrance of a cemetery, under the shelter of which the mourners rested with the corpse, while the procession of the clergy came to meet them. There is a very fine one at Ashwell, Herts.

LIERNE RIB, a rib crossing nearly horizontally from the ogive ribs to the tiercerons or the *arcs doubleaux*, or forming patterns in fan and stellar vaulting. (See GROINED VAULTING.)

LIP MOULD, a moulding of the Perpendicular period like a hanging lip.

LOFT, the highest room in a house, particularly if in the roof; also a gallery raised up in a church to contain the rood, the organ, or singers.

LOOP HOLE (Fr. *archière*, *meurtrière*, Ital. *feritoia*), an opening in the wall of a building, very narrow on the outside, and splayed within, from which arrows or darts might be discharged on an enemy. They are often in the form of a cross, and generally have round holes at the ends. (See OYLETS.)

LOUVRE, a lantern upon the roof of a hall for the passage of the smoke, when the fire was made on the pavement in the middle. (See FEMERELL, LANTERN.)

LUCARNE, a French term for a garret window; also used to signify the lights or small windows in spires.

LUFFERS (probably the same as Louvres), pieces of board, slate, or stone, placed slanting so as to exclude the rain, but to allow the passage of smoke, the sound of bells, &c.

LUNETTE, the French term for the circular opening in the groining of the lower stories of towers through which the bells are drawn up.

MACHICOLATION (Fr. *machicoulis*), an opening between a wall and a parapet, formed by corbelling over the latter, so that the defenders of the building might throw down darts, stones, and sometimes hot sand, melted lead, &c., upon their assailants below.

MANOR HOUSE, the residence of the suzerain or lord of the manor; in France the central tower or keep of a castle is often called the *manoir*. (See KEEP.)

MERLON, the solid part of a parapet between the embrasures of a battlement, sometimes pierced by loop-holes.

METOPE (Gr. *μετόπη*, a middle space), the square recess between the triglyphs in a Doric frieze. It is sometimes occupied by sculptures.

MEZZANINE (Ital. *mezzanino*, dim. of *mezzo*, the middle), a low story between two lofty ones. It is called by the French entresol, or inter-story.

MINSTER (Ger. *Münster*), probably a corruption of monasterium—the large church attached to any ecclesiastical fraternity. If the latter be presided over by a bishop, it is generally called a *Cathedral;* if by an abbot, an *Abbey;* if by a prior, a *Priory*.

MISERERE (Fr. *miséricorde*, Ital. *predella*), a seat in a stall of a large church made to turn up and afford support to a person in a position between sitting and standing. The under side is generally carved with some ornament, and very often with strange grotesque figures and caricatures of different persons. (See STALL.)

MITRE. A moulding returned upon itself at right angles is said to mitre. In joinery the ends of any two pieces of wood of corresponding form cut off at 45° necessarily abut upon one another so as to form a right angle, and are said to mitre.

MODILLION (Lat. *modulus*, a measure of proportion), so called because of its arrangement in regulated distances, the enriched block or horizontal bracket generally found under the cornice of the Corinthian entablature. Less ornamented, it is sometimes used in the Ionic. (See also MUTULE.)

MODULE (Lat. *modulus*, from *modus*, a measure or rule). This is a term which has been generally used by architects in determining the relative proportions of the various parts of a columnar ordinance. The semidiameter of the column at its base is the module, which being divided into thirty parts called minutes, any part of the composition is said to be of so many modules and minutes, or minutes alone, in height, breadth, or projection. The whole diameter is now generally preferred as a module, it being a better rule of proportion than its half.

MONASTERY, a set of buildings adapted for the reception of any of the various orders of monks, the different parts of which are described in the separate article ABBEY.

MONOPTEROS (Gr. *μόνος*, one, or single, and *πτερόν*, a wing). This term is used by Vitruvius to describe a temple composed of a circular range of columns supporting a tholus, cupola, or dome, but without walls. (See PERIPTEROS.) Such an edifice would be more correctly designated as Cyclostylar. (See CYCLOSTYLE.)

MONOTRIGLYPH (Gr. *μόνος*, one, or single, and TRIGLYPH, *q.v.*) The intercolumniations of the Doric order are determined by the number of triglyphs which intervene instead of the number of diameters of the column as in other cases; and this term designates the ordinary intercolumniation of one triglyph.

MONUMENT, a name given to a tomb, particularly to those fine structures recessed in the walls of mediæval churches.

MOSAIC (Lat. *opus musivum*, Ital. *musaico*, Fr. *mosaique*), pictorial representations, or ornaments formed of small pieces of stone, marble, or enamel of various colours. In Roman houses the floors are often entirely of mosaic, the pieces being cubical. There are several fine specimens in Westminster Abbey, particularly the pavement of the choir.

MOULDING (Lat. *modulus*, Ital. *modanatura*, Fr. *moulure*, Ger. *Simswerk*). When any work is wrought into long regular channels or projections, forming curves or rounds, hollows, &c., it is said to be *moulded*, and each separate member is called a *moulding*. In mediæval architecture the principal mouldings are those of the arches, doors, windows, piers, &c. The remains of Saxon work are so few, that we can tell but little about these mouldings. The arches have sometimes a simple rib on them, sometimes are chamfered, and sometimes are quite plain. Early Norman work is much the same. By degrees, however, the arrises were finished by a round or bowtell. Later, hollows and rounds together became common, and the arches were set back one behind another, each being frequently supported by a jamb-shaft or column, though very often the arch mouldings continued down the jambs without any break. In the Early English style, the mouldings, for some time, like those of the preceding period, formed groups set back in squares; they are smaller, lighter, more graceful, and frequently very deeply undercut. The *scroll* moulding is also common. Small fillets now became very frequent in the outer parts of the rounds. This has often been called the *keel* moulding, from its resemblance in section to the bottom of a ship: sometimes also it has a peculiar hollow on each side like two wings. Later in the Decorated style the mouldings are more varied in design, though hollows and rounds still prevail. The undercutting is not so deep, fillets abound, ogees are more frequent, and the *wave* mould, double ogee, or double ressaunt, is often seen. In many places the strings and labels are a round, the lower half of which is cut off by a plain chamfer. The mouldings in the later styles in some degree resemble those of the Decorated, flattened and extended; they run more into one another, having fewer fillets, and being as it were less grouped. One of the principal features of the change is the substitution of one, or perhaps two (seldom more), very large hollows in the set of mouldings. These hollows are neither circular nor elliptical, but obovate, like an egg cut across, so that one-half is larger than the other. The brace mould also has a small bead, where the two ogees meet. Another sort of moulding, which has been called a *lip mould*, is common in parapets, bases, and weatherings. For the ancient mouldings see the general article, *supra*.

MOULDINGS, ORNAMENTED. The Saxon and early Norman mouldings do not seem to have been much enriched, but the complete and later styles of Norman are remarkable for a profusion of ornamentation, the most usual of which is what is called the zig-zag. This seems to be to Norman architecture what the meander or fret was to the Grecian; but it was probably derived from the Saxons, as it is very frequently found in their pottery. Bezants, quatrefoils, lozenges, crescents, billets, beads of nails, are very common ornaments; besides these, battlements, cables, large ropes, round which smaller ropes are turned, or, as our sailors say, "wormed," scallops, pellets, chains, a sort of conical barrels, quaint stiff foliages, beaks of birds, heads of fish, ornaments of almost every conceivable kind, are sculptured in Norman mouldings; and they are used in such profusion as has been attempted in no other style. The decorations on Early English mouldings are chiefly the dog-tooth, which is one of the great characteristics of this style, though it is to be found in the Transition Norman. It is generally placed in a deep hollow between two projecting mouldings, the dark shadow in the hollow contrasting in a very beautiful way with the light in these mouldings. In this period and in the next the tympanum over doorways, particularly if they are double doors, is highly ornamented. Those of the Decorated period resemble the former, except that the foliage is more natural, and the dog-tooth gives way to the ball-flower. Some of the hollows also are ornamented with rosettes set at intervals, which are sometimes connected by a running tendril, as the ball-flowers are frequently. Some very pleasing leaf-like ornaments in the labels of windows are often found in Continental architecture. In the Perpendicular period the mouldings are ornamented very frequently by square four-leaved flowers set at intervals, but the two characteristic ornaments of the time are running patterns of vine leaves, tendrils, and grapes in the hollows, which by old writers are called "vignettes in casements," and upright stiff leaves, generally called the Tudor leaf. On the Continent mouldings partook much of the same character.

MULLION, MUNION, often corrupted into *munting*, *monyal* (Fr. *meneau*, Ital. *regolo*, Ger. *Fensterpfoste*). The perpendicular pieces of stone, sometimes like columns, sometimes like slender piers, which divide the bays or lights of windows or screen work from each other. In all styles, in less important work, the mullions are often simply plain chamfered, and more commonly have a very flat hollow on each side. In larger buildings there is often a bead or bowtell on the edge, and often a single very small column with a capital; these are more frequent in foreign work than in English. Instead of the bowtell they often finish with a sort of double ogee. As tracery grew richer, the windows were divided by a larger order of mullion, between which came a lesser or subordinate set of mullions, which ran into each other.

MUTULE (Lat. *mutulus*, a stay or bracket), the rectangular impending block under the corona of the Doric cornice, from which guttæ or drops depend. Mutule is equivalent to modillion, but the latter term is applied more particularly to enriched blocks or brackets, such as those of Ionic and Corinthian entablatures.

NAOS (Gr. ναός, a temple). This term is sometimes used instead of the Latin *cella*, as applied to the interior; strictly, however, it means the body of the edifice itself, and not merely its interior or cell.

NARTHEX (Gr. νάρθηξ, a ferula or rule), the long arcaded porch forming the entrance into the Christian basilica. Sometimes there was an inner narthex or lobby before entering the church. When this was the case, the former was called exo-narthex, and the latter eso-narthex. In the Byzantine churches this inner narthex forms part of the solid structure of the church, being marked off by a wall or row of columns, whereas in the Latin churches it was usually formed only by a wooden or other temporary screen.

NAVE (Lat. *navis*, Ital. *navata*, Fr. *nef*, Ger. *Schiff*), the central part between the arches of a church, which formerly was separated from a chancel or choir by a screen. It is so called from its fancied resemblance to a ship. In the nave were generally placed the pulpit and font. Abroad it often also contains a high altar, but this is of rare occurrence in England. Instances of this, however, are to be found at Durham and St Albans.

NECKING, the annulet or round, or series of horizontal mouldings, which separates the capital of a column from the plain part or a shaft. In Norman work they are often corded.

NEWEL (Fr. *noyau*, Ital. *albero d'una scala*, Ger. *Spindel*), in mediæval architecture, the circular ends of a winding staircase which stand over each other, and form a sort of cylindrical column.

NICHE (Fr. *niche*, Ital. *nicchia*, Gr. *Nische*), a recess sunk in a wall, generally for the reception of a statue. They sometimes are terminated by a simple label, but more commonly by a canopy, and with a bracket or corbel for the figure, in which case they are often called *tabernacles*.

OCTASTYLE (Gr. ὀκτώ, eight, and στῦλος, a column), a portico of eight columns in front.

OGEE (Lat. *cyma reversa*, Ital. *gola dritta*, *gola a rovescio*, Fr. *cimaise*, *doucine*, *gorge*, *gueule*, *gueule renversée*, *talon*, Ger. *Hohlleisten*), the name applied to a moulding, partly a hollow and partly a round, and derived no doubt from its resemblance to an *O* placed over a *G*. It is rarely found in Norman work, and is not very common in Early English. It is of frequent use in the Decorated, where it becomes sometimes double, and is called a *wave* moulding; and later still, two waves are connected with a small bead, which is then called a *brace* moulding. In ancient MSS. it is called a RESSAUNT, *q.v.*

OGIVE, a term applied by the French to the pointed arch. OGIVE RIB, the main ribs which cross each other on the intersection of the vaulting. (See GROINED VAULTING.)

ORATORY (Fr. *oratoire*), a small chapel or place for prayer for the use of private individuals, generally attached to a mansion, and sometimes to a church. The name is also given to small chapels built to commemorate some special deliverance.

ORDER. A column with its entablature and stylobate is so called. The term is the result of the dogmatic laws deduced from the writings of Vitruvius, and has been exclusively applied to those arrangements which they were thought to warrant. For the different details of an order, see Plate XXIV., fig. 1.

ORDER, the name given to the subordinate mullions and tracery which are of smaller size than others in the same window, &c. It is also applied to the groups of mouldings arranged on square faces set back behind one another in Norman and Early English work, and not cut in on the splayed faces of the jambs and arch moulds as in subsequent periods.

ORDINANCE, a composition of some particular order or style. It need not be restricted to a columnar composition, but applies to any species which is subjected to conventional rules for its arrangement.

ORIEL or ORYEL. See BAY WINDOW.

ORTHOGRAPHY (Gr. ὀρθός, straight or true, and γραφή, a description or representation), a geometrical elevation of a building or other object, in which it is represented as it actually exists or may exist, and not perspectively, or as it would appear.

ORTHOSTYLE (Gr. ὀρθός, straight or true, and στῦλος, a column), any straight range of columns. This is a term suggested to designate what is generally but improperly called a PERISTYLE, *q.v.*, that is, columns in a straight row or range, but not forming a portico.

OSSUAIRE. See CHARNEL HOUSE.

OVOLO (from the Ital., meaning egg-formed), the name most commonly applied to the moulding which appears to have originated in the moulded head of the Doric column, and which, with an abacus, formed its capital.

OYLEMENTS, a word used in the Beauchamp Roll, signifying the small quatrefoil lights in the head of a Perpendicular window.

OYLETS, or OIELLETS, a name sometimes applied to the arrow-slits in towers, &c.; but it seems more probable its strict meaning is the round hole or circle with which these terminate.

PACE, the landing on a broad step in a stair; also any stage raised above the floor.

PAN or PANE. See POST AND PANE WORK.

PANE, probably a diminutive of *panneau*, a term applied to a bay of a window, compartment of a partition, side of a tower, turret, &c. (See BAY.)

PANEL (Fr. *panneau*, Ital. *quadretto*, *formello*, Ger *Feld*), properly the piece of wood framed within the styles and rails of a door, filling up the aperture, but often applied both to the whole square frame and the sinking itself; also to the ranges of sunken compartments in cornices, corbel tables, groined vaults, ceilings, &c. In Norman work these recesses are generally shallow, and more of the nature of *arcades*. In Early English work the square panels are ornamented with quatrefoils, cusped circles, &c., and the larger panels are often deeply recessed, and form niches with trefoil heads and sometimes canopies. In the Decorated style the cusping and other enrichments of panels become more elaborate, and they are often filled with shields, foliages, and sometimes figures. Towards the end of this period the walls of important buildings were often entirely covered with long or square panels, the former frequently forming niches with statues. The use of panels in this way became very common in Perpendicular work, the wall frequently being entirely covered with long, short, and square panels, which latter are frequently richly cusped, and filled with every species of ornament, as shields, bosses of foliage, portcullis, lilies, Tudor roses, &c. Wooden panellings very much resembled those of stone, except in the Tudor period, when the panels were enriched by a varied design, imitating the plaits of a piece of linen or a napkin folded in a great number of parallel lines. This is generally called the *linen pattern*. Wooden ceilings, which are very common, are composed of thin oak boards nailed to the rafters, collars, &c., and divided into panels by oak mouldings fixed on them, with carved bosses at the intersections.

PARADISE, PARVISE, PARVYCE, a word of uncertain origin, but supposed to be a corruption of *paradisus*, an enclosed garden. Paradises were open places surrounded with an enceinte or stone parapet in front of cathedrals or other great buildings, and probably were used to keep the people from pressing on and confusing the marshalling of the public processions. That at Nôtre Dame, at Paris, is of irregular shape; that at Amiens was round. Nothing of the kind is left in England, though, from a passage in Chaucer, it is supposed there was one in the front of Westminster Hall. The *Promptorium Parvulorum* calls a parvise *parlatorium*, a place for conversation. The small chambers over porches have also been named parvises. The irregularly-shaped cloister at Chichester is still called a paradise.

PARAPET (from the Italian *parapetto*, something which comes against the breast, *i.e.*, to lean against, Fr. *parapet*, Ger. *Brustwehre*), a dwarf wall along the edge of a roof, or round a lead flat, terrace walk, &c., to prevent persons from falling over, and as a protection to the defenders in case of a siege. Parapets are either plain, embattled, perforated, or panelled. The last two are found in all styles except the Norman. Plain parapets are simply portions of the wall generally overhanging a little, with a *coping* at the top and *corbel* table below. Embattled parapets are sometimes panelled, but oftener pierced for the discharge of arrows, &c. Perforated parapets are pierced in various devices—as circles, trefoils, quatrefoils, and other designs—so that the light is seen through. Panelled parapets are those ornamented by a series of panels, either oblong or square, and more or less enriched, but are not perforated. These are common in the Decorated and Perpendicular periods.

PARASCENIUM, in a Greek theatre, the wall at the back of the stage.

PARASTAS (Gr. παραστάς, standing before), an end pilaster, the Greek term for which the Latin *antæ* is generally used. (See ANTÆ.)

PARCLOSE, a word used for any enclosure to a chantry, tomb, &c.

PAREMENT, a French term for the outside ashlar or casing of a rubble wall, which is tied together by through or bond stones. (See PERPENT.)

PARGETTING, a species of plastering decorated by impressing patterns on it when wet. These seem generally to have been made by sticking a number of pins in a board in certain lines or curves, and then pressing on the wet plaster in various directions, so as to form geometrical figures. Sometimes these devices are in relief, and in the time of Elizabeth represent figures, birds, foliages, &c.; fine examples are to be seen at Ipswich, Maidstone, Newark, &c. The word (which is Latinised *gypsacio* in the *Promptorium*) may be derived from the old French *géter*, to cast, to throw, as outside plastering is often thrown against the laths to make it adhere better. (See ROUGH CAST.)

PARVISE. See PARADISE.

PATIN, PATAND, from the French *patin*, a wooden sole, clog, or patten. The sills in timber-framing are thus named in some old works, though modern French authors call them *sablières*.

PEDESTAL. An insulated stylobate is for the most part so called. The term is, moreover, generally applied to any parallelogramic or cylindrical mass, used as the stand or support of any single object, as a statue or vase.

PEDIMENT, that part of a portico which rises above its entablature to inclose the end of the roof, whose triangular form it takes. The cornice of the entablature, or its corona, and part of the bed-mould only, with the addition of a cymatium, bounds its inclined sides, and gives it an obtuse angle at the apex. In Pointed architecture, however, the angle of a pediment is for the most part acute.

PENDENT, a name given to an elongated boss, either moulded or foliated, such as hang down from the intersection of groins, specially in fan tracery, or at the end of hammer beams. Sometimes long corbels, under the wall pieces, have been so called. The name has also been given to the large masses depending from enriched ceilings, in the later works of the Pointed style.

PENDENT POSTS, a name given to those timbers which hang down the side of a wall from the plate, and which receive the hammer braces.

PENDENTIVE, a name given to an arch which cuts off, as it were, the corners of a square building internally, so that the superstructure may become an octagon or a dome. In mediæval architecture these arches, when under a spire in the interior of a tower, are called SQUINCHES (which see).

PERIBOLUS (Gr. περί, around or about, and βάλλω, to throw), an inclosure. Any inclosed space is a peribolus; but the term is applied more particularly to the sacred enclosure about a temple. The wall forming the enclosure is also called the peribolus.

PERIPTEROS (Gr. περί, around or about, and πτερόν, a wing), a temple or other structure with the columns of its end prostyles, or porticoes, returned on its sides as wings at the distance of one intercolumniation from the walls. Almost all the Doric temples of the Greeks were peripteral. The term is applied by Vitruvius to peristylar structures.

PERISTYLE (Gr. περί, around or about, and στῦλος, a column), a range of columns encircling an edifice, such as that which surrounds the cylindrical drum under the cupola of St Paul's. The columns of a Greek peripteral temple form a peristyle also, the former being a circular, and the latter a quadrilateral peristyle.

PERPENT STONES (Fr. *parpaing*), bond or "through stones," the διατόνοι of the Greeks and Romans. Long stones going right through walls, and tying them together from face to face.

PERRON, the grand flight of external steps entering the mansions of the mediæval nobility or high officials, and considered in itself as a mark of jurisdiction, as it is said that sentence was there pronounced against criminals, who were afterwards executed at the foot of the steps—as at the Giant Stairs at Venice. One of the finest later examples is the flight in the Horse-shoe Court at Fontainebleau.

PEWS (Lat. and Gr. *podium*; comp. Fr. *pui*), fixed seats in churches, composed of wood framing, mostly with ornamented ends. They seem to have come into general use early in the reign of Henry VI., and to have been rented and "well payed for" (see Bale's *Image of Both Churches*) before the Reformation. Some bench ends are certainly of Decorated character, and some have been considered to be of the Early English period. They are sometimes of plain oak board, 2½ to 3 inches thick, chamfered, and with a necking and finial generally called a *poppy head;* others are plainly panelled with bold cappings; in others the panels are ornamented with tracery or with the *linen pattern*, and sometimes with running foliages. The divisions are filled in with thin chamfered boarding, sometimes reaching to the floor, and sometimes only from the capping to the seat.

PIERS, the solid parts of a wall between windows and between voids generally. The term is also applied to masses of brickwork or masonry which are insulated to form supports to gates or to carry arches.

PIGNON, a French term for the gable of a roof. (See GABLE.)

PILASTER (from Lat. *pila*, a pillar), an inferior sort of column or pillar; a projection from or against a pier, with the form and decorations of antæ, but frequently (always in Roman examples) having capitals, like those of columns, assigned them.

PILLAR, or PYLLER (Fr. *pilier*, Ital. *pilastro, colonna*, Ger. *Pfeiler*), a word generally used to express the round or polygonal piers or those surrounded with clustered columns, which carry the main arches of a building. Saxon and early Norman pillars are generally stout cylindrical shafts built up of small stones. Sometimes, however, they are quite square, sometimes with other squares breaking out of them (this is more common on the Continent), sometimes with angular shafts, and sometimes they are plain octagons. In Romanesque Norman work the pillar is sometimes square, with two or more semicircular or half columns attached. In the Early English period the pillars become loftier and lighter, and in most important buildings are a series of clustered columns, frequently of marble, placed side by side, sometimes set at intervals round a circular centre, and sometimes almost touching each other. These shafts are often wholly detached from the central pillar, though grouped round it, in which case they are almost always of Purbeck or Bethersden marbles. In Decorated work the shafts on plan are very often placed round a square set angle-wise, or a lozenge, the long way down the nave; the centre or core itself is often worked into hollows or other mouldings, to show between the shafts, and to form part of the composition. In this and the latter part of the previous style there is generally a fillet on the outer part of the shaft, forming what has been called a keel moulding. They are also often as it were tied together by bands formed of rings of stone and sometimes of metal. About this period, too, these intermediate mouldings run up into and form part of the arch moulds, the impost not being continuous; or rather there is no impost, but the shafts have each their own separate cap. (See IMPOST.) This arrangement became much more frequent in the Perpendicular period; in fact it was almost universal, the commonest section being a lozenge set with the long side from the nave to the aisle, and not towards the other arches, as in the Decorated period, with four shafts at the angles, between which were shallow mouldings, one of which in general was a wide hollow, sometimes with wave moulds. As the pillar altogether by the arrangement was wider than the wall above, the shafts facing the nave ran up to the roof, and served in place of the vaulting shafts of the previous periods. The small pillars at the jambs of doors and windows, and in arcades, and also those slender columns attached to pillars, or standing detached, are generally called SHAFTS (which see.)

PILLOWED. A swollen or rounded frieze is said to be pillowed or pulvinated.

PINNACLE (Fr. *pinacle, finoison*, Ital. *pinacolo*,—literally a little feather—Ger. *Pinnakyl*), an ornament originally forming the cap or crown of a buttress or small turret, but afterwards used on parapets at the corners of towers and in many other situations. Some writers have stated there were no Norman pinnacles; but ... caps to circular buttresses, with a sort of finial, are not uncommon in France at very early periods. Viollet-le-Duc gives examples from St Germer and St Remi, and there is one of similar form at the west front of Rochester Cathedral. In the later Norman period, two examples have been cited, one from Bredon in Worcestershire, and the other from Cleeve in Gloucestershire. In these the buttresses run up, forming a sort of square turret, and crowned with a pyramidal cap, very much like those of the next period, the Early English. In this and the following styles the pinnacle seems generally to have had its appropriate uses. It was a weight to counteract the thrust of the groining of roofs, particularly where there were flying buttresses; it stopped the tendency to slip of the stone copings of the gables, and counterpoised the thrust of spires; it formed the piers to steady the elegant perforated parapets of later periods; and in France especially served to counterbalance the weight of overhanging corbel tables, huge gargoyles, &c. In the Early English period the smaller buttresses frequently finished with GABLETS (which see), and the more important with pinnacles supported with clustered shafts. At this period the pinnacles were often supported on these shafts alone, and were open below; and in larger work in this and the subsequent periods they frequently form niches and contain statues. About the Transition and during the Decorated period, the different faces above the angle shafts often finish with gablets. Those of the last-named period are much richer, and are generally decorated with crockets and finials, and sometimes with ball-flowers. Very fine groups are found at Beverley Minster and at the rise of the spire of St Mary's, Oxford. Perpendicular pinnacles differ but little from Decorated, except that the crockets and finials are of later character. They are also often set angle-ways, particularly on parapets, and the shafts are panelled. In France, pinnacles, like spires, seem to have been in use earlier than in England. There are small pinnacles at the angles of the tower in the Abbey of Saintes. At Roullet there are pinnacles in a similar position, each composed of four small shafts, with caps and bases surmounted with small pyramidal spires. In all these examples the towers have semicircular headed windows.

PISCINÆ, one or more hollows or *cuvettes* near the altars, with drains to take away the water used in the ablutions at the mass. They seem at first to have been mere cups or small basins, supported on perforated stems, placed close to the wall, and afterwards to have been recessed therein and covered with niche heads, which often contained shelves to serve as aumbries. They are rare in England till the 13th century, after which there is scarcely an altar without one. They frequently take the form of a double niche, with a shaft between the arched heads, which are often filled with elaborate tracing.

PITCH OF A ROOF, the proportion of the height of a roof to its span. (See GABLE.)

PLAN, a horizontal geometrical section of the walls of a building; or indications, on a horizontal plane, of the relative positions of the walls and partitions, with the various openings, such as windows and doors, recesses and projections, chimneys and chimney-breasts, columns, pilasters, &c. This term is often incorrectly used in the sense of DESIGN, *q.v.*

PLANCEER is sometimes used in the same sense as soffit, but is more correctly applied to the soffit of the corona in a cornice.

PLASTERING (Fr. *plâtre*, Ital. *intonaco*, Ger. *Putzarbeit*), a mixture of lime, hair, and sand, to cover lath-work between timbers or rough walling, used from the earliest times, and very common in Roman work. In the Middle Ages, too, it was used not only in private but in public constructions. On the inside face of old rubble walls it was not only used for purposes of cleanliness, rough work holding dirt and dust, but as a ground for distemper painting (*tempera*, or, as it is often improperly called, *fresco*), a species of ornament often used in the Middle Ages. At St Alban's Abbey the Norman work is plastered and covered with lines imitating the joints of stone. The same thing is found in the Perpendicular work at Ash in Kent. On the outside of the like walls, and often of wood-framing, it was used as *rough cast;* when ornamented in patterns outside, it is called *pargetting*.

PLINTH (Gr. πλίνθος, a square tile). In the Roman orders the lowest member of the base of a column is square and vertically faced; this is called a plinth.

PODIUM, strictly something upon or against which the foot may be placed; and in this sense, probably, it was applied to the wall which bounds the arena of an amphitheatre, and is thereby at the feet of the most advanced of the spectators.

POLYTRIGLYPH, an intercolumniation in the Doric order of more than two triglyphs. (See MONOTRIGLYPH, DITRIGLYPH, and TRIGLYPH.)

POMMEL, a name given to any round knob, as a boss, a finial, &c.

POPPY HEADS, probably from the French *poupée*, the finials or other ornaments which terminate the tops of bench ends, either to pews or stalls. They are sometimes small human heads, sometimes richly carved images, knots of foliages, or finials, and sometimes *fleurs-de-lis* simply cut out of the thickness of the bench end and chamfered.

PORCH (Gr. νάρθηξ, Lat. *porticus*, Fr. *porche*, Ital. *portico*, Ger. *Vorhalle*), a covered erection forming a shelter to the entrance door of a large building. The earliest known are the long arcaded porches in front of the early Christian basilicas, called NARTHEX (which see). In later times they assume two forms—one the projecting erection covering the entrance at the west front of cathedrals, and divided into three or more doorways, &c., and the other a kind of covered chambers open at the ends, and having small windows at the sides as a protection from rain. These generally stand on the north or south sides of churches, though in Kent there are a few instances (as Snodland and Boxley) where they are at the west ends. Porches are of very early use. Those of the Norman period generally have but little projection, and are sometimes so flat as to be but little more than outer dressings and hood-moulds to the inner door. They are, however, often very richly ornamented, and, as at Southwell in England and Kelso in Scotland, have rooms over, which have been erroneously called *parvises*. (See PARADISE.) Early English porches are much longer, or project much further from the faces of the churches to which they are attached, and in larger and more important buildings have very frequently rooms above; the gables are generally bold and high pitched. In larger buildings also, as at Wells, St Albans, &c., the interiors are very rich in design, quite as much so, in fact, as the exteriors. Decorated and Perpendicular porches partake of much the same characteristics, the pitch of roof, mouldings, copings, battlements, &c., being of course influenced by the taste of the time. As a general rule, however, the later porches had rooms over them more frequently than in earlier times; these are often approached from the lower story by small winding stairs, and sometimes have fire-places, and are supposed to have served as vestries; and sometimes there are the remains of a piscina, and relics of altars, as if they had been used as chantry chapels. It is probable there were wooden porches at all periods, particularly in those places where stone was scarce; but, as may be expected from their exposed position, the earliest have decayed. At Cobham, Surrey, there was one that had ranges of semicircular arches in oak at the sides, of strong Norman character, which is now unfortunately destroyed. It is said there are several in which portions of Early English work still are traceable, as at Chevington, in Suffolk. In the Decorated and later periods, however, wooden porches are very common, some plain, and others with richly carved tracery and barge boards; these frequently stand on a sort of half story of stone work or *bahut*. The entrance porches at the west end of our cathedrals are generally called *portals*, and where they assume the character of separate buildings, are designated *galilees*. Both these are more common on the Continent than in England. Many of the French cathedrals have the doors so deeply recessed as to be almost like open porches. These are called *portails* or *portes abrités*. Many, however, have detached porches in front of the portals themselves. The noblest example of an open projecting western porch in England, and probably in the world, is at Peterborough, of the Early English period, attached to the Early Norman nave.

PORTAL (Fr. *portail*, Ital. *portone*), a name given to the deeply recessed and richly decorated entrance doors to the cathedrals on the Continent.

PORTCULLIS (M. Lat. *cataracta*, Fr. *herse*, *coulisse*, Ital. *saracinesca*, Ger. *Fallgatter*), a strong-framed grating of oak, the lower points shod with iron, and sometimes entirely made of metal, hung so as to slide up and down in grooves with counterbalances, and intended to protect the gateways of castles, &c. The defenders having opened the gates and lowered the portcullis, could send arrows and darts through the gratings, and yet the assailants could not enter. One of these constructions was in existence until modern times in a gateway at York; they are said not to be older than the 12th century, and were probably (as their Italian name imports) invented as a defence against the sudden attacks of the Saracens on the coasts of that country.

PORTICO (an Italicism of the Lat. *porticus*), an open space before the door or other entrance to any building fronted with columns. A portico is distinguished as prostyle or *in antis* according as it projects from or recedes within the building, and is further designated by the number of columns its front may consist of. (See DISTYLE, TETRASTYLE, HEXASTYLE, OCTASTYLE, &c.)

PORTICUS. In an amphiprostylar or peripteral temple this term is used to distinguish the portico at the entrance from that behind, which is called the posticum.

POST AND PANE WORK, a name given to the carpentry framing of old wooden houses, *panne* in old French signifying any horizontal piece of timber, as a head, sill, or purlin, though its use now is confined to the latter, sills and plates at present being called *sablières*. Where timber was abundant, and stone scarce and dear to work, timber-framed houses naturally abounded. The posts or uprights seem in early times to have been constructed of small oak trees, 6 or 7 inches square, roughly trimmed by the axe; the girders, &c., are larger, but seldom seem to have been sawn. The framing of the lower story generally stands on a sort of plinth or *bahut* of stone or brick, sometimes as high as the window sills, and the other fronts are each framed separately; and as the joists of each story project over those of that below, each story also projects, till, in narrow streets, it is said the houses almost touched each other at the top. To strengthen the framing, it was customary to tie the angles together with circular braces cut out of the crooked boughs of trees, and to fill in under and sometimes over the window openings with cross struts, sometimes like the St Andrew's cross, and sometimes in circles and various designs. The main posts also were strengthened inside and out with a sort of projecting corbels, called in French *liens* or *décharges*, and by us *spervers*, which helped to carry the projecting plates above. In the better sort of work these timbers are chamfered and sometimes carved, and the gables have rich barge boards; the roofs invariably have great projections to throw off the wet, and the jutting of the stories, one over the other, no doubt was intended for the same purpose. Old post and pane work is put together with mortices and tenons pinned with pins or trunnels of hard wood; very often there is not a nail in the whole construction. The intermediate upright posts or quarters were called *prick posts*. All these houses are plastered, rough cast, or pargetted between the timbers, sometimes in handsome designs, and as the old oak gets black with age, or as the timbers are often rubbed over with oil, and the plaster whited, they are called in England *black and white houses*. (See PARGETTING and PLASTERING.) Several churches in Essex have post and pane work.

POSTERN, a small gateway in the enceinte of a castle, abbey, &c., from which to issue and enter unobserved. They are often called *Sally Ports*

POSTICUM (Lat.) A portico behind a temple. (See POSTICUS and PORTICO.)

PRECEPTORY, a small establishment of the Knights Templars, managed by a preceptor, a subordinate officer to a master, in the same way as a priory was by a prior, and not an abbot.

PRESBYTERY (Lat. *presbyterium*, Ital. *presbiterio*, Fr. *presbytère*), a word applied to various parts of large churches in a very ambiguous way Some consider it to be the choir itself; others, what is now named the *sacrarium*. Traditionally, however, it seems to be applied to the vacant space between the back of the high altar and the entrance to the lady chapel, as at Lincoln and Chichester; in other words, the *Back* or *Retro Choir*.

PRICK POSTS, an old name given sometimes to the queen posts of a roof, and sometimes to the filling in quarters in framing. (See POST and PANE.)

PRIORY, a monastic establishment, generally in connection with an abbey, and presided over by a prior, who was a subordinate to the abbot, and held much the same relation to that dignitary as a dean does to a bishop. (See ABBEY.)

PROCESSION PATH (Lat *ambitus templi*), the route taken by processions on solemn days in large churches—up the north aisle, round behind the high altar, down the south aisle, and then up the centre of the nave.

PRONAOS (Gr. πρό, before, and ναός, a temple), the inner portico of a temple, or the space between the porticus, or outer portico, and the door opening into the cella. This is a conventional use of the term; for, strictly, the pronaos is the portico itself.

PROPYLÆUM (Gr. πρό, before, and πύλη, a portal), any structure or structures forming the entrance to the peribolus of a temple; also the space lying between the entrance and the temple. In common usage this term in the plural (propylæa) is almost restricted to the entrance to the Acropolis of Athens, which is known by it as a name. The form *propylon* occurs in the Latin of Vitruvius.

PROSCENIUM, the stage in ancient theatres.

PROSTYLE (Gr. πρό, before, and στῦλος, a column), a portico in which the columns project from the building to which it is attached.

PSEUDO-DIPTERAL (Gr. ψευδής, false, and DIPTEROS, *q.v.*), false double-winged. When the inner row of columns of a dipteral arrangement is omitted and the space from the wall of the building to the columns is preserved, it is pseudo-dipteral The portico of University College, London, is pseudo-dipterally arranged, the returning columns on the ends or sides not being carried through behind those in front.

PSEUDO-PERIPTERAL (Gr. ψευδής, false, and PERIPTEROS, *q.v.*), false-winged. A temple having the columns on its flanks attached to the walls, instead of being arranged as in a peripteros, is said to be a pseudo-peripteral.

PULPIT (Fr. *chaire de l'église*, Ital. *pulpito*, Ger. *Kanzel*), a raised platform with enclosed front, whence sermons, homilies, &c., were delivered. Pulpits were probably derived in their modern form from the *ambones* in the early Christian church. There are many old pulpits of stone, though the majority are of wood. Those in churches are generally hexagonal or octagonal; and some stand on stone bases, and others on slender wooden stems, like columns. The designs vary according to the periods in which they were erected, having panelling, tracery, cuspings, crockets, and other ornaments then in use. Some are extremely rich, and ornamented with colour and gilding. A few also have fine canopies or sounding-boards. Their usual place is in the nave, mostly on the north side, against the second pier from the chancel arch. Pulpits for addressing the people in the open air were common in the mediæval period, and stood near a road or cross. Thus there was one at Spital Fields, and one at St Paul's, London. External pulpits still remain at Magdalene College, Oxford, and at Shrewsbury. Pulpits, or rather places for reading during the meals of the monks, are found in the refectories at Chester, Beaulieu, Shrewsbury, &c., in England; and at St Martin des Champs, St Germain des Prés, &c., in France; also in the cloisters at St Dié and St Lo. Shortly after the Reformation the canons ordered pulpits to be erected in all churches where there were none before. It is supposed that to this circumstance we owe so many of the time of Elizabeth and James. Many of them are very beautifully and elaborately carved, and are evidently of Flemish workmanship. The pulpits in the Mahometan mosques are quite different in form, being usually canopied and approached by a straight flight of steps. These have a doorway at the foot, with an architrave, and boldly moulded head; the whole of the work to this and to the stairs, parapet, and pulpit itself being of wood, richly inlaid, and often in part gorgeously painted and gilt.

PULVINATED (Lat. *pulvinus*, a cushion or bolster), a term used to express the swelling or bolstering of the frieze which is found in some of the inferior works of the Roman school, and is common in Italian practice. It is used indifferently with *pillowed*.

PYCNOSTYLE (Gr. πυκνός, dense, and στῦλος, a column), having columns thickly set. The space or intercolumniation implied by this term is one diameter and a half. (See EUSTYLE.)

QUARREL, QUARRY (from the French *carré*, square), any square-shaped opening; applied in the Beauchamp Roll to the quatrefoils in Perpendicular windows, sometimes to squares of paving, but most commonly to the lozenge-shaped pieces of glass in lead casements.

QUARTERS, the main upright posts in framing, sometimes called studs; the filling in quarters were formerly named prick posts.

QUATREFOIL, any small panel or perforation in the form of a four-leaved flower. They are sometimes used alone, sometimes in circles, and over the aisle windows, but more frequently they are in square panels. They are generally cusped, and the cusps are often feathered. (See CINQUEFOIL.)

QUOINS, large squared stones at the angles of buildings, buttresses, &c., generally used to stop the rubble or rough stone work, and that the angles might be true and stronger. Saxon quoin stones are said to have been composed of one long and one short stone alternately. Early quoins are generally roughly axed; in later times they had a draft tooled by the chisel round the outside edges, and later still were worked fine from the saw.

RAG-STONE, a name given by some writers to work done with stones which are quarried in thin pieces, such as the Horsham sandstone, Yorkshire stone, the slate stones, &c.; but this is more properly flag or slab work. By rag-stone, near London, is meant an excellent material from the neighbourhood of Maidstone. It is a very hard limestone of bluish-grey colour, and peculiarly suited for mediæval work. It is often laid as uncoursed work, or random work, sometimes as random coursed work, and sometimes as regular ashlar. The first method, however, is the more picturesque.

RANDOM WORK, a term used by the rag-stone masons for stones fitted together at random without any attempt at laying them in courses. *Random Coursed Work* is a like term applied to work coursed in horizontal beds, but the stones are of any height, and fitted to one another.

REAR VAULT, a name sometimes applied to the inner hood-mould of a window or doorway, but no ancient authority for the use of such a term has been cited.

REFECTORY, the hall of a monastery, convent, &c., where the religious took their chief meals together. It much resembled the great halls of mansions, castles, &c., except that there frequently was a sort of ambo, approached by steps, from which to read the legenda sanctorum, &c., during meals. (See PULPIT.)

REGULA (Lat.), a rule or square, the short fillet or rectangular block, under the tænia, on the architrave of the Doric entablature.

REREDOS, DORSAL, or DOSSEL (Fr., *retable*), the screen or other ornamental work at the back of an altar. In some large cathedrals, as Winchester, Durham, St Albans, &c., this is a mass of splendid tabernacle work, reaching nearly to the groining. In smaller churches there are sometimes ranges of arcades or panellings behind the altars; but, in general, the walls at the back and sides of them were of plain masonry, and adorned with hangings or paraments. In large churches abroad, the high altar usually stands under a sort of canopy or ciborium, and the sacrarium is hung round at the back and sides with curtains on movable rods. (See CIBORIUM.) In private houses the iron plates behind the fire, where there are andirons, are sometimes called *reredoses*.

RESPOND, the half pier or pillar at the end of a range of piers and arches, or other arcades; they are generally exactly half the other piers, with a short piece of wall finishing at right angles to the end or cross wall.

RESSAUNT, a sort of flat ogee. A *ressaunt lorymer* (or *larmier*) is supposed to be an ogee with a drip.

RETRO CHOIR. (See BACK CHOIR, PRESBYTERY.)

RIB (Fr. *nerf d'arête*, *nervure*, Ital. *costola*, Ger. *Rippe*). (See GROIN RIB, and also GROINED VAULTING.) The earliest groining had no ribs. In early Norman times plain flat arches crossed each other, forming *Ogive Ribs*. These by degrees became narrower, had greater projection, and were chamfered. In later Norman work the ribs were often formed of a large roll placed upon the flat band, and then of two rolls side by side, with a smaller roll or a fillet between them, much like the lower member. Sometimes they are enriched with zigzags and other Norman decorations, and about this time bosses became of very general use. (See BOSS.) As styles progressed, the mouldings were more undercut, richer and more elaborate, and had the dog-tooth or ball-flower or other characteristic ornament in the hollows. In all instances the mouldings are of similar contours to those of arches, &c., of the respective periods. (See MOULDINGS.) In Perpendicular work the ribs are broader and shallower, and almost always have two great hollows of elliptic shape, one on each side. In those churches of the Early English and Decorated periods where there is a groining of wooden ribs filled in between the spandrils with their narrow oak boards, these ribs resemble those of stone, but are slighter, and the mouldings not so bold. (See CEILING.) Later, wooden roofs are often formed into cants or polygonal barrel vaults, and in these the ribs are generally a cluster of rounds, and form square or stellar panels, with carved bosses or shields at the intersections.

RIDGE (Fr. *faîte*, *faîtage*, Ital., *comignolo*, Ger. *Rücken*), a flat piece of board running from the apex of principal to principal, to which the heads of the common rafters are nailed; also the lead or tile covering to the same. (For ornamental ridges, see CRESTING.)

ROLL MOULDING or SCROLL MOULDING, a moulding so called because it resembles the section of half a scroll or flexible book rolled up so that the edge projects over the other part. (See LABEL.)

ROOD, a name applied to a crucifix, particularly to those which were placed in the rood-loft or chancel screens. These generally had not only the image of the crucified Saviour, but also those of St John and the Virgin Mary, standing one on each side. Sometimes other saints and angels are by them, and the top of the screen is set with candlesticks or other decorations.

ROOD-LOFT, ROOD-SCREEN, ROOD-BEAM, JUBE GALLERY, &c., the arrangement to carry the crucifix or rood, and to screen off the chancel from the rest of the church during the breviary services, and as a place whence to read certain parts of those services. (See JUBE.) Sometimes the crucifix is carried simply on a strong transverse beam, with or without a low screen, with folding-doors below but forming no part of such support. The general construction of wooden screens is close panelling beneath, about 3 feet to 3 feet 6 inches high, on which stands screen work composed of slender turned balusters or regular wooden mullions, supporting tracery more or less rich with cornices, crestings, &c., and often painted in brilliant colours, and gilded. These not only enclose the chancels, but also chapels, chantries, and sometimes even tombs. In mansions, and some private houses, the great halls were screened off by a low passage at the end opposite to the dais, over which was a gallery for the use of minstrels or spectators. These screens were sometimes close and sometimes *glazed*. There are many of these in England, generally more or less mutilated: one of the most perfect galleries is that at Charlton-on-Otmoor, in Oxfordshire.

ROOD-STAIR, a small winding stair or vice leading to the gallery. (See ROOD-LOFT.) In England they generally run up in a small turret in the wall at the west end of the chancel. This also often leads out on the roof. On the Continent these stairs often lead out of the interior of churches, and are enclosed with exquisitely perforated tracery, as at Rouen, Strasbourg, &c.

ROOD-TOWER, a name given by some writers to the central tower, or that over the intersection of the nave and chancel with the transepts.

ROSE WINDOW (Fr. *rosace*), a name given to a circular window with radiating tracery, called also *wheel window*.

ROUGH CAST, a sort of external plastering in which small sharp stones are mixed, and which, when wet, is forcibly thrown or *cast* from a trowel against the wall, to which it forms a coating of pleasing appearance. Some of the rough cast at St Albans is supposed to be coeval with the building itself. This material was also much used in timber houses, and when well executed the work is sound and durable.

ROVING, anything following the line of a curve; thus the bowtell or torus going up the side of a bench end and round a finial is called a roving bowtell. (See BOWTELL.)

RUBBLE WORK, a name applied to several species of masonry. One kind, where the stones are loosely thrown together in a wall between boards, and grouted with mortar almost like concrete, is called in Italian *muraglia di getto*, and in French *blocage*. Work executed with large stones put together without any attempt at courses, or random work, is also called rubble.

SACRISTY (Lat. *sacrarium*, Fr. *sacristie*, Ital. *sagrestia*), a small chamber attached to churches, where the chalices, vestments, books, &c., were kept by the officer called the sacristan. In the early Christian basilicas there were two semicircular recesses or apsides, one on each side of the altar. One of these served as a sacristy, and the other as the bibliotheca or library. Some have supposed the sacristy to have been the place where the vestments were kept, and the vestry that where the priests put them on; but we find from Durandus that the *sacrarium* was used for both these purposes. Sometimes the place where the altar stands enclosed by the rails has been called *sacrarium*.

SADDLE BARS (Fr. *traverses*), narrow horizontal iron bars passing from mullion to mullion, and often through the whole window from side to side, to steady the stone work, and to form stays, to which the lead work is secured. When the bays of the windows are wide, the lead lights are further strengthened by upright bars, passing through eyes forged on the saddle bars, and called *stanchions* (see STANCHION and ARMATURE). When saddle bars pass right through the mullions in one piece, and are secured to the jambs, they have sometimes been called *stay bars*.

SANCTUS BELL-COT or TURRET, a turret or enclosure to hold the small bell sounded at various parts of the service, particularly where the words "Sanctus," &c., are read. This differs but little from the common bell-cot, except that it is generally on the top of the arch dividing the nave from the chancel. At Cleeve, however, the bell seems to have been placed in a cot outside the wall. Sanctus bells have also been placed over the gables of porches. On the Continent they run up into a sort of small slender spire, called *flèche* in France, and *guglio* in Italy. (See BELL-COT.)

SCAPPLING, reducing a stone to a rough square by the axe or hammer; in Kent, the rag-stone masons call this knobbling.

SCOTIA (Gr. σκοτία, shadow or darkness), a concave moulding most commonly used in bases, which projects a deep shadow on itself, and is thereby a most effective moulding under the eye, as in a base. It is like a reversed ovolo, or rather what the mould of an ovolo would present.

SCREEN, any construction subdividing one part of a building from another—as a choir, chantry, chapel, &c. The earliest screens are the low marble *podia*, shutting off the *chorus cantantium* in the Roman basilicas, and the perforated *cancelli* enclosing the bema, altar, and seats of the bishops and presbyters. The chief screens in a church are those which enclose the choir or the place where the breviary services are recited. This is done on the Continent, not only by doors and screen work, but also, when these are of open work, by curtains, the laity having no part in these services. In England screens were of two kinds, one of open wood work, generally called *rood-screens* or *jubes* (which see), and which the French call *grilles*, *clôtures du chœur*; the other, massive enclosures of stone work enriched with niches, tabernacles, canopies, pinnacles, statues, crestings, &c., as at Canterbury, York, Gloucester, and many other places both in England and abroad.

SCROLL, synonymous with VOLUTE, *q.v.*, but commonly applied to ordinary purposes, whilst volute is generally restricted to the scrolls of the Ionic capital.

SCUTCHEON. (See ESCUTCHEON.)

SECTION, a drawing showing the internal heights of the various parts of a building. It supposes the building to be cut through entirely, so as to exhibit the walls, the heights of the internal doors and other apertures, the heights of the stories, thicknesses of the floors, &c. It is one of the species of drawings necessary to the exhibition of a DESIGN, *q.v.*

SEDILIA, seats used by the celebrants during the pauses in the mass. They are generally three in number, for the priest, deacon, and sub-deacon, and are in England almost always a species of niches cut into the south walls of churches, separated by shafts or by species of mullions, and crowned with canopies, pinnacles, and other enrichments more or less elaborate. The piscina and aumbry sometimes are attached to them. Abroad, the sedilia are often movable seats: a single stone seat has rarely been found as at Lenham; but some have considered this to be a confessional chair, and others a frith-stole, or place to which criminals fled for sanctuary.

SEPULCHRE, EASTER, a recess in the wall of a church generally in the north side, often ornamented with a canopy, finials, &c., for the crucifix to stand in during certain rites from Good Friday to Easter Day.

Set-off, the horizontal line shown where a wall is reduced in thickness, and consequently the part of the thicker portion appears projecting before the thinner. In plinths this is generally simply chamfered. In other parts of work the set-off is generally concealed by a projecting string. Where, as in parapets, the upper part projects before the lower, the break is generally hid by a corbel table. The portions of buttress caps which recede one behind another are also called sets-off.

Severy (probably connected with the English word *sever*), any main compartment or division of a building. (See Bay.) The word has been supposed to be a corruption of Ciborium, as Gervase of Canterbury uses the word in this sense; but he probably alludes to the *vaulted* form of the upper part of the groining of each severy. (See Ciborium.)

Shaft (Fr. *colonnette*, Ital. *colonnetto*, Ger. *Schaft*), in classical architecture that part of a column between the necking and the apophyge at top of the base. In later times the term is applied to slender columns either standing alone or in connection with pillars, buttresses, jambs, vaulting, &c.

Shed Roof or **Lean-to**, a roof with only one set of rafters, falling from a higher to a lower wall, like an aisle roof.

Shingle (Med. Lat. *scandula, scindula*, Fr. *bardeau, essente*, Ital. *scandola*, Ger. *Schindel*), a sort of wooden tile, generally of oak, used in places where timber is plentiful, for covering roofs, spires, &c. In England they are generally plain, but on the Continent the ends are sometimes rounded, pointed, or cut into ornamental form.

Shrine (Med. Lat. *feretorium, scrinium*, Fr. *châsse, écrin*, Ital. *scrigno*), a sort of ark or chest to hold relics. Sometimes they are merely small boxes, generally with raised tops like roofs; sometimes actual models of churches; sometimes large constructions like that at St Albans, that of Edward the Confessor at Westminster, of St Geneviève at Paris, &c. Many are covered with jewels in the richest way; that of San Carlo Borromeo, at Milan, is of beaten silver.

Sill or **Sole** (Lat. *solum*, a threshold, whence the Fr. *seuil*), the horizontal base of a door or window-frame. A technical distinction is made between the inner or wooden base of the window-frame and the stone base on which it rests,—the latter being called the sill of the window, and the former that of its frame. This term is not restricted to the bases of apertures; the lower horizontal part of a framed partition is called its sill. The term is sometimes incorrectly written cill.

Sleeper (Fr. *dormant*), a piece of timber laid on low cross walls as a plate to receive ground joists.

Slype, a name for the covered passage usually found in monasteries between the end of the transept and the chapter-house.

Soffit (Ital. *soffitta*, a ceiling), the inverted horizontal face of anything, as, for example, of an entablature resting on and lying open between the columns or the underface of an arch where its thickness is seen.

Solar, **Soller** (Med. Lat. *solarium*, Fr. *galetas*, Ital. *solaio*), a room in some high situation, a loft or garret, also an elevated chamber in a church from which to watch the lamps burning before the altars.

Sole. See Sill.

Sommer (Fr. *sommier*), a girder or main-beam of a floor; if supported on two story posts and open below, it is called a *brace-summer*.

Sound Board (Fr. *abat-voix*), the covering of a pulpit to deflect the sound into a church. (See Testee.)

Span, the width or opening of an arch between the walls, &c., from which it springs, also the width of a roof between the plates.

Span Roof, a roof having two sides inclining to a centre or ridge, in contradistinction to a Shed Roof (which see).

Spandril or **Spandrel**, the space between any arch or curved brace and the level label, beams, &c., over the same. The spandrils over door-ways in Perpendicular works are generally richly decorated. At Magdalene College, Oxford, is one which is perforated, and has a most beautiful effect. The spandril of doors is sometimes ornamented in the Decorated period, but seldom forms part of the composition of the doorway itself, being generally over the label.

Spire (Fr. *aiguille, flèche*, Ital. *guglio*, Ger. *Spitze*), a sharply-pointed pyramid or large pinnacle, generally octagonal in England, and forming a finish to the tops of towers. In this country, in Norman times, the only attempt at anything like a spire consisted in the termination of some turrets, as those at Rochester, at St Peter's, Oxford, &c.; but these are rather Pinnacles (which see) than spires. Later Norman spires are supposed to have been merely low pyramidal roofs. In the Early English period they appear at first to have been low, as the remains of the one at Christ Church, Oxford, show; but afterwards they become much more lofty and sharply pointed. The probability is that the sight of the high domes and aspiring minarets of the Holy Land had suggested the erection of these lofty monuments to the Crusaders. At this period the spires generally covered the whole tower top, and had launchings where the square broke into the octagon. In the Decorated period the spires became still slenderer and sharper; the broach spire gradually gave place to those rising at once in octagon form from the flat of the towers surrounded with parapets, often richly perforated, and with pinnacles at the angles. The spires themselves often are decorated with ball-flowers and crockets, and sometimes have broad horizontal bands of tracery at intervals. In both these styles spire lights or *lucarnes* are common. Perpendicular spires partake also of most of these characteristics, except that they scarcely furnish an example of a broach spire. It is remarkable with how little material some of the loftiest spires have been erected, that at Salisbury being barely 9 inches thick for a great part of its height. On the Continent the spire seems to have been used earlier than with us. That at Brantôme is a mere low pyramid. At Saintes it is a low carved cone, with something of domical character. At Roullet it is a sharp circular cone, with four open pinnacles at the base. At Isomes it is octagonal, and as sharp as many of our Early English spires. In all these examples the windows below are semicircular. Timber spires are very common in England. Some are covered with lead in flat sheets, others with the same metal in narrow stripes laid diagonally. Very many are covered with shingles. Abroad there are some elegant examples of spires of open timber work covered with lead.

Spire-Lights. See Lucarne.

Springer, the stone from which an arch springs; in some cases this is a capital, or impost, in other cases the mouldings continue down the pier. The lowest stone of the gable is sometimes called a springer.

Spur, **Sperver**. The word *spur* is often applied to the carved wooden brackets or *hanses* which support the penthouse of a door, the level part being called a *sperver*.

Squinches, small arches or corbelled sets-off running diagonally, and, as it were, cutting off the corners of the interior of towers, to bring them from the square to the octagon, &c., to carry a spire. (See Pendentive.)

Squint, an oblique opening, often a mere narrow, square-headed slit, piercing the walls of the chancel arch, and evidently intended to afford a view of the high altar. Squints are often without any ornament, but are sometimes arched and occasionally enriched with open tracery. Sometimes they look from the rooms over porches, sometimes from side chapels, but in every instance are so situated that the altar may be seen. The most probable use of them was to let the acolyte appointed to ring the sanctus bell see the performance of mass, and enable him to sound the bell at the proper time.

Stage, an elevated floor, particularly the various stories of a bell-tower, &c. The term is also applied to the plain parts of buttresses between cap and cap where they set back, or where they are divided by horizontal strings and panelling. It is used, too, by William of Worcester to describe the compartments of windows between transom and transom, in contradistinction to the word *bay*, which signifies a division between mullion and mullion. (See Story.)

Stall, a fixed seat in the choir for the use of the clergy. In early Christian times the *thronus, cathedra*, or seat of the bishop, was in the centre of the apsis or bema behind the altar, and against the wall; those of the presbyters also were against the wall, branching off from side to side round the semicircle. In later times the stalls occupied both sides of the choir, return seats being placed at the ends for the prior, dean, precentor, chancellor, or other officers. The seats are very peculiar. (See Miserere.) In general, in cathedrals, each stall is surmounted by tabernacle work, and rich canopies, generally of oak, of which those at Winchester, Henry VII.'s Chapel, and Manchester, may be quoted as fine instances. (See Tabernacle, Canopy.) The word is sometimes used to express any chief seat, as in a dining hall.

Stanchion, a word derived from the French *étançon*, a wooden post, and applied to the upright iron bars which pass through the eyes of the saddle bars or horizontal irons to steady the lead lights. The French call the latter *traverses*, the stanchions *montans*, and the whole arrangement *armature*. Stanchions frequently finish with ornamental heads forged out of the iron.

Stay Bars, saddle bars passing through the mullions in one length across the whole window, and secured to the jambs on each side. (See Saddle Bar.)

Steeple (Fr. *clocher*, Ital. *campanile*, Ger. *Glockenthurm*), a general name for the whole arrangement of Tower, Belfry, Spire, &c. (See under those headings.)

Stele (Gr. στήλη, Lat. *cippus*, a small monument), the ornament on the ridge of a Greek temple, answering to the antefixæ on the summit of the flank entablatures.

Stereobate (Gr. στερεός, solid, and βάσις, a base), a basement, distinguished from the nearly equivalent term Stylobate, *q.v.*, by the absence of columns

Stilted, anything raised above its usual level.

Stoa (Gr. στοά, a portico), the Greek equivalent for the Latin Porticus, and the Italo-English Portico, *q.v.*

STORY (Lat. *tabulatum*, Fr. *étage*, Ital. *piano*, Ger. *Geschoss*). When a house has rooms one over the other, each set of chambers divided horizontally by the floors is called a story. They are thus named in the different languages :—

	English.	French	Italian.	German.
Lowest story.	Basement.	Souterrain—Cave.	Sotterraneo.	Kellergeschoss.
Ground do.	Ground floor.	Rez de chaussée.	Pianterreno.	Bodengeschoss.
Half story or intermediate.	Mezzanine.	Entresol.	Mezzanino.	...
First story.	First floor.	Premier étage, also Bel etage.	Primo piano, also piano, nobile.	Hauptgeschoss.
Second story.	Second floor.	As their	numbers.	...
Upper story.	Garret.	Mansard.	Solaio.	Dachgeschoss.

STOUP (Fr. *bénitier*), a vessel placed close to the entrance of a church to contain the holy water. They are generally small bowls fixed against a column, or on a stem. In the north of Italy they are larger, and often carried on the back of a lion, and sometimes they are elegant *tazze* of exquisite workmanship.

STRING or STRING-COURSE, a narrow, vertically-faced, and slightly projecting course in an elevation. If window-sills are made continuous, they form a string-course; but if this course is made thicker or deeper than ordinary window-sills, or covers a set-off in the wall, it becomes a blocking-course.

STRING-COURSES, horizontal mouldings running under windows, separating the walls from the plain part of the parapets, dividing towers into stories or stages, &c. Their section is much the same as the labels of the respective periods; in fact, these last, after passing round the windows, frequently run on horizontally and form strings. Like labels they are often decorated with foliages, ball-flowers, &c.

STRIP PILASTER, a very narrow pilaster.

STUDS, an old name for upright quarters or posts; thus door-studs are door-posts or jambs.

STYLE (Gr. στῦλος, a column). The term style in architecture has obtained a conventional meaning beyond its simpler one, which applies only to columns and columnar arrangements. It is now used to signify the differences in the mouldings, general outlines, ornaments, and other details which exist between the works of various nations, and also those differences which are found to exist between the works of any one nation at different times.

STYLOBATE (Gr. στῦλος, a column, and βάσις, a base), a basement to columns. (See STEREOBATE.) Stylobate is synonymous with pedestal, but is applied to a continued and unbroken substructure or basement to columns, while the latter term is confined to insulated supports.

SURBASE (Lat. *super*, whence the Fr. *sur*, above or upon, and BASE, *q.v.*), an upper base is the term applied to what, in the fittings of a room, is familiarly called the chair-rail. It is also used to distinguish the cornice of a pedestal or stereobate, and is separated from the base by the dado or die.

SYSTYLE (Gr. σύν, together with, and στῦλος, a column), having columns rather thickly set,—an intercolumniation to which two diameters are assigned. (See EUSTYLE.)

TABERNACLE, a species of niche or recess in which an image may be placed. In Norman work there are but few remains, and these generally over doorways. They are shallow and comparatively plain, and the figures are often only in low relief, and not detached statues. In Early English work they are deeper, and instead of simple arches there is often a canopy over the figure, which was placed on a small low pedestal. Later in the style the heads of the tabernacles became cusped, either as trefoils or cinquefoils, and they are often placed in pairs, side by side, or in ranges, as at Wells Cathedral. Decorated tabernacles are still deeper and more ornamented, the heads are sometimes richly cusped and surmounted with crocketed gables, as at York, or with projecting canopies, very much like the arcade at Lichfield. In this case the under side of the canopy is carved to imitate groin ribs, and the figures stand either on high pedestals, or on corbels. Perpendicular tabernacles possess much the same features, but the work is generally more elaborate; the figures generally stand on rich pedestals, but sometimes on corbels, and the canopies generally project, sometimes in a triangular form, and sometimes with a sort of domical top. (See CORBEL, CANOPY, NICHE, &c.) The word tabernacle is also often used for the receptacle for relics, which was often made in the form of a small house or church. (See SHRINE.)

TABERNACLE-WORK. The rich ornamental tracery forming the canopy, &c., to a tabernacle is called tabernacle-work; it is common in the stalls and screens of cathedrals, and in them is generally open or pierced through.

TABLE, TABLET, a name for various mouldings, as string-courses, cornices, &c.

TERMINAL. Figures of which the upper parts only, or perhaps the head and shoulders alone, are carved, the rest running into a parallelopiped, and sometimes into a diminishing pedestal, with feet indicated below, or even without them, are called terminal figures.

TESSELLATED PAVEMENTS, those formed of *tesseræ*, or, as some write it, *tessellæ*, or small cubes from half an inch to an inch square like dice, of pottery, stone, marble, enamel, &c. (See MOSAIC.)

TESTER, anything placed horizontally over the head, as the sound-board of a pulpit, the flat boards over an old-fashioned bed, &c.

TETRASTOÖN (Gr. τέτρα, four, and στόα, a portico). An atrium or rectangular court-yard, having a colonnade or projected orthostyle on every side, is called a tetrastoön.

TETRASTYLE (Gr. τέτρα, four, and στῦλος, a column), a portico of four columns in front.

THOLOBATE (Gr. θόλος, a dome or cupola, and βάσις, a base or substructure), that on which a dome or cupola rests. This is a term not in general use, but it is not the less of useful application. What is generally termed the attic above the peristyle and under the cupola of St Paul's would be correctly designated the tholobate. A tholobate of a different description, and one to which no other name can well be applied, is the circular substructure to the cupola of the University College, London.

THROUGH CARVING, a term supposed to signify such as is much undercut, as the tendrils, stalks, &c., in Decorated, and the vignettes in Perpendicular work. In the Durham roll it clearly means perforated work, as it is "to giue ayre."

TILES, ROOF (Lat. *tegula*, *imbrex*, Fr. *tuile*, Ital. *tegola*), flat pieces of clay burned in kilns, to cover roofs in place of slates or lead. In England, in mediæval times, the flat or planetile seems only to have been used, judging from what we find now left. From MS. and remains abroad, a kind of plane-tile, with ornamented ends, forming a sort of scale covering, seems to have been in vogue.

TORUS (Lat.), a protuberance or swelling, a moulding whose form is convex, and generally nearly approaches a semicircle. It is most frequently used in bases, and is generally the lowest moulding in a base.

TOWER (Gr. Πύργος, Lat. *turris*, Fr. *tour*, *clocher*, Ital. *torre*, Ger. *Thurm*), an elevated building originally designed for purposes of defence. Those buildings are of the remotest antiquity, and are, indeed, mentioned in the earliest Scriptures. In mediæval times they are generally attached to churches, to cemeteries, to castles, or are used as bell-towers in public places of large cities. In churches, the towers of the Saxon period are generally square, the only round example being supposed to be that of Tasburgh. They are not very lofty, and are of strong, rude workmanship. Two only, Brigstock and Brixworth, have staircases supposed to be original; both these are on the west front of the tower. The masonry partakes of the usual character attributed to Saxon work, as strip pilasters, long and short work, &c. The upper windows are generally circular-headed in two lights, separated by a shaft much resembling a turned baluster sometimes with heavy projecting caps. Norman towers are also generally square. Many are entirely without buttresses; others have broad, flat, shallow projections, which serve for this purpose. The lower windows are very narrow, with extremely wide splays inside, probably intended to be defended by archers. The upper windows, like those of the preceding style, are generally separated into two lights, but by a shaft or short column, and not by a baluster. Sometimes these towers have arcades round them, and are ornamented, as at St Albans, in some cases very richly, as at Norwich, Winchester, Tewkesbury, Southwell, Sandwich, &c. They frequently have stone staircases at one of the angles. In many of our churches the Norman tower is placed between the chancel and nave, and is of the full width of the latter. For the covering of these towers abroad, see SPIRE, PINNACLE, PARAPET. A few round towers of this period (and also of the next) are found on the coasts of Norfolk and Suffolk; as these mostly have no external doors, and are accessible only from the church, and as some have chimneys, they are supposed to have been built as places of refuge in case of invasion. Early English towers are generally taller, and of more elegant proportions. They almost always have large projecting buttresses, and frequently stone staircases. The lower windows, as in the former style, are frequently mere arrow-slits; the upper are in couplets or triplets, and sometimes the tower top has an arcade all round, as at Middleton Stoney. The spires are generally BROACH SPIRES (which see); but sometimes the tower tops finish with corbel courses and plain parapets, and (rarely) with pinnacles. Some of the towers and spires, particularly in the midland counties, are richly ornamented; a very good specimen is at Raunds. A few Early English towers break into the octagon from the square towards the top, and still fewer finish with two gables, as at Brookthorpe and Ickford. Both these methods of termination, however, are common on the Continent. At Vendôme, Chartres, and Senlis, the towers have octagonal upper stages surrounded with pinnacles, from which elegant spires arise. Decorated towers differ but little from these last, except that they are often lighter in effect; the buttresses, too, are set angularly; the parapets are also frequently embattled, or perforated in elegant designs, and these generally have pinnacles. The spires, also, now generally arise at once from the octagon, and are not broach spires; those that are of this latter character have the haunchings much smaller. There is a fine example of a Decorated tower and spire at Ellington, in Huntingdonshire. Most Perpendicular towers are very fine, particularly the great central towers, as at Canterbury and Gloucester. They are generally richly panelled throughout; the buttresses project boldly, and are sometimes set anglewise, and sometimes square, not close to each other, but showing a small portion of the angle of the tower where they otherwise would have intersected. The pinnacles are often richly canopied and the battlements panelled, and often perforated; sometimes a pinnacle, and sometimes a canopied niche, is placed in the middle of the parapet. At Boston, and in several other places, there are fine lanterns at the tops of the towers. Taunton, Evesham, Louth, Magdalene College, Oxford, and very many other places, have very fine Perpendicular towers. In the north of Italy, and in Rome, they are generally tall, square shafts in four to six etages, without buttresses, with couplets or triplets of semicircular windows in each stage, generally crenellated at top, and covered with a low pyramidal roof. The well-known hanging tower at Pisa is cylindrical, in five stories of arcaded colonnades. In Ireland there are in some of the churchyards very curious round towers.

TRACERY, the ornamental filling in of the heads of windows, panels, circular windows, &c., which has given such characteristic beauty to the architecture of the 14th century. Like almost everything connected with mediæval architecture, this elegant and sometimes fairy-like decoration seems to have sprung from the smallest beginnings. The circular-headed window of the Normans gradually gave way to the narrow-pointed lancets of the Early English period, and as less light was afforded by the latter system than by the former, it was necessary to have a greater number of windows; and it was found convenient to group them together in couplets, triplets, &c. When these couplets were assembled under one label, a sort of vacant space or spandril was formed over the lancets and under the label. To relieve this, the first attempts were simply to perforate this flat spandril, first by a simple lozenge-shaped or circular opening, and afterwards by a quatrefoil. By piercing the whole of the vacant spaces in the window head, carrying mouldings round the tracery, and adding cusps to it, the formation of tracery was complete, and its earliest result was the beautiful geometrical work such as is found at Westminster Abbey. When this style had reached perfection the usual decline followed; and the architects of the Decorated period designed tracery, beautiful in itself, but which wants the vigour of the geometrical, and appears more as if the stonework had been twisted than if it had been cut out of the solid. Nevertheless, however fanciful the design may be, the whole element is really geometrical—that is, it is formed of portions of circles, the centres of which fall on the intersections of certain geometrical figures. The great east window at Carlisle is composed of 86 distinct pieces of stone, and is struck from 263 centres; and the glorious west window at York is probably produced from a still greater number. Probably as a reaction against the weakness of the Decorated, the flowing tracery gradually admitted upright straight lines into its element. This change was perhaps made to afford, as it were, rectilineal frames to suit the glass painter, the foliages and medallions of the preceding styles having given way to single figures, standing on pedestals under rich canopies. Be this as it may, these have given a name to the style of the 15th and 16th centuries. The mullions then, as at King's College Chapel, at St John's, Oxford, and in several other examples, had more flow, and fewer perpendicular lines, till at last plain, upright, and transverse bars took their place, and held casement lights, which were at last superseded by our modern sash windows. On the Continent, the windows of the first period, or *ogivale primitive*, were very much like our own Early English. So in like manner those of the early part of the *ogivale secondaire* were very much like our own Geometrical Decorated. Later, however, in France and Germany, two styles prevailed, the *Rayonnant* and *Flamboyant*, the one having tracery assuming the character of stars or rays, and after this another coeval with our Perpendicular, resembling flames of fire.

TRACHELIUM (Gr. τράχηλος, the neck). In Doric and Ionic columns there is generally a short space intervening between the hypotrachelium and the mass of the capital, which may be called the trachelium or neck.

TRANSEPT (Med. Lat. *crux*, Fr. *transept*, Ital. *crociata*, Ger. *Kreuzgang*), that portion of a church which passes transversely between the nave and choir at right angles, and so forms a cross on plan.

TRANSOM (Fr. *traverse*, Ital. *traversa*, Ger. *Querbalken*), the horizontal construction which divides a window into heights or stages. Transoms are sometimes simple pieces of mullions placed transversely as cross-bars, and in later times are richly decorated with cuspings, &c.

TRAYLE. See VIGNETTE.

TREFOIL (Lat. *trifolium*), a cusping, the outline of which is derived from a three-leaved flower or leaf, as the *quatrefoil* and *cinquefoil* are from those with four and five.

TRIFORIUM, the arcaded story between the lower range of piers and arches and the clerestory. The name has been supposed to be derived from *tres* and *fores*—three doors or openings—that being a frequent number of arches in each bay. Professor Willis, however, believed that the word is to be traced to a monkish latinisation of "thoroughfare."

TRIGLYPH (Gr. τρεῖς, three, and γλυφή, an incision or carving). The vertically channelled tablets of the Doric frieze are called triglyphs, because of the three angular channels in them, two perfect and one divided,—the two chamfered angles or hemiglyphs being reckoned as one. The square sunk spaces between the triglyphs on a frieze are called metopes.

TUDOR FLOWER, or CRESTING, an ornament much used in the Tudor period on the tops of the cornices of screen work, &c., instead of battlements. It is a sort of stiff, flat, upright leaf standing on stems.

TURRET (Fr. *tourelle*), a small tower, especially at the angles of larger buildings, sometimes overhanging and built on corbels, and sometimes rising from the ground.

TYMPANUM (Gr. τύμπανον), the triangular recessed space enclosed by the cornice which bounds a pediment. The Greeks often placed sculptures representing subjects connected with the purposes of the edifice in the tympana of temples, as at the Parthenon and Ægina.

UNDER-CROFT, a vaulted chamber under ground.

VALURE, VAMURE. See ALURE.

VANE (Fr. *girouette*, Ital. *banderuola*, Ger. *Wetterfahne*), the weathercock on a steeple. They seem in early times to have been of various forms, as dragons, &c.; but in the Tudor period, the favourite design was a beast or bird sitting on a slender pedestal, and carrying an upright rod, on which a thin plate of metal is hung like a flag, ornamented in various ways.

VAULT (from Ital. *voltato*, turned over), an arched ceiling or roof. A vault is, indeed, a laterally conjoined series of arches. The arch of a bridge is, strictly speaking, a vault. Intersecting vaults are said to be groined. (See GROINED VAULTING.)

VAULTING SHAFT, a small column or series of clustered shafts, rising from above the capitals of the pillars of an arcade, and generally supported on a corbel, and thence rising and finishing with a capital, from which the various groin ribs spring.

VERGE, the edge of the tiling projecting over the gable of a roof; that on the horizontal portion being called *eaves*.

VERGE BOARD, often corrupted into Barge Board, the board under the verge of gables, sometimes moulded, and often very richly carved, perforated, and cusped, and frequently having pendents and sometimes finials at the apex.

VESICA PISCIS (Fr. *amande mystique*), panels, windows, and other ornaments of the form of a species of oval with pointed end, but in reality struck from two centres, and forming part of two circles cutting each other.

VESTRY. See SACRISTY.

VIGNETTE, a running ornament, representing, as its name imports, a little vine, with branches, leaves, and grapes. It is common in the Tudor period, and runs or *roves* in a large hollow or *casement*. It is also called *Trayle*.

VOLUTE (Lat. *volutum*, from *volvo*, to roll up or over), the convolved or spiral ornament which forms the characteristic of the Ionic capital. The common English term is SCROLL, *q.v.* Volute, scroll, helix, and cauliculus, are used indifferently for the angular horns of the Corinthian capital.

VOUSSOIR, a name in common use for the various wedge-shaped stones of an arch.

WAGGON-CEILING, a boarded roof of the Tudor time, either of semicircular or polygonal section. It is boarded with thin oak, and ornamented with mouldings forming panels, and with loops at the intersections. (See PANEL.)

WARD, a name for the inner courts of a fortified place. At Windsor Castle they are called the upper and lower wards. (See BAILEY, BASE COURT, ENCEINTE, &c.)

WEATHERING, a slight fall on the top of cornices, window sills, &c., to throw off the rain.

WICKET (Fr. *guichet*, Ital. *portello*), a small door opening in a larger. They are common in mediæval doors, and were intended to admit single persons, and guard against sudden surprises.

WIND BRACES, diagonal braces to tie the rafters of a roof together and prevent *racking*. In the better sort of mediæval roofs they are arched, and run from the principal rafters to catch the purlins.

ZOÖPHORUS (Gr. ζῷον, an animal, and φέρω, to bear). This term is used in the same sense as frieze, and is so called because that part of the entablature frequently bore sculptures representing various animals

ARCHIVES (Greek $\grave{\alpha}\rho\chi\epsilon\hat{\iota}o\nu$, Lat. *archivum*), a room or building in which are kept the records, charters, and other papers belonging to any state, community, or family. Very frequently the name is applied to the documents themselves. The archives of Britain are now superintended by the Public Record Office.

ARCHON ($\check{\alpha}\rho\chi\omega\nu$), the title of the highest magistrates in Athens. The last king of Athens, Codrus, having given up his life for the advantage of the state, it is said that the people, out of gratitude for his noble act, passed a resolution that in future none of their rulers should bear the ancient and venerated title of king ($\beta\alpha\sigma\iota\lambda\epsilon\acute{\upsilon}s$). The holder of supreme power in the state received from that time the name of archon or ruler. This is the popular account of the change, but it is not improbable that, on the death of Codrus, disputes arose with regard to the succession, and that the nobles took advantage of the opportunity to gain an addition to their own power. For the archon appears to have been in all respects equal to the king, and his office was hereditary, but he was made responsible for his acts to the Eupatridæ or nobles. Thirteen descendants of Codrus successively held the office. In 752 B.C., during the archonship of Alcmæon, the time of office was reduced to ten years, though the office itself remained hereditary. Seven decennial archons are enumerated, extending from 752 to 684. But during this time, about the year 714, a very important change had been introduced into the archonship. The office at that date ceased to be hereditary; the exclusive right of the Medontidæ was abolished, and the whole body of nobles became eligible for the magistracy. In 684 a further change was effected; the office was made annual, and the supreme power was distributed among nine officials, each of whom received the title of archon. This arrangement of the magistracy continued till the time of Solon, who introduced the classification of the citizens according to property and not to birth, and threw the office open to all who possessed an income of the first class, apparently calculated as five hundred measures of corn, wine, and oil (Plutarch, *Aristides*, 1). The most extensive and important change was introduced by Aristides, who after the battle of Platæa threw open the highest magistracy to all citizens, whether of the propertied class or not. The mode of election to the archonship, after the office was taken from the family of Codrus, was by the suffrage ($\chi\epsilon\iota\rho o\tau o\nu\acute{\iota}\alpha$) of the nobles; and this continued to be the case even after the reform effected by Solon, for it is expressly stated that though he altered the qualification he made no change in the manner of election. The great reform in this respect was probably due to Clisthenes, who in 508 introduced the election by lot, and who further, by his distribution of the people into tribes and appointment of generals, seriously impaired the power of the archons. To secure that the office and honours were not conferred on unworthy persons, the newly elected archons were subjected to a double scrutiny, before the senate and in the agora, in which they were required to show that they were true Athenian citizens, whose ancestors had been citizens for three generations, and to swear that they would obey the laws and revere the religion of their country.

Of the nine archons to whom in conjunction were entrusted the duties of the supreme magistracy, the first was called specially "The Archon" ($\acute{o}\ \check{\alpha}\rho\chi\omega\nu$); there was also attached to his name the epithet *eponymus* ($\grave{\epsilon}\pi\acute{\omega}\nu\upsilon\mu o s$), because the year in which he held office was named after him, just as at Rome it was named after the two consuls. At first this archon had the general administration of state affairs, but gradually the expansion of democratic power reduced his authority, and at the period of which we have accurate information his duties were not very extensive. He had the superintendence of the festivals of the greater Dionysia and of the Thargelia, the arrangement of the tragic choruses, and the conduct of certain sacrifices. As a special department of civil administration, he had under his care all orphans, particularly heiresses, all widows, and others who were left without protection, provided they were citizens of Athens; and had, in short, the charge of all matters in which questions of inheritance were involved. When his power was still further reduced, there remained to him the privilege of bringing disputed cases of succession into the proper courts, and of casting lots for the dicasts who were to try the cause. The second archon had the title of king ($\beta\alpha\sigma\iota\lambda\epsilon\acute{\upsilon}s$); to him had been handed over the name, as well as the sacred duties of priesthood which formerly belonged to the supreme ruler. He was the *rex sacrorum*, and to his province pertained all that concerned the religion and public worship of the state. In conjunction with his wife, who was called $\beta\alpha\sigma\acute{\iota}\lambda\iota\sigma\sigma\alpha$ (or queen), he offered up certain state sacrifices; and he had specially intrusted to him the superintendence of the mysteries, the festival of the Lenæa, the torch races, and the gymnic contests. He acted as public prosecutor in matters of religion; and, in cases of murder or offence against the gods, he brought the indictment into the Areopagus, and voted with its members. In later times he acted as president of the court in all cases concerning the rights and duties of priests. The third archon bore the title of polemarch ($\pi o\lambda\acute{\epsilon}\mu\alpha\rho\chi o s$), which indicates that originally he was the supreme commander of the Athenian forces. As late as the battle of Marathon we find the polemarch Callimachus marching along with the ten generals, and taking the command of the right wing. But after this we no longer hear of the polemarch as actively engaged in leading the army. Doubtless the introduction of the ten generals by Clisthenes tended to limit the military functions of this archon. His duties in later times seem to have been the superintendence and protection of the personal and family rights of the resident aliens and foreigners. To these he stood in the same relation as the archon eponymus stood to citizens. He had also the arrangement of the funeral games in honour of those who had fallen in battle, and the offering up of the annual sacrifice to Artemis in commemoration of the battle of Marathon. Each of the three superior archons was allowed to select two assessors or assistants ($\pi\acute{\alpha}\rho\epsilon\delta\rho o\iota$), who were sanctioned after examination by the senate. The remaining six archons were called thesmothetæ ($\theta\epsilon\sigma\mu o\theta\acute{\epsilon}\tau\alpha\iota$), a name which is sometimes applied to the whole body of archons. The six formed a college of justice, whose jurisdiction seems at first to have extended to all cases not directly under the cognisance of other magistrates. They received information against parties for various offences, brought the cases to trial in the proper court, appointed the juries, and gave public notice of the days of sitting. They revised every year the body of laws to see that no discrepancies were allowed to creep in, and they were required to enter all new laws. They also drew up and ratified the treaties with foreign states. Their assessors were called symbuli ($\sigma\acute{\upsilon}\mu\beta o\upsilon\lambda o\iota$). After the introduction of popular courts by Solon, the archons seem to have lost their special juridical powers; they then acted simply as presidents of the courts and sometimes as a grand jury. During their year of office the archons were exempt from all state burdens, and at its close they were required to give an account of the manner in which they had discharged their duties; if found blameless, they became members of the Areopagus.

The name archon is frequently applied by Greek authors to magistrates in general; it was also used as a title under the Greek empire, and the Jews sometimes applied it to members of their Sanhedrim. It was even given metaphorically by the Gnostice to their mystic æons.

ARCHYTAS, of Tarentum, son of Mnesagoras or Histiæus, was one of the most celebrated men of antiquity. He was distinguished as a mathematician, a philosopher, a statesman, and a general; nor was he less remarkable for the purity and integrity of his life and the mildness and benevolence of his disposition. The time at which he flourished can be settled approximately from the fact that he was contemporary with Plato, whom he knew personally, and whose life he saved by interceding with the tyrant Dionysius. He took a prominent part in the administration of the state, and was seven times made general of the army, although by a law it was forbidden that any citizen should hold the command more than once. It is said that he was never defeated in battle. He was also intrusted with the charge of many important civil affairs. There seems to have been a tradition (see Horace, *Odes*, i. 28) that Archytas was drowned while crossing the Adriatic, but of this there is no certain information. Archytas belonged to the Pythagorean school of philosophy, and is said by some to have been the teacher of Philolaos. This, however, must certainly be an error. According to others, he was the eighth leader of the Pythagorean school. Fragments of writings, said to be his, on various points of ethical and metaphysical philosophy, are given by Stobæus, Simplicius, and others. To portions of these Aristotle has been supposed to owe his doctrine of the Categories and some of his principal ethical theories. But it seems quite clear that scarcely any of these fragments are genuine, and that they belong to the 1st or 2d century A.D., a period during which Eclecticism, and a consequent desire to find traces of later doctrines in old writers, were the prevailing influences. Such fragments as do appear genuine are of no philosophical value, and are generally on special subjects. Archytas is particularly celebrated as a mathematician. To him are ascribed a solution of the problem of the duplication of the cube, and the application of analysis to the resolution of geometrical problems. He was also a skilled mechanician, and was one of the first to apply mathematics to mechanics and music. On the fragments of Archytas see Hartenstein, *De Archy. Taren. frag.*, Leipsic, 1833; Gruppe, *Ueber d. Frag. d. Archy.*, 1840; and Beckmann, *De Pythagor. Reliquiis*; also Zeller, *Phil. d. Griech.* 2d ed. iii. 2, 88, *sqq.*

ARCIS-SUR-AUBE, the chief town of the arrondissement of the same name, in the department of Aube, in France, is situated, in long. 4° 9′ E., lat. 48° 31′ N., about 17 miles (28 kilometres) N. of Troyes, on the left bank of the river, just at the point where it becomes navigable. It is mentioned in the *Itinerary* of Antoninus; but successive fires (1719, 1727, and 1814) have destroyed the ancient buildings, and it is now a town built in modern style, with wide and regular streets. An old castle, where Brunehaut and afterwards Diana of Poitiers resided, looks down on it from a height, the only other building of interest being the church, which dates from the 16th century. A battle was fought here on the 20th and 21st of March 1814 between Napoleon and the Austro-Russian army under Schwarzenberg, which led the former to retire upon Vitry, leaving the way open to Paris. There are important hosiery manufactures in the town, and it carries on a large trade in grain and coal, besides being an emporium for the wooden wares of the Vosges. Arcis-sur-Aube is on the highway between Troyes and Chalons-sur-Marne, and by means of the Aube it has intercourse with Paris. It is a subprefecture, and in 1872 had a population of 2845.

ARCOS DE LA FRONTERA, a Spanish town in the province of Cadiz, on the river Guadalete, which flows past Santa Maria into the bay of Cadiz. It is built upon a high and precipitous rock, and commands magnificent views. The special designation "of the frontier" is due to its position as a border town after its capture from the Moors by Alphonso the Wise. Its horses, reared in the plains below, are famous in the ancient ballads of Spain. It contains two parish churches, a number of convents, and 15,378 inhabitants.

ARCOT, two districts and a city of British India, within the presidency of Madras, and under the jurisdiction of the governor of that province. The district of NORTH ARCOT lies between 12° 22′ and 14° 11′ N. lat.; and between 78° 17′ and 80° 12′ E. long. It is bounded on the N. by the districts of Cuddapah and Nellor; on the E. by the district of Chengalpat; on the S. by the districts of South Arcot and Salem; and on the W. by the Mysor territory. The area of North Arcot, according to the *Annals of Indian Administration* for 1871–72, is 15,146 square miles; the population, as ascertained by a census taken in July 1871, being 2,007,667 souls. The aspect of the country, in the eastern and southern parts, is flat and uninteresting; but the western parts, where it runs along the foot of the Eastern Gháts, as well as all the country northwards from Trivellam to Tripalí and the Karkambadi Pass, are mountainous, with an agreeable diversity of scenery. The elevated platform in the west of the district is comparatively cool, being 2000 feet above the level of the sea, with a maximum range of the thermometer in the hottest weather of 88°. The hills are composed principally of granite and sienite, and have little vegetation. Patches of stunted jungle here and there diversify their rugged and barren aspect; but they abound in minerals, especially copper and iron ores. The narrow valleys between the hills are very fertile, having a rich soil and an abundant water-supply even in the dryest seasons. The principal river in the district is the Palár, which rises in Mysor, and flows through North Arcot from west to east past the towns of Vellor and Arcot, into the neighbouring district of Chengalpat, eventually falling into the sea at Sadras. Although a considerable stream in the rainy season, and often impassable, the bed is dry or nearly so during the rest of the year. Other smaller rivers of the district are the Painí, which passes near Chittur and falls into the Palár, the Sonámukhí, and the Chayaur. These streams are all dry during the hot season, but in the rains they flow freely and replenish the numerous tanks and irrigation channels. The principal roads in the district of North Arcot are the Trunk road from Madras to Bangalor, running from east to west; a road from north-east to south-west from Madras through North Arcot to Coimbator; and a road running north and south from Chittur to Arcot. The Madras Railway, and the Great Southern Indian Railway, also pass through the district. Grain of many species and cotton are largely grown throughout North Arcot, as well as sugar-cane and indigo. A part of the latter is sent to the Madras market. Cotton cloth is largely manufactured, and oil is prepared in considerable quantities for local consumption and for export. For fiscal purposes, the district is divided into the following fifteen *táluks*:—(1.) Chittur, (2.) Tripalí, (3.) Káverí Pak, (4.) Sholingarh, (5.) Trivellam, (6.) Sátgarh, (7.) Caddapanatam, (8.) Arcot, (9.) Vellor, (10.) Trivatur, (11.) Polur, (12.) Wandiwash, (13.) Satwaid, (14.) Penmari, and (15.) Venkatagiri Kota.

ARCOT, SOUTH, lies between 11° 0′ and 11° 39′ N. lat., and between 78° 42′ and 80° 4′ E. long. The district of South Arcot is bounded on the N. by the districts of North Arcot and Chengalpat; on the E. by the French territory of Pondecherri and the Bay of Bengal; on the S. by the British districts of Tanjor and Trichinopoly; and on the W. by the British district of Sálem. It contains an area, according to the *Annals of Indian Administration* for 1871–72, of 4779 square miles; and a population, as ascertained by a house census in July 1871, of 1,762,525. South Arcot is divided into thirteen fiscal divisions or táluks, as follows:—(1.) Tindevanum, (2.) Trivadi, (3.) Vilup-puran, (4.) Bhawangirí, (5.) Managudi, (6.) Chilambram, (7.) Trinsmáli, (8.) Vardháchalam, (9.) Elovansa, (10.) Trikalor, (11.) Kalakurchi, (12) Chaitpet, and (13.) Cuddalor. The aspect of the district resembles that of other parts of the Coromandel coast. It is low and sandy near the sea, and for the most part level till near the western border, where ranges of hills form the boundary between this and the neighbouring district of Sálem. These ranges are in some parts about 5000 feet high, with solitary hills scattered about the district. In the western tracts, dense patches of jungle furnish covert to tigers, leopards, bears, and monkeys. The principal river is the Coleroon or Kalerun, which forms the southern boundary of the district, separating it from Trichinopoly. This river is abundantly supplied with water during the greater part of the year, and two irrigating channels distribute its waters through the district. The other rivers are the Vellaur, Ponnár, and Gadalum, all of which are used for irrigation purposes. Numerous small irrigation channels lead off from them, by means of which a considerable area of fresh land has been brought under cultivation. Under the East India Company, a Commercial Resident was stationed at Cuddalor, and the Company's weavers were encouraged by many privileges. The manufacture and export of native cloth have now been almost entirely superseded by the introduction of European piece goods. The sea-ports of the district of South Arcot are Cuddalor or Fort St David, with a population, in 1855, returned at 36,686; and Porto Novo, with a population estimated, in 1855, at about 12,000 souls. The other places of importance in the district are Chilambram, Vardháchalam, Trivadi, Tiagár, Ginji or Chenji, Trinomáli, Chaitpet, Merkanam, and Verdur. The number of villages in South Arcot was returned, in 1850, at 3376. The total revenue of the district in that year amounted to £284,708, of which £234,055, or 82 per cent., represented the land revenue.

Arcot City, the principal town in the district of North Arcot, is situated on the south bank of the Palár river, in 12° 54′ N. lat., and 79° 24′ E. long. It is a station on the line of railway from Madras to Beypur, and is also a military cantonment. The population of the town, in 1862, was returned at 53,474 souls, inhabiting 10,042 houses. Arcot occupies a very prominent place in the history of the British conquests of India. In the middle of the last century, during the war between the rival claimants to the throne of the Carnatic, Muhammad Alí and Chandá Sáhib, the English supported the claims of the former and the French those of the latter. In order to divert the attention of Chandá Sáhib and his French auxiliaries from the siege of Trichinopoly, Clive suggested an attack upon Arcot, and offered to command the expedition. His offer was accepted; but the only force which could be spared to him, was 200 Europeans and 300 native troops to attack a fort garrisoned by 1100 men. The place, however, was abandoned without a struggle, and Clive took possession of the fortress. The expedition produced the desired effect; Chandá Sáhib was obliged to detach a large force of 10,000 men to recapture the city, and the pressure on the English garrison at Trichinopoly was removed. The siege of Arcot, in 1751, was conducted with great vigour by Rájá Sáhib, son of Chandá Sáhib, and is thus described by Macaulay:—

"Rájá Sáhib proceeded to invest the fort, which seemed quite incapable of sustaining a siege. The walls were ruinous, the ditches dry, the ramparts too narrow to admit the guns, and the battlements too low to protect the soldiers. The little garrison had been greatly reduced by casualties. It now consisted of 120 Europeans and 200 Sepoys. Only four officers were left, the stock of provisions was scanty, and the commander who had to conduct the defence under circumstances so discouraging was a young man of five-and-twenty, who had been bred a book-keeper. During fifty days the siege went on, and the young captain maintained the defence with a firmness, vigilance, and ability which would have done honour to the oldest marshal in Europe. The breach, however, increased day by day. Under such circumstances, any troops so scantily provided with officers might have been expected to show signs of insubordination; and the danger was peculiarly great in a force composed of men differing widely from each other in extraction, colour, language, manners, and religion. But the devotion of the little band to its chief surpassed anything that is related of the Tenth Legion of Cæsar, or the Old Guard of Napoleon. The Sepoys came to Clive, not to complain of their scanty fare, but to propose that all the grain should be given to the Europeans, who required more nourishment than the natives of Asia. The thin gruel, they said, which was strained away from the rice would suffice for themselves. History contains no more touching instance of military fidelity, or of the influence of a commanding mind. An attempt made by the governor of Madras to relieve the place had failed; but there was hope from another quarter. A body of 6000 Marhattás, half soldiers, half robbers, under the command of a chief named Murárí Ráo had been hired to assist Muhammad Alí; but thinking the French power irresistible, and the triumph of Chandá Sáhib certain, they had hitherto remained inactive on the frontiers of the Carnatic. The fame of the defence of Arcot roused them from their torpor; Murárí Ráo declared that he had never before believed that Englishmen could fight, but that he would willingly help them since he saw that they had spirit to help themselves. Rájá Sáhib learned that the Marhattás were in motion, and it was necessary for him to be expeditious. He first tried negotiations,—he offered large bribes to Clive, which were rejected with scorn; he vowed that if his proposals were not accepted, he would instantly storm the fort, and put every man in it to the sword. Clive told him, in reply, with characteristic haughtiness, that his father was a usurper, that his army was a rabble, and that he would do well to think twice before he sent such poltroons into a breach defended by English soldiers. Rájá Sáhib determined to storm the fort. The day was well suited to a bold military enterprise. It was the great Mahometan festival, the Muharram, which is sacred to the memory of Husain, the son of Alí. Clive had received secret intelligence of the design, had made his arrangements, and, exhausted by fatigue, had thrown himself on his bed. He was awakened by the alarm, and was instantly at his post. The enemy advanced, driving before them elephants whose foreheads were armed with iron plates. It was expected that the gates would yield to the shock of these living battering-rams. But the huge beasts no sooner felt the English musket balls than they turned round and rushed furiously away, trampling on the multitude which had urged them forward. A raft was launched on the water which filled one part of the ditch. Clive perceiving that his gunners at that post did not understand their business, took the management of a piece of artillery himself, and cleared the raft in a few minutes. Where the moat was dry, the assailants mounted with great boldness; but they were received with a fire so heavy and so well directed, that it soon quelled the courage even of fanaticism and of intoxication. The rear ranks of the English kept the front ranks supplied with a constant succession of loaded muskets, and every shot told on the living mass below. The struggle lasted about an hour; 400 of the assailants fell; the garrison lost only five or six men. The besieged passed an anxious night, looking for a renewal of the attack. But when day broke, the enemy were no more to be seen. They had retired, leaving to the English several guns and a large quantity of ammunition."

Arcot was afterwards captured by the French; but in 1760 was retaken by Colonel Coote after the battle of Wandiwash. It was also taken by Haidar Alí when that invader ravaged the Carnatic in 1780, and held by him for some time. The town of Arcot, together with the whole of the territory of the Carnatic, passed into the hands of the British in 1801, upon the formal resignation of the government by the Nawáb, Azím-ud-daulá, who received a liberal pension.

ARCTIC OCEAN. The Arctic Circle (66° 30′) being taken as a boundary, the whole of the ocean lying to the north is called the Arctic Ocean. From a physical point of view this limit is hardly satisfactory, since between Greenland and Europe the Atlantic, with its Gulf Stream, makes an inroad on the Arctic territory, and the southern extremity of Greenland brings down the Arctic region beyond the Arctic limit; but the other parallel of latitude (70°) which has been chosen as a southern limit is perhaps still more objectionable. The Arctic Ocean washes the north of Europe, Asia, and America. It communicates with the Atlantic by a broad opening on the east of Greenland, and a narrow but important channel on the west, which has been traced as far north as 84°, and is known in the various parts of its extent by special names—Davis' Strait, Baffin's Bay, Utlak Soak, Smith Sound, Kennedy Channel, Robeson Channel, Lincoln Sea,—but might conveniently be distinguished by some such general designation as the West Greenland Channel. With the Pacific there is communication between Asia and America through Behring's Strait. The coast line of all the three continents is for the most part exceedingly irregular, though this is less the case with Asia than with the other two. Europe sends down the Onega, Dwina, Pinega, Mezen, and Petchora; Asia the Obi, Yenisee, Lena, Indigarka, and Robima; and America the Mackenzie River. The most important of the numerous islands are Spitzbergen and Nova Zembla, with the multitudinous adjacent islets, to the north of Europe; the Liakhov Islands, or New Siberia, off the coast of Asia; and the vast irregular Archipelago into which the north-eastern portion of America is split, which extends to the quasi-continent of Greenland. While for human habitation the regions of the Arctic Ocean are the most desolate that can well be conceived, there is extraordinary abundance of the lower forms of animal life; and while for centuries men have only visited them to gather their living harvests, or for purposes of exploration, traces are in many places to be found of human inhabitants in a distant age. At a still remoter period the islands of the Arctic Archipelago have been covered with forests, and Barrow's Straits have been the habitat of coral and sponge (Markham, in the *Journ. Roy. Geogr. Soc.* 1865, p. 88). A very large portion of the area included by the Arctic Ocean is still unexplored; but almost every year diminishes the extent of the unknown. The nearest approach to the Pole has been made up the West Greenland Channel; the passage along the eastern coast away to the north of Spitzbergen being the next in order of success. For information regarding the various Arctic expeditions, see the article POLAR REGIONS.

ARDEA, a Latian city, probably of Pelasgian origin, famous chiefly for its accidental connection with the semi-mythical rape of Lucretia and the expulsion of the Tarquins from Rome. It lies 24 miles almost due S. from Rome, and 4 miles from the coast, on a small stream. It seems at one time to have been a place of great wealth and power; but the little hamlet which still preserves its name hardly numbers 200 inhabitants. A few fragments of tufa-built fortifications are the only remains of its ancient architecture.

ARDEBIL, or ARDABIL, one of the chief towns of Azerbijan in Persia, situated in 38° 15′ N. lat., and 48° 19′ E. long., on the Karasu or Balulk, a tributary of the Aras, in a fertile plain about 40 miles from the Caspian, seems to have been built out of the ruins of a former city. It is surrounded with a mud wall and towers, has a square castle with bastions at the corners fortified after European fashion, and contains the tomb of Shah Ismael Sufi, the founder of the Sufi dynasty of Persia. It is an emporium in the trade of Tiflis, Derbend, and Baku with Ispahan and Teheran. By a great council of the Persian empire, which met in 1736 in the neighbouring plain of Chowal-Mogam, Nadir Shah was chosen king, and his coronation took place next year at Ardebil. In the vicinity there are a number of warm mineral springs, and to the west stands the great mountain Sevilan, of volcanic origin, forming the eastern extremity of the water-shed between the Aras and the Tigris. From its remarkable salubrity Ardebil has acquired the Persian title of *Abadan i Firuz*, the abode of happiness.

ARDECHE, a department in the south of France, bounded on the N.W. by the department of Loire, on the E. by Isère and Drôme, on the S. by Gard, and on the W. by Lozère and Haute Loire. It extends 72 miles from N. to S., and 45 from E. to W., at the widest points; and its area is 2134 square miles. The surface of Ardèche is almost entirely covered by the Cevennes Mountains; the main line forming the western boundary of the department, and sending out the Boutières, Coiron, Tanargue, and other branches, for the most part in an easterly direction. Several of the summits, of which the highest, Mount Mezenc, is 5972 feet above the sea, are evidently extinct volcanoes. The Rhone bounds Ardèche on the east, and receives most of its rivers, including the Cance, the Ay, the Doux, the Erieux, and the Ardèche. A few rivers, however, belong to the Atlantic side of the water-shed, the chief being the Loire, which rises on the western borders of the department, and the Allier, which for a short distance separates it from Lozère. The climate in the valley of the Rhone is warm, and sometimes very hot; but westward, as the elevation increases, the cold becomes more intense and the winters longer. Some districts, especially in summer, are liable to sudden alterations in the temperature. Grain and pulse are produced, but not in quantities sufficient for the population, a large part of the fare of the peasants consisting of potatoes and chestnuts. The latter, besides, form one of the main articles of export, another being oil extracted from nuts. Wine is produced in considerable quantities along the valley of the Rhone. The rearing of the silk-worm, however, is of all the industries the most important and remunerative. Goats and sheep are kept in large numbers, Ardèche being one of the chief sources of the supply of skins for glove-making. The number of horses is small, asses and mules being the beasts of burden mainly employed. Iron, coal, lignite, marble, limestone, and porcelain clay are among the mineral products. Hot springs are numerous, and some of them, as St Laurent, Celles, and Neyrac, are largely resorted to. Natural curiosities are the *Pont d'Arc* over the Ardèche, and the *Chaussée des Géants*, near Vals. The country people adhere to their provincial habits and dialect, go barefoot, and wear tall hats and long blouses. Among the celebrated men of the department may be named Cardinal Tournon and the brothers Montgolfier. The chief town is Privas; the arrondissements are Privas, Largentière (which derives its name from its ancient silver mines), and Tournon. Population, 380,277

ARDELAN, a province of Persia, forming the eastern division of Kurdistan, and lying south of Azerbijan. Its capital Senna, in long. 40° E., and lat. 35° 12′ N., is built in a deep valley, which is well tilled and rich in orchards. The north part presents a succession of great table-lands, inhabited in the summer by wandering shepherds, who migrate in winter to the vicinity of Baghdad. The soil in the valleys is good, and abundance of wheat, barley, and the oil-plant (*Sesamum orientale*) is grown, besides a little tobacco. The oak forests of the mountains to the west yield fine timber, which is floated down the Tab into the Tigris, and gall-nuts, which are sent to India. The inhabitants, mostly Kurds, are greatly given to war and robbery, and many of the tribes are subjects of Persia only nominally.

ARDENNES, a department on the N.E. frontier of France, which derives its name from the famous forest, is bounded on the N. and N.E. by Belgium, on the E. by the department of the Meuse, on the S. by that of Marne, and on the W. by that of the Aisne. In shape it is an irregular pentagon, with a cape-like prolongation into Belgium on the north. It has a superficial extent of 523,000 hectares, or 1,291,810 acres, of which 300,000 hectares, or 741,000 acres, are arable land, while 154,000 hectares, or 383,800 acres, are occupied with forest, wood, and heath. The wooded plateaus which begin in the department of the Meuse are continued in a north-west direction, and divide the basin of the Meuse from the basin of the Aisne, till they form a junction with the Ardennes proper. At one time this was a very inaccessible region, and formed a strong defence, as Dumouriez showed in 1792, against invasion from the east. The Meuse (Maas), flowing in a northern direction, enters obliquely from the east, and cuts off a narrow and irregular strip along the Belgian side of the department, which it leaves at the extreme north, to flow through Belgium and join the western branch of the Rhine. The Aisne enters near the south-east corner and leaves at the south-west; its course through the department skirting the base of the Argonne range, and forming an irregular arc with its convexity to the north. The chief wealth of Ardennes consists in mineral productions, wood, cattle, and sheep The number of cattle in 1872 was 82,975, of sheep 393,044, of horses 49,748, and of pigs 51,809. The sheep are small, but are valued for the quality of their mutton. Agriculture has recently made considerable advances in the department. There are upwards of 150 iron-mines, as at Grandpré, Champigneulle, Raucourt, Brevilly, Monthermé, and Flize; a great number of excellent slate-quarries, as at Deville, Monthermé, Rimagne, and Fumay; while copper also is obtained in considerable quantities, and there is an abundant supply of building-stone, limestone, and marl. Peat is very common in the north, and coal is worked near Sedan. The people are well educated, active, and industrious, and can boast of having furnished from their ranks such men as Gerson, Robert de Sorbon, Mabillon, Corvisart, Marshal Macdonald, de Wailly, Léon Renier, H. Taine, and the publisher Hachette. It is said that they are marked by a special aptitude for the exact sciences. The department has about 240 miles of imperial road and 131 of departmental. Its two great rivers are united by the Canal des Ardennes. A branch of the Paris and Strasburg railway runs through it in a north-east direction, joining Rheims (in Marne) with Réthel and Mézières, and holding north along the valley of the Meuse to Namur (in Belgium). At Mézières this branch meets almost at right angles with a line running north-west, and connecting Thionville (in the district acquired by Germany) with Montmédy, Sedan, Maubert, &c. The department is divided into five arrondissements: Mézières, towards the centre; Rocroy, in the N.; Rethel, in the W. and S.; Vouziers in the S.; and Sedan in the E. Mézières is the capital, and a prefecture. Ecclesiastically the department, which has 46 cures, is part of the diocese of Rheims. It contains communal colleges and normal schools, and has 720 free public schools. The population in 1872 was 320,217, the falling off from 331,296 in 1851 being due to the war of 1870–71. See Elizé de Montagnac, *Les Ardennes Illustrées* (*France et Belgique*) 4 vols. fol. 1873.

ARDFERT, a small village in Kerry, in the S.W. of Ireland, about 4 miles N.N.W. of Tralee, and nearly as much from the coast. It had at one time a university, and was the seat of a very ancient bishopric; but both it and Aghadoe, with which it was combined, are united to the see of Limerick The cathedral, a very old building, was the church of St Brendan's monastery. A pillar tower, which stood near it, and was one of the finest and loftiest in the kingdom, fell in 1780. Population, 192.

ARDGLASS (*the green height*), a town of Ireland in Down county, Ulster, at the head of a small bay about 8 or 9 miles S. of the entrance of Strangford Lough, and 7 miles S.S.E. of Downpatrick, was a place of great importance soon after the Norman invasion. It had a considerable trade, was a royal burgh, and sent a representative to the Irish parliament. It is still remarkable for the ruins of five Anglo-Norman castles. Its permanent inhabitants, who are chiefly engaged in the fisheries, numbered only 613 in 1871; but its population during the bathing season is considerably increased by visitors. Ships of 500 tons may enter the harbour at all tides, and its inner cove admits vessels of 100 tons. There is a lighthouse at the end of the pier, in lat. 54° 15′ N., long. 5° 36′ W.

ARDOCH, a parish in Perthshire, famous for its Roman military antiquities, which are situated in the grounds of Ardoch House, about 2½ miles N. of Greenloaning, on the Caledonian Railway. They consist of—(1), a strong fort or station, surrounded by a series of ramparts and ditches, (2), vestiges of an intrenched outwork of considerable extent at the north side of this station; and (3), traces of two camps, still further to the north, capable, according to General Roy, of containing 28,800 and 14,000 men respectively, the smaller camp being partly included within the limits of the larger. See Gordon's *Itiner. Septent.*, p. 41; Pennant's *Tour*, iii. 102; Roy's *Military Antiquities*, pp. 62, 226; Stuart's *Caledonia Romana*, pp. 187–194.

ARDRES, a French town, in the department of Pas de Calais, and arrondissement of St Omer, on a canal joining Calais and St Omer, to which it gives its name. The "Field of the Cloth of Gold," where Henry VIII. of England and Francis I. of France tried to outdazzle each other in 1520, was in the immediate neighbourhood. The town contains several distilleries and breweries. Population, about 2200.

ARDROSSAN, a sea-port in Ayrshire, Scotland, 31 miles by rail from Glasgow, in N. lat. 55° 38′, and W. long. 4° 49′ It dates from an early period, as there seems to have been a castle and a small fishing village in existence for several centuries. The name of Arthur of Ardrossan is found in connection with a charter dated 1226; and Sir Fergus of Ardrossan accompanied Edward Bruce in his Irish expedition in 1316, and in 1320 signed the appeal to the Pope, by the barons of Scotland, against the aggressions of Edward I. of England. The castle, famous for its capture by Wallace, was finally destroyed by Cromwell, who is said to have used part of its masonry for the construction of the fort at Ayr. The family of the barons of Ardrossan is now merged, by marriage, in that of the earl of Eglinton and Winton. The rise of Ardrossan into commercial importance is due to the exertions of Hugh the twelfth earl of Eglinton, who commenced the construction of the present town and harbour in 1806. The harbour was intended to be in connection with a canal from Glasgow to Ardrossan, but this was only completed as far as Johnstone. Owing to the stoppage of the canal works, and the death of Lord Eglinton, the construction of the harbour was suspended till 1845, when it was partially completed and placed in connection with the Glasgow and South-Western Railway by a branch railway which joins the main line at Kilwinning. The cost of the harbour up to 1874 has been upwards of £200,000. The works now consist of a wet dock of 4 acres in area, with 19 feet at high water over the lock sill, and of two tidal harbours—one 18 acres, and the other 6 acres in area. There is a lighthouse on the north-west point of the outer breakwater, with a white flashing light. The works are well supplied with steam cranes, and all modern appliances for discharging and loading vessels. The exports consist principally of coal and iron from collieries and ironworks in the neighbourhood, and the imports of timber, ores, and general goods. There are lines of steamers plying to Glasgow, Arran, Belfast, Newry, and to various ports in Spain. In 1874 the number of vessels entering and leaving the port was 2044, with a registered tonnage of 296,690; the number of vessels belonging to the port was 114, with a registered tonnage of 15,611, and there were exported 276,081 tons of coal, and 80,516 tons of iron. Iron founding and shipbuilding are carried on to a considerable extent; and for the repair of vessels there are a graving-dock, which can take in vessels of 1500 tons, and a floating dock and patent slip, which can each accommodate vessels of 500 tons. In 1846 an Act of Parliament was obtained, erecting the town into a burgh, with a corporation consisting of a provost, two bailies, and five town councillors. The public buildings consist of a townhall, the property of the corporation, and of five churches, belonging to the Established Church, the Episcopal, the Free, the United Presbyterian, and the Evangelical Union denominations respectively. There are three branch banks in the town. The population in 1851 was 2071; it was 3929 in 1871; and in 1874 it is estimated to be 4228.

AREMBERG, a small market-town of Prussia, in the government of Coblentz and circle of Adenau. It is situated not far from the river Ahr, and has a castle which was formerly the residence of the dukes of Aremberg. About the year 1298 the earldom of Aremberg, which had previously belonged to a branch of the house of Hostaden, came by his marriage with Matilda to John of Engelbert, earl of Mark (Westphalia), and continued in his family till 1547, when John of Barbançon, of the celebrated house of Ligne, by marrying the only sister of the childless Robert III., obtained possession of the lands, which were raised by Maximilian II. to a principality, and ranked among the German states. John, who is remembered as the leader of troops from the Netherlands to serve against the Huguenots, having fallen (1568) in the battle of Heiligerlee, was succeeded by his son Philip Charles, admiral of Flanders, who greatly increased his possessions by marrying Ann of Croy, heiress of Croy, Arschot, Chimay, &c. He died in 1616, and was followed by his eldest son, stadtholder of Namur, who, having informed the Spanish government of a conspiracy, was rewarded by arrest (1634) and imprisonment at Berdessillas, where he died in 1640. Under his son, Philip Francis, Aremberg was raised to a dukedom (1644). Alexander Joseph and Philip Charles Francis both fell in battle against the Turks, the former in 1663, and the latter in 1691. Charles's widow, Maria Henrietta, left her country and possessions rather than recognise the duke of Anjou as king of Spain, and lived in dignified poverty till the battle of Ramilies gave back the Netherlands to their rightful possessor. She died in 1744. Her only son Leopold is known in history as a military leader (at Malplaquet, Belgrade, Ettinghen, &c.), and as the patron of Rousseau and Voltaire. His son and successor, Charles Leopold, was distinguished in the Seven Years' War as an Austrian field-marshal, and increased his possessions by marriage with Margaret of Mark. By the peace of Luneville (Feb. 1801), the next duke, Engelbert, lost the greater part of his ancestral domain, but received in compensation Meppen and Recklinghausen. On the establishment of the confederation of the Rhine, his son Prosper-Louis (to whom, becoming blind, he had ceded his domains in 1803) became a member (1807), and showed great devotion to the interests of France; but in 1810 he lost his sovereignty, Napoleon incorporating his dukedom with France and the grand duchy of Berg, and indemnifying him by a rent of 240,702 francs. In 1815 he received back his possessions, which were mediatised by the Congress of Vienna, part falling to Prussia and part to Hanover. On account of the one portion he became a peer of the Westphalian estates, and by the other, a member of the House of Lords in Hanover. George IV. of England, on 9th May 1826, elevated the duke's Hanoverian possessions to a dukedom under the title of Aremberg Meppen. His territory extended over 780 geographical square miles, with 94,000 inhabitants; of which, 544 square miles, with 50,000 inhabitants, were in Hanover; besides which he had large estates in France, and extensive tracts of forest in the Pyrenees. His brother Augustus-Raymond (b. 1753, d. 1833) became famous, under the title of Count of Mark, for his connection with the French Revolution and his friendship with Mirabeau. Duke Prosper-Louis died in 1861, and was succeeded by his son Engelbert.

ARENDAL, a sea-port town of Norway on the Skagerrack, 35 miles north-east of Christiansand. It is built at the mouth of the river Nidelf, on a number of small islands and rocks, the houses in many places being erected on piles. From its situation, and the number of canals by which it is traversed, it has acquired the name of Little Venice. There is a considerable shipping trade, particularly in iron and timber; and ship-building, distillation, and iron-mining are carried on. The neighbourhood is remarkable for the number of beautiful and rare minerals found there; one of these, a variety of epidote, was formerly called Arendalite. Louis Philippe lived here a long time during his exile. Population in 1855, 4456; in 1865, 5800.

AREOPAGUS (Ἄρειος πάγος), a small barren hill to the west and within bowshot of the Acropolis of Athens, for an attack upon which it would form a natural base. It was so used (480 B.C.) by the Persians (Herodotus, viii. 52). For the same purpose it had been occupied also in the legendary age by the Amazons, when in the time of Theseus they menaced Athens, and from the circumstance of their having then sacrificed to Ares, the hill, according to Æschylus (*Eumenides*, 685, *ff.*), derived its name. Assuming the occupation by the Amazons to have been typical of what frequently happened during the hostilities of early times, it is easy to understand how the hill came to be associated with the war god (Köhler, in the *Hermes*, 1872, p. 105). To the popular mind the Areopagus was always the "hill of Mars." But the popular mind required a more definite account of the origin of the name, and to supply this, there took shape the legend of Ares having been here called before a court of the twelve gods to answer for the murder of Halirrhotius (Pausanias, i. 285). This explains at once the origin of the name of the hill and of the court which held its sittings there. Æschylus, however, gives in the *Eumenides* a different origin to the court, declaring it to have been first appointed by Athene to try Orestes for the murder of his mother Clytæmnestra. In later times both legends were dismissed, and the explanation of the name referred to the nature of the cases—cases of murder—tried before the court (Suidas, *s. v.*, Ἄρειος πάγος· ἐπεὶ τὰ φονικὰ δικάζει· ὁ δὲ Ἄρης ἐπὶ τῶν φόνων). The four legendary cases of murder tried before this court were those in which Ares, Cephalus, Dædalus, and Orestes appeared as the accused. But the selection of this hill as the site of a criminal court, in the first instance, is to be sought for in the sacred relation in which it stood to the worship of the Erinnyes, or Eumenides, and not in its connection with Mars, for whom it had no sanctity, and between whose worship and that of the Erinnyes K. O. Müller (*Eumenides*, p. 178) has not succeeded in proving any community. On the top of the hill towards the east is an artificial plateau accessible from the south by steps cut in the rock. In several places are still to be traced the rock-hewn seats on which the court sat in the open air so that the judges and the accusers might not be under the same roof with a polluted criminal. The sittings were held by day, not by night, unless the authority of Lucian be accepted (*Hermot.*, 46; *De Domo*, 78). Raised upon two unhewn stones (ἀργοὶ λίθοι) the accuser and the accused made their pleadings, the stone used by the former being called λίθος ἀναιδείας, "stone of implacability," not of "impudentia" as translated by Cicero (*De Leg.*, ii. 11), or "impudence," as given by Dyer (*Athens*, p. 451); the other was called λίθος ὕβρεως, or "stone of crime."

Within the boundary of the court stood also an altar to Athene Areia, believed to have been dedicated by Orestes, and blocks of marble (ἄξονες), on which were inscribed the laws defining the powers of the judges. On another part of the hill stood one of the most revered of Athenian sanctuaries, that of the Erinnyes, containing statues of these three goddesses, but not in the hideous aspect in which they were usually conceived, and also statues of those other deities connected with the lower world, Pluto, Hermes, and Ge. Within the boundary of this temple was the tomb of Œdipus, and very close to the boundary, if not within it, was the heroön or sanctuary of Hesychus, the founder of the priestly line in whose hands were the rites of the Erinnyes. Near the temple was the Κυλώνειον, a memorial of the pollution of the spot caused by the treacherous slaughter of those who, having failed in the conspiracy of Cylon, had taken refuge there as suppliants (Herod., v. 71; Thucyd., i. 126). Towards the north-east foot of the hill was a temple of Ares containing statues of that god, of Enyo, Aphrodite, and Athene, while outside were statues of Hercules, Apollo, Pindar, and a poet named Caladas. On the north-east side there is a chasm in the rocks with a spring of dark water, which may have been associated with the worship of the Erinnyes.

The court and council of the Areopagus (ἡ βουλὴ ἡ ἐξ 'Αρείου πάγου or ἡ ἄνω βουλή), with a legendary history which distinctly pointed to it as an institution of primitive origin and intrusted with functions of the first importance, was yet in regard to the period of its history before Solon (594 B.C.) so little known that most people in later times had come to believe it to have been created by him (Plutarch, *Solon*, 19). As proof that the court had not existed before the time of Solon, it was urged that in the legislation of Draco (620 B.C.) there is no mention of the Areopagus, he having referred all such cases as in later times came within the powers of that court to a class of judges called the Ephetæ. But there is no reason why "Ephetæ" may not have been previous to Draco the title applied to the judges of the court of Areopagus, instead of "Areopagites," just as it was the title borne even after Solon by the judges of the other four Athenian courts which tried cases of bloodshed, unless we accept the statement of Pollux (viii. 18) that the appointment of the Ephetæ to all these courts, including the Areopagus, was the work of Draco. For then, these courts having admittedly been in existence before his time, there is no help but to assume that the judges had previously borne other titles, and that in the case of the Areopagus the title used could only have been Areopagites. But it is quite within fair criticism to throw aside this statement of Pollux, as has been done by the most recent writer on this subject (Philippi, *Rheinisches Museum*, 1874, p. 12), and to assume, with K. O. Muller, that the Ephetæ had acted from time immemorial as judges in all the five courts. There would remain for the fame of Draco the organisation of the courts, and possibly the limitation of the number of Ephetæ to 51. We must then conceive Solon as having found the Ephetæ acting as judges in the Areopagus and in the other four courts. He set himself to alter the constitution of the Areopagus by adding to the Ephetæ already in office there the nine Athenian archons on their retiring from public duties, and provided that they had rendered a satisfactory account of their administration. It is probable that from this new source alone a sufficient number of judges was supplied, and that, therefore, the original Ephetæ were allowed to die out, though in that case the number of Areopagites could scarcely have been a fixed one (given at 51 by the scholiast to the *Eumenides*, v. 743), considering the liability of an archon to be rejected. The new judges retained their office for life subject to dismissal only by their own body. For the most part they were advanced in years, and necessarily always men of integrity and experience, qualifications which were demanded in the highest degree from a court which, instead of administering strictly defined laws, had to base its verdicts on a careful investigation of the life and circumstances of parties arraigned before it. Its decisions were quoted as models of justice. Its competency was limited to cases of wilful murder (φόνος ἑκούσιος or ἐκ προνοίας), bodily injury with intent to kill (τραῦμα ἐκ προνοίας), incendiarism (πυρκαϊά), and poisoning (φάρμακα, ἐὰν τις ἀποκτείνῃ δούς). Other degrees of homicide were referred, according to their nature, to the other four Athenian courts, viz., accidental homicide (φόνος ἀκούσιος) to the Palladium, justifiable homicide (φόνος δίκαιος) to the Delphinium; at the Prytaneum was heard the formal indictment of inanimate objects, such as wood or stone, which by falling had caused the loss of life; while before the court of Phreathys at the Piræus appeared those who having been banished for accidental homicide had during their banishment committed wilful murder. There were, however, cases of a complicated nature in regard to which the records are far from explicit as to the courts to which they were referred. Of this kind was a case in which the actual perpetrator (χειρὶ ἐργασάμενος) was found to have been only a tool in the hands of a third person. It was with the latter that the prosecution had principally to deal, and against him was issued a charge of βούλευσις, or premeditation of murder. Obviously, such a person was equally guilty whether his victim died or not (Harpocration, *s.v.* βουλεύσεως), and therefore equally within the jurisdiction of one and the same court. Still it has been usual to follow Schömann (*Griech. Alterthümer*, i. p. 449) in drawing this distinction, that when death ensued the case went before the Areopagus, and before the Palladium when the victim survived. But this distinction has been made for the sake of admitting both authorities to be correct, when, on the one hand, Isæus and Aristotle (as quoted by Harpocration) refer βούλευσις to the Palladium, while Dinarchus (see Harpocration) on the other hand refers it to the Areopagus. It would be better to dismiss the authority of Dinarchus altogether, the more so since in a speech of Antiphon, admittedly in a case of βούλευσις (Choreutæ), a form of address is employed, ὦ ἄνδρες (once, ὦ ἄνδρες δικασταί), which would not have been proper for the Areopagus, where the form was ω βουλή (Philippi, *Der Areopag*, p. 32). The punishments inflicted by the Areopagus were—(1.) For wilful murder, death, the execution of which was witnessed by the accuser. It is probable that confiscation of the criminal's property wa included in the sentence, but this point is obscure. His property was certainly confiscated when it happened that he escaped before sentence was pronounced. (2.) For injury with intent (τραῦμα ἐκ προνοίας) the sentence was confiscation of property and banishment, but not for life. If the victim of either of these crimes was a μέτοικος, or alien, the punishment, it has been supposed, was less severe, but of this there is no real evidence. The proceedings, in cases that came before the Areopagus, began, as did all δίκαι φονικαί, with a charge (γραφή) made before the archon king sitting in his chambers in the agora. It was his business to take down the charge and to make such a preliminary inquiry into the facts as would guide him in sending the case for trial. For this purpose he appointed three separate occasions in three successive months, but whether he was contented to search into the facts alleged by the accuser, or whether he examined also the accused, is a point on which there is no evidence. It is only known in general terms that the inquiry was conducted with great care, and, it is not improbable, in presence of members of the Areopagus, who would thus obtain a mastery of the evidence before the trial took place.

The accuser was required to prove his relationship to the murdered person as giving him the right to prosecute; he had to take an oath in pledge of his sincerity, and to denounce the accused. A denunciation (πρόρρησις) having been publicly made, the accused was regarded as polluted, and durst enter neither temple nor market-place on peril of his life. Some have thought that the practice was to make a formal denunciation three times, first at the grave of the deceased, next in the market-place, and then before the archon as just stated (Schömann, *Antiquitates Jur. Pub.*, p. 289), but it is probable that only the last mentioned, if the others were actually made, was regarded as legal. In the fourth month, after determining that the case was to go before the Areopagus, the archon king in his capacity of president of the court laid the case before it. The court sat on the last three days of every month (Pollux, viii. 18). Of the first part of the proceedings (προδικάσιαι) the principal feature was the administration of an oath to the parties and the witnesses; the ceremony consisting in the sacrifice of a wild boar, an ox, or a ram, before which those who took the oath called on the Erinnyes to destroy them and their family if they failed to speak the truth. When the evidence had been gone through (ἀνάκρισις) there followed the δίκη proper, consisting of the speeches. Each party was allowed to speak twice, once, it is said, on each of the first two days, the third day being reserved for judgment. They were charged to avoid everything irrelevant to the issue. After the first speech, the accused might choose voluntary exile unless the charge against him were that of the murder of a parent. In exile, beyond the boundaries of the Athenian state, he was entitled to the full protection of law, and if himself murdered could be avenged as if he had then been a true Athenian citizen. Should the trial go its full length, he could only be convicted by a majority of the judges. If the votes were equal he was acquitted, and when acquitted he offered a sacrifice to the Erinnyes and the other deities of the lower world. When it happened that the person entitled to prosecute had missed the regular occasions of making his charge, it was still competent for him to take the summary proceedings of an ἀπαγωγὴ φόνου, that is, to lay his case before the Eleven who presided over the prisons, and have the case tried by a Heliastic court. But this could not well be done unless the accused had been caught in the act, or failed to give a reasonable account of himself. When the victim survived he himself was the proper prosecutor; but when in the contrary event the task devolved on his relatives, it was necessary for them to be within the prescribed degree of cousinship (ἀνεψιότης), as may be seen from the formula in Pseudo-Demosthenes (*Adv. Macartatum*, p. 1069, § 57), which again has been strikingly confirmed by the decree (Köhler, *Hermes*, ii. p. 27), discovered at Athens in 1843, and setting forth part of the laws of Draco in regard to murder. This decree, inscribed on marble and in a very fragmentary condition, bears date 409–8 B.C. A slave having in the eyes of the law no relatives, could not prosecute the murderer of one of his class, but he could appear against the murderer of his master if empowered in writing to do so before the master's death. The master was the lawful accuser when a slave was murdered, and similarly only the legal patron could appear in the case of a freedman or other who had not the rights of citizenship. The theory of the prosecution being to obtain, as had been the custom from time immemorial, vengeance for the relatives of the deceased, and being therefore more of a religious than political character, it becomes a question whether, in the event of the relatives refusing to prosecute, or of there being no relatives, the state permitted a foul crime to pass unpunished. On this point there is no information.

Besides being a court of justice (δικαστήριον), the Areopagus was also a council (βουλή), empowered to interfere in matters affecting religion and morals, and, previously to the time of Pericles, in the administration of public affairs. With powers of this order honestly exercised, it is not singular that Isocrates (*Areopag.*, 39) in his picture of Athens in the happy times gone by, should point to the action of the Areopagus as one of three great sources of this happiness (*cf.* Plutarch, *Solon*, 22; *Themist.*, 10; and Bockh, *Staatshaushaltung*, i. p. 208). Nor is it against the view of Isocrates that Pericles and his party should have bee opposed to the Areopagites. The mere fact of their being strongly conservative, and of their having the power of opposing, if not with a veto, at least with enormous official influence, his new schemes of administration, would be sufficient excuse. And it appears certain that the scope of the measure proposed by his friend Ephialtes, and carried during the absence of Cimon the conservative leader, was only to withdraw from the Areopagus this power of interference. Its criminal jurisdiction remained as before, though so much would hardly be gathered from the tone of Æschylus in the *Eumenides*, which appeared as a protest, it has usually been thought, at the time. Ἐφιάλτης μόνα κατέλιπε τῇ ἐξ Ἀρείου πάγου βουλῇ τὰ ὑπὲρ τοῦ σώματος, says Philochorus, while Demosthenes (*Adv. Aristocrat.*, p. 644 § 66) states that no tyrant, oligarchy or democracy, had ever ventured to withdraw from that court its jurisdiction in high crimes. Only a passage in a speech of Lysias (*Eratosth.* 30) really favours the opposite view.

Among the many other functions which the Areopagites retained after the measure of Ephialtes were—(1.) those pertaining to religion. They appointed the ἱεροποιοί for the temple of the Eumenides, and took care of the sacred olives (μορίαι), which existed partly in large plantations near the academy, and partly on private lands, such trees being the property of the goddess Athene, against whom it was a crime to injure one of them. The Areopagus could oppose the introduction of new deities or foreign rites, as in the case of St Paul, who had to appear before it (Acts xvii. 19, *ff.*); but it does not seem that it could, as has been assumed, prohibit such a step if once approved of by a public decree. It saw that no object of public sanctity was violated. (2.) In education and morals little positive is known of its action. It seems to have appointed the masters in the gymnasia, and brought to punishment vagabonds and spendthrifts under the law entitled νόμος ἀργίας. (3.) Its business was to see that public spaces were not occupied or built on by private persons, as in the case of Timarchus (Æschines, *Adv. Timarch.*, § 80), who had put it to the public assembly whether the deserted Pnyx might not be built on. Many inscribed bases of statues in Athens, though mostly of a comparatively late date, bear witness that the consent of the Areopagus, if not indispensable, was very frequently obtained for the erection of statues. (4.) It protected the standards of weight and measure from falsification. (5.) It exercised an inquisitorial power, partly *sua sponte* (αὐτὴ προελομένη), and partly by mandate from the public assembly (τοῦ δήμου προστάξαντος αὐτῇ). In the latter case it merely investigated the facts (ζήτησιν ποιεῖσθαι), and laid them before a Heliastic court. Work of this kind, depending as it did on the public assembly, necessarily varied greatly at different times. From about 350 to 320 B.C. it seems to have been of a very grave character. (6.) The Areopagus reviewed the conduct of magistrates and the administration of the laws, a function which was relegated, probably by the measure of Ephialtes, to the Nomophylaces, who, though they do not become conspicuous till the time of Demetrius of Phaleron (317–307 B.C.), had yet existed doubtless long before.

If now it is true that the Areopagites as a criminal court were created and organised by Solon to supersede the Ephetæ in the trial of certain crimes, what is to be said of their origin as a state council (βουλή)? Obviously most of their duties as a council were such as must have grown up gradually upon an institution of very high antiquity, such an institution, for example, as the Homeric βουλὴ γερόντων. Yet there is no direct evidence of the existence of the Areopagus as a council before the time of Solon. It has therefore been suggested that the Areopagitic council appointed by Solon took upon itself the duties of a differently constituted council, which also may have held its sittings on the hill of the Areopagus. This superseded council it was first thought by K. O. Müller consisted of Ephetæ, who, according to the most recent derivation of the name (ἐπὶ and ἔτης = ἔτης, Ϝέτης), were the heads of clans. The opinion of Müller has been adopted by Philippi (*Der Areopag*, p. 208). With less probability Wecklein (*Bericht. d. Münch. Akad.*, 1873, p. 38, *ff.*) had suggested the Naucrari. From the time of Solon, except for the change introduced by Ephialtes, the powers of the Areopagus seem to have remained much the same down to the Roman period, its position in point of respect and influence apparently increasing the longer it continued, though clearly it is too much to say as Cicero does (*De Nat. Deor.* ii. 29, 74) *Atheniensium rempublicam consilio regi Areopagi.* But its constitution had been changed by Plutarch's time, possibly long before. It was then presided over by an ἐπιστάτης with a κήρυξ by his side, and was no longer composed of the retiring archons. The principle of election is not known. (A. S. M.)

AREQUIPA, one of the 18 departments of Peru. It lies along the Pacific from lat. 15° to 17° 20′ S. Its chief productions are silver, alpaca and other wools, sugar, wine, and brandy. The population is stated at 200,000, which is probably in excess. The district is volcanic, and contains several volcanoes, which appear, however, to be mostly extinct. Of these Misti, otherwise known as the Arequipa, one of the most perfectly cone-shaped of mountains, occasionally throws out smoke or vapour. It rises to the height of 20,320 feet above the sea. An eruption of Ubinas, a mountain on the eastern boundary of the department, occurred in 1839.

AREQUIPA, the chief town of the department, stands at the foot of Misti, in the fertile valley of the Chile, 7775 feet above the level of the sea, in lat. 16° 16′ S., long. 72° 31′ W. It is divided into five districts—Santo Domingo, San Francesco, La Merced, San Augustin, and Miraflores—contains 2064 houses, and has a population of about 30,000. In each of the districts there is a monastery and a church; and besides there are three nunneries in the city. The cathedral is quite modern, the former building having been destroyed by fire in 1849. Solidity rather than beauty is the principal characteristic of Arequipan architecture, as might be expected in a city so liable to suffer from earthquakes. These occur with great frequency, and are sometimes of great severity; in 1582, 1609, 1784, and 1868 the city was greatly damaged. In general the streets run at right angles, and are wide and well paved. The better houses are all built in the Spanish style, with two or three courts; the walls are massive, and the ceilings vaulted. The material used is a soft magnesian limestone. The town has a faculty of medicine which rivals that of Chuquisaca in Upper Peru, a university, two academies, a college founded by Grand-Marshal de la Fuente, a public library, established in 1821, two printing-offices, each publishing a small newspaper, an hospital, and a foundling asylum. Arequipa is united to Mollendo on the coast by a railroad completed in 1870, 107 miles in length, nearly the whole of which is over a waterless desert. An iron pipe, which supplies Mollendo with water runs along the line for 85 miles. The railway has now been extended across the Andes, reaching a height of 14,660 feet, to Puno, which is connected with Bolivia by steam navigation across Lake Titicaca.

ARES [MARS], in *Greek Mythology*, the god of war, not, however, of war in its wide sense including campaigns, the disposition and command of forces, but in its more primitive meaning of a fierce encounter between bodies of men. Neither the causes nor the ultimate effects of war were ascribed to him. He was simply a personification of the wild impetuous spirit with which battles were fought,

Ares. From brass coin of the Mamertini. Brit. Mus.

Ares. From brass coin of the Bruttii. Brit. Mus.

and as such he was conceived as the model of a hero, splendidly armed with cuirass, helmet, shield, and spear, swift, of great size (πελώριος), raging (μαινόμενος), murderous (βροτολοιγός), unsatiable of war (ἆτος πολέμοιο). Enyo, the furious war goddess, Eris (Strife), Deimos and Phobos (Dread and Alarm), were usually by his side. Even his mother Hera denounces him (*Iliad*, v. 761) as senseless, and knowing no bounds. It was doubtless only as an illustration of the habitual strife between Hera and Zeus that Ares was accounted their son. When wounded by Diomedes assisted by Athena (*Iliad*, v. 853, *ff.*), he fell with a noise like that of nine or ten thousand men in battle; and again (*Iliad*, xxi. 400, *ff.*), when Athena wounded him with a stone, he fell, and covered with his fall seven acres of ground. On this latter expression it is to be observed, that, while it conveys a picture of broad-strewn carnage consistent with the usual character of Ares, it suggests also, from the measurement given, thoughts of the destruction of cultivated land in war, the more so when taken in connection with the story of Otus and Ephialtes, which reads in the *Iliad* (v. 385) like a reminiscence from an earlier time, when war was the dread of the husbandman. These two giants, sons of Aloeus, the planter, born very small, but grown by being fed on grain to immense size, and occupied, as their names imply, with husbandry (Otus = ὠθέω, and Ephialtes = ἐπιάλλομαι), had seized Ares and confined him in a large brazen jar for thirteen months, so that for one year there was entire peace over the fields. If, as is not improbable, the first conception of a war god originated in connection with invasion from non-Hellenic tribes, it would be natural to regard him perhaps more as a ruthless destroyer of fields than of human life, and equally natural that this view of his character should die out when war became, so to speak, a trade, as it had become by the time of the Iliad. Even then he was still recognised as a god whose home was among the warlike Thracians (*Iliad*, xiii. 298; *Odyssey*, viii. 361). This, it is true, may have been nothing more than another instance of the Greek tendency to assign a northern or Hyperborean home to deities in whose character something analogous to the stormy elements of nature was found. On the other hand, it appears that the Thracians and Scythians in historical times (Herodotus, i. 59) worshipped chiefly a war god and that certain Thracian settlements, formed in Greece in prehistoric times, left behind them traces of the worship of a god whom the Greeks called Ares. At Thebes, for instance, had been such a settlement, and there, above all the rest of

Greece, were afterwards found the oldest traditions of the worship of Ares, and that not altogether in the character of a war god. The fountain of Ares guarded by a dragon, and the legend of the Spartæ, who sprang from a field sown with dragon's teeth, seem rather to symbolise some destructive influence in nature, such as that of the sun in summer scorching the fields. That influence of this kind was ascribed to the Thracian god follows from the identification of him with the Sabine and Roman Mars, to the latter of whom the Arval brethren in Rome made annual sacrifice of a red dog to avert the calamity of the ripe grain taking fire. Apollo is the god who in Greek mythology, as we know it, discharged such functions. But it is argued that in this matter he may have superseded Ares, who on assuming the Thracian character of war god may have gradually resigned his original office. In one of the Homeric hymns Ares is described as a sun god who makes courage and valour stream into the hearts of men, and again, Æetes, king of Colchis, though a son of Helios, was yet the guardian of the grove of Ares, where was the golden fleece. Meleager, whose valour was displayed against the Calydonian boar, a pest to the fields of Ætolia, was a son of Ares and the fostering nymph Althæa. Œnomaus was a son of Ares and a daughter of the river god Asopus. The dog, which had originally referred to the dog star, remained his symbol, but could only be accounted for by the constant presence of that animal on battle-fields. From the destruction of crops by summer heat to similar destruction by war-like invasion seems a natural step. The next step was to take the point of view of the invader, and to magnify the exploits of war. By the time of Homer this had been done effectually, though traces of an older form of belief remain both in the *Iliad* and *Odyssey*. Besides those already mentioned, there is the remarkable incident in the *Odyssey* (viii. 266, *ff.*) where Hephæstos, informed by Helios of the infidelity of his wife Aphrodite with Ares, captures them together in a net, and there holds them for the ridicule of the gods. In what appears to be a very early development of her character, Aphrodite was a war goddess, and was styled Areia. But it is scarcely possible that a phase of character shared also, for example, by Athena, could have suggested such a relation between Ares and Aphrodite, though Hesiod's statement (*Theogony*, 934) that Deimos and Phobos were their offspring points in that direction. Again, though Ares and Aphrodite were worshipped together at Thebes, it is not known that they were worshipped there as deities of war. Harmonia, the wife of Cadmus, the founder of that town, was regarded as their daughter. Possibly the connection originated in some other approximation between Ares and Aphrodite in an earlier form of their worship. Women were excluded from the festivals of Ares except at Tegea, in Arcadia, where he was called γυναικοθοίνας. But that exception appears to have been based only on an instance in which that town was successfully defended by its women. While honoured here and there with festivals and sacrifice, as at Sparta, where young dogs, and apparently once men, were offered to him under his title of Enyalios and Theritas, there were yet wanting in his case those local beliefs and traditions which gave vitality to the worship of a god. Next to Thebes, already mentioned, it was at Athens that this vitality obtained most, through the legend attaching to the Areopagus (Αρειος πάγος). The nymph Agraulos had born him a daughter Alcippe, whom Halirrhotius, a son of Neptune, had seized with violence, and for this was slain by Ares, who was tried by a council of the gods sitting on the Areopagus and acquitted. At the foot of the Areopagus was a temple of Ares, with a statue of the god from the hands of Alcamenes. To judge now of the fluctuation in the conception of Ares from works of art, it is found that previous to the 5th century B.C., he was figured bearded, grim, and heavily armed. From that time, apparently under the influence of Athenian sculptors, who had to render his form in some harmony with their local war goddess Athena, he was conceived as the ideal of a youthful warrior, and for a time associated with Aphrodite and Eros, as in the group of the villa Borghese at Rome, where Eros plays with his weapons, and in many other groups of Ares and Aphrodite in marble and on engraved gems of Roman times. But before this grouping had recommended itself to the Romans, with their legend of Mars and Rhea Silvia, the Greek Ares had again become under Macedonian influence a bearded, armed, and powerful god. The Romans, however, though they readily adopted the Greek Mars and Venus, yet retained the former deity in his native character as a god representing the influence of the sun on cultivated fields, resembling the Mamers of the Mamertines in Sicily, with a wolf as his symbol (Conze, *Heroen und Götter Gestalten*, p. 22, Vienna, 1874; Preller, *Griechische Mythologie*, i. pp. 251–259; Welcker, *Griechische Götterlehre*, i. pp. 413–424).

(A. S. M.)

ARESON, JON (or HANS), a poet, and the last Roman Catholic bishop in Iceland, was born in 1484. He endured many privations in his youth, and at the age of twenty took holy orders, and was attached as priest to the parish of Helgastad. Here he was taken under the protection of Gottskalk, bishop of Holum, who twice sent him on missions to Norway. He acquitted himself so well that in 1522 he was appointed successor to Gottskalk. To many his election was displeasing, chiefly on account of his ignorance of Latin; and Ogmund, bishop of Skalholt, the other diocese, drove Areson with violence from his bishopric. He was reinstated in 1524, and spent some rather stormy years till 1540, when Frederic III., king of Denmark, wrote to the bishops of Iceland desiring them to take measures for the introduction of Lutheranism. This Areson declined to do, and he even denied the king's power as head of the church. The greater part of the island, however, became Protestant. In 1548 the Lutheran bishop of Skalholt died, and Areson made an armed excursion into his successor's territory. For this he was in 1549 declared an outlaw. He again sent an expedition against Skalholt, and captured the bishop, whom he treated with indignity. In 1550 his forces were defeated; he was taken, and executed along with two of his sons. Areson is celebrated as a poet, and as having been the first to introduce printing into Iceland. Several of his poems are collected by Harboe in his *History of the Reformation in Iceland.*

ARETÆUS, a Greek physician of Cappadocia, who lived, according to some, in the reign of Augustus; according to others, under Trajan or Hadrian. He was one of the class of Pneumatic physicians, who made the heart the seat of life and of the soul. He wrote, in the Ionic dialect, several treatises on acute diseases and other medical subjects, some of which are still extant. The best editions of his works are—that of Boerhaave, in Greek and Latin, with notes, 1731; that printed at Oxford in 1723, in folio; and those by C. G. Kühn, 1828, and Ernerius, 1847.

ARETHUSA, a fountain at Syracuse, in Sicily, famed among the ancients for the abundance of its waters and the number of its fishes, but still more so for the connection which was fabled to exist between it and Alpheus, the river of the Peloponnesus, "who stole under seas to meet his Arethuse." According to the anthropomorphic legend, Arethusa was a daughter of Nereus and Doris, who was changed into the fountain by her mistress Diana (Artemis), to deliver her from the pursuit of her lover Alpheus. There is still a copious supply of water in the modern fountain, but the taste is brackish, and it can only be used for washing; while the fish are no longer to be found. There was a fountain of the same name in Ithaca (Homer), and another at Chalcis in Eubœa, which supplied the city with water, but, according to Leake, has now disappeared. There was also a lake Arethusa, through which the Tigris flowed, identified by Ritter with L. Nazuk.

Arethusa was also the name of two cities: Arethusa in Macedonia, famous for the tomb of Euripides, and Arethusa in Syria (*Rastan*), which gives its name to Marcus, a bishop who was persecuted by the Arethusans, and is honoured as a martyr by the Greek Church.

ARETINO, Pietro, an Italian writer of the 16th century, was born in 1492 at Arezzo in Tuscany, from which place he took his name. He is said to have been the natural son of Luigi Bacci, a gentleman of the town. He received little education, and lived for some years poor and neglected, picking up such scraps of information as he could. When very young he was banished from Arezzo on account of a satirical sonnet which he composed against indulgences. He went to Perugia, where for some time he worked as a bookbinder, and continued to distinguish himself by his daring attacks upon religion. After some years' wandering through parts of Italy he reached Rome, where his talents, wit, and impudence commended him to the Papal Court. This favour, however, he lost in 1523 by writing a set of obscene sonnets, to accompany an equally immoral series of drawings by the great painter, Julio Romano. He left Rome and was received by John de Medici, who took him to Milan and introduced him to Francis I. He gained the good graces of that monarch, and received handsome presents from him. Shortly after this Aretino attempted to regain the favour of the Pope, but, having come to Rome, he composed a sonnet against a rival in some low amour, and in return was assaulted and severely wounded. He could obtain no redress from the Pope, and returned to John de Medici. On the death of the latter in December 1526, he withdrew to Venice, where he afterwards continued to reside. He spent his time here in writing comedies, sonnets, licentious dialogues, and a few devotional and religious works. He led a profligate life, and procured funds to satisfy his needs by writing sycophantish letters to all the nobles and princes with whom he was acquainted. This plan proved eminently successful, for large sums were given him, apparently from fear of his satire. So great did Aretino's pride grow, that he styled himself the "divine," and the "scourge of princes." He died in 1557, according to some accounts by falling from his chair in a fit of laughter caused by hearing some indecent story of his sisters. The reputation of Aretino in his own time rested chiefly on his satirical sonnets or burlesques; but his comedies, five in number, are now considered the best of his works. His letters, of which a great number have been printed, are also commended for their style. The dialogues and the licentious sonnets have been translated into French, under the title *Académie des Dames.*

AREZZO, the ancient Arretium, a Tuscan city on the Chiana (*Clanis*), which is now an affluent of the Arno, but formerly flowed into the Tiber. Arretium was one of the twelve cities of the ancient Etruscan Confederation, and continued after its incorporation with the Roman dominion to be a highly important military post. Having sided with Marius in the civil war, the Aretines were deprived by Sulla of their Roman citizenship; but the city received a colony under Augustus, and seems to have had a peculiar municipal constitution. In the time of Pliny it was known for its pottery, and many specimens of the bright red ware, with ornaments in relief, differing from the productions of Southern Etruria, have been preserved to the present day. Among the relics that have been discovered here are the bronze statues of Minerva and the Chimæra, now in the Florentine Gallery. In modern history Arezzo is chiefly remarkable for the obstinate opposition it maintained against the pertinacious encroachments of the Florentines, to whom, however, it had finally to submit. It is now a clean, well-built, well-paved, and flourishing town of 10,000 inhabitants, the seat of a bishop and a prefect, with a theological seminary, a surgical school, a library, and a museum. In its cathedral are the tombs of Guido Tarlati, its warlike bishop, who died in 1327, Gregory X. (1276), and Redi the naturalist (1698). Few cities can show such a list of remarkable men as Arezzo—Mæcenas (?), Guido, famous for his musical discoveries, Guittone the poet, Petrarch, Leonardo Bruno the historian, Cesalpini the botanist, Margheritone and Spinello the painters, Alberghotti the jurist, Pope Julius III., Pietro Aretino the satirist, Vasari the author of *Lives of the Artists*, Redi already mentioned, Fossombroni the mathematician and engineer.

ARGÁM, a village of Haidarábád, in the Nizám's dominions, situated in 21° 2′ N. lat., and 77° 2′ E. long., 40 miles south-west of Elichpur, and 135 miles north-east of Aurungábád. The village is rendered memorable as the site of an action which took place on the 28th November 1803 between the British army, commanded by Major-General Wellesley (afterwards Duke of Wellington), and the Marhattás under Sindhiá and the Rájá of Berar, in which the latter were defeated with great loss. A medal struck in England in 1851 commemorates the victory.

ARGELANDER, Friedrich Wilhelm August, a distinguished German astronomer, was born at Memel, 22d March 1799; and died at Bonn, 17th February 1875. He studied at the university of Königsberg, where his attention was attracted to the study of astronomy by Bessel, whose assistant he became in 1821. In the following year he published an essay on the path of the great comet of 1811, the period of which he determined with great accuracy. In 1823 he was made superintendent of the observatory at Abo; and in 1832 was transferred to the university of Helsingfors, where he remained for five years. In 1837 he published an admirable essay upon the proper motion of the solar system, and in the same year was appointed professor of astronomy at Bonn, where he spent the remainder of his life. Argelander's fame rests principally on the extensive and accurate observations he undertook in continuation of the plan laid down by Bessel. His results were published in the *Observationes Astronomicæ Aboæ factæ*, 3 vols., 1830–32; DLX *Stellarum Fixarum Positiones Mediæ*, 1835; *Durchmusterung des nörd. Himmels zwischen* 45° *und* 80° *nördl. Breite*, 1846; and in the *Sternverzeichniss*, containing upwards of 210,000 stars, in the 3d and 4th vols. of the *Astron. Beobacht. auf der Sternwarte zu Bonn.* The *Neue Uranographie*, 1843, and the *Atlas des nördl. gestirnten Himmels*, 1857, are also valuable works. For several years before his death, Argelander was engaged in observations on stars of variable magnitude and brilliancy, and the results of his labours will probably be put forth in a collected form.

ARGENSOLA, the name of two Spanish poets, brothers, who are sometimes called the "Spanish Horaces." The elder, Lupercio Leonardo y Argensola, was born in 1565 and died in 1613. He was educated at the universities of Huesca and Saragossa, and became secretary first to his patron, the duke of Villahermosa, and afterwards to the ex-Empress Maria of Austria. In 1599 he was made historiographer of Aragon, and a few years later historiographer royal. In 1610 he accepted the office of secretary to the Count of Lemos, then viceroy of Naples, at which place he died. His works consist of three tragedies, highly praised by Cervantes, and lyric poems, published along with those of his brother. Some historical writings of his have not been published. The younger brother, Bartolomeo Leonardo, was born in 1566 and died in 1631. He entered the church, and in 1588 received the rectory of Villahermosa. He afterwards acted as chaplain to the Empress Maria. Sometime after the death of his brother he succeeded to the office of historiographer. His principal works are—a history of the Conquest of the Molucca Islands (*Conquista de las Islas Molucas*, 1609), which has been translated into English, a continuation of Zurita's *Annals of Aragon*, and a translation from the English, called *Regla de Perfeccion*. His fame rests chiefly on his poems, which are highly esteemed by competent critics.

ARGENTAN, a town in the department of Orne, in France, situated in the midst of a fertile plain at the junction of the Ure and Orne, about 31 miles from Alençon. It is a sub-prefecture, and the chief town of an arrondissement, and has an ancient castle, now used as a court-house and prison, several important churches, and a handsome town-house. Its manufactures are a coarse kind of lace called after its name, gloves, leather, and fine cloth. Cattle and horses are reared. Argentan was a viscountship from the 11th century downwards; it has been often taken and destroyed; and during the religious wars it remained attached to the Catholic party. François-Eudes de Mézeray, the historian, was born at Rie, in the neighbourhood. Population in 1872, 5725.

ARGENTEUIL, a market-town of France, in the department of Seine-et-Oise, and arrondissement of Versailles, on the Seine, in lat. 48° 56′ N., long. 2° 15′ E. It gathered round a monastery, which, dating from 656 A.D., was by Charlemagne changed into a nunnery, afterwards famous for its connection with Heloise, and on her expulsion in 1129, was again turned into a monastery. Francis I. surrounded the town with walls and a ditch. The Chateau du Marais was once possessed by Mirabeau, and the parish church dates in some portions from the time of Clovis. Vinegar and an indifferent kind of wine are manufactured, and in the neighbourhood there are fine quarries of gypsum. Population, 8176.

ARGENTINE REPUBLIC

Plate XXV.

THE ARGENTINE REPUBLIC comprises the greater part of what was formerly the Spanish viceroyalty of Buenos Ayres. On the separation of the country from Spain the remainder of the viceroyalty seceded from the authority of the government established at Buenos Ayres, and formed the three important republics of Bolivia, Paraguay, and the Banda Oriental del Uruguay, commonly called either the Oriental Republic or Uruguay. The city of Buenos Ayres, the capital of the province of the same name, then became the seat of the national government of the United Provinces of the Rio de la Plata,—so named in the treaty with England, by which their independence was recognised, and since termed the Argentine Republic. Including the Indian tribes, who are in almost undisputed possession of half its territory, the country does not contain half so many inhabitants as the city of London, though it extends over an area as great as all Central and Western Europe combined; and the fertility of its vast plains, together with the yet undeveloped wealth of its mineral resources, indicate that it is well able to sustain as numerous a population as that of the part of Europe just alluded to. Its extent in latitude is greater than that of any other existing country, if we except the comparatively useless foreign regions of British America and those of the Russian empire, though it only slightly exceeds that of the comparatively narrow slip of land which forms the neighbouring Republic of Chili.

Boundaries.

It is bounded on the W. by Chili; on the S. by the Strait of Magellan; on the E. by the Atlantic Ocean, the Oriental Republic, the Empire of Brazil, and the Republic of Paraguay; and on the N. by the Republic of Bolivia. The boundary to the W. is formed by the mountain chain of the Andes. The southern limit is at present a question in dispute with the Government of Chili, who claim the entire extent of the Strait of Magellan; but it is probable that the Argentine Government will make good its claim to the eastern portion. The broad stream of the Uruguay below its tributary, the Guarey, or Cuareim, divides it from the Oriental Republic, except that the small but important island of Martin Garcia, close to the Oriental shore of the Uruguay at its junction with the Parana, belongs to the Argentine Republic. The boundary with Brazil is then formed by the Uruguay and its tributary, the Pepiri Guazu, from the head waters of which it crosses the Sierra de los Missiones to the head waters of the San Antonio Guazu, the course of which it follows, and then that of the Iguazu, or Rio Grande de Caritiba, an important tributary of the Parana. The Parana, down to its junction with the Paraguay, and the latter upwards as far as the mouth of the Pilcomayo, form the boundary with the Republic of Paraguay. South of the 22d degree of latitude the country between the Pilcomayo and the Paraguay is disputed by the Argentine Republic and Paraguay. The boundary with Bolivia lies along the 22d degree of latitude between the Pilcomayo and the Vermejo, and then, leaving important tributaries of the latter to Bolivia, it follows the course of that river to its source, whence it takes a devious course westwards among the mountains which form spurs to the Andes. On reaching the latter it follows the main chain southwards to latitude 25° 30′, where it passes to a more westerly ridge of the Andes on which the boundaries of the three neighbouring republics unite. The boundary we have described with Bolivia cannot be considered as permanently settled; and the boundary between Bolivia and Paraguay to the north of the Argentine Republic has not been determined. The boundary questions with all these republics are in an unsatisfactory state.

Physical geography. Plains

The most remarkable feature of the country is its plains, which may be said to extend over more than three-fourths of it. The plains of Patagonia in the south, the Pampas across the extending central part of the country, and the Chaco in the north-east, have no very definite natural boundaries. The two latter are, in fact, the same continuous formation, in which a slight undulation divides the streams of the Chaco, which join the Parana, from those of the Pampas, which either flow into the Atlantic south of the mouth of the latter river, or disappear by absorption into the soil, and evaporation as they spread over the plains. The best parts of these plains are covered with a rich alluvial soil from 3 to 6 feet in thickness, formed by the constant decaying of the luxuriant vegetation which grows upon it, and this soil rests upon a sedimentary deposit of earth, which appears to have been scoured away from the Andes and the high lands of the central part of the continent. A great part of Patagonia and the western Pampas consists of gravel and coarse detritus from the Andes, and, though apparently sterile, only requires irrigation to become productive. Other parts of the plains are dry, saline wastes or brackish marshes, which probably mark the former position of an inland sea. Excepting the hills in the south

Mountains. of the province of Buenos Ayres and those of Cordova, the mountain districts of the country consist of the eastern slope of the gigantic range of the Andes and its branches, which latter make all the north-western part of the country a mountainous region. The great chain of the Andes consists of a confused mass of broken and contorted strata, piled upon an elevated ridge of granite, through which numerous volcanoes, many of them still active, have ejected vast quantities of lava and scoriæ. Along most parts of the great mountain chain there are three subsidiary and more or less parallel ridges, between which fertile valleys are formed in many places, whilst in other parts the separation between them is not very clearly defined. In the north-west the boundary with Bolivia lies along the most eastern of the ridges just mentioned, so that the valleys to the west of it are within that republic, but the boundary with Chili lies along the western ridge, so that the central and eastern ridges, with the fine valleys which lie between them, belong to the Argentine Republic. The great chain of the Andes, as described by Mr Evan Hopkins, who made extensive explorations in various parts of it, is formed of innumerable varieties of granite, gneiss, schists, hornblende, chloritic slates, porphyries, &c., and these rocks alternate with each other in great meridional bands. The crystalline rocks follow no particular order in the alternation. For miles only granite and gneiss are found, and again schist, quartz, gneiss, &c., intervening. The whole of the crystalline rocks, especially the micaceous variety, pass insensibly from the crystalline to the laminated structure. We have first the granite base, in which the crystals are somewhat confusedly mixed; these gradually become arranged upwards into parallel lines, and the rock is then called gneiss; by degrees the felspar is decomposed, and the mass becomes schistese, with enclosed veins of the predominating element of the compound below. This is the general character of the primary structure of the Andes, and upon it there are many bits of sandstones, limestones, &c., especially on the eastern chain.

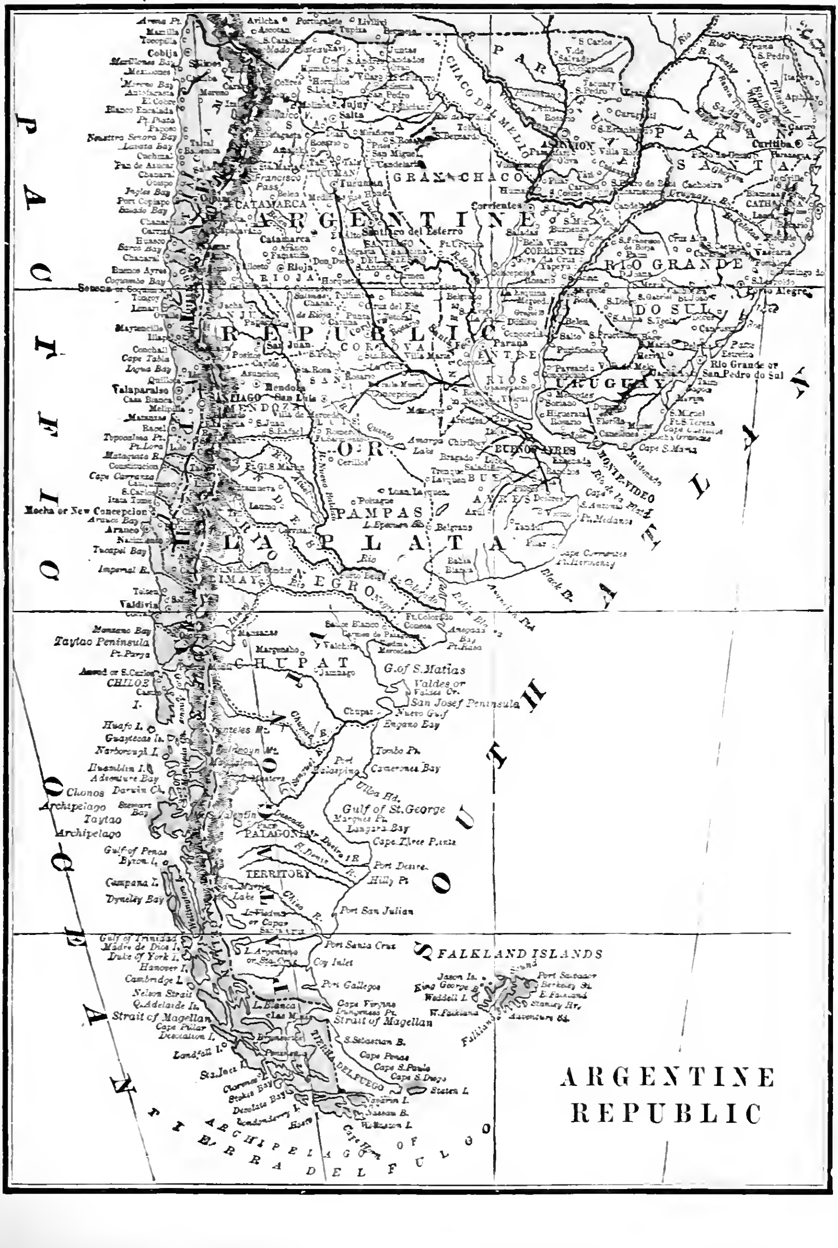
Darwin's researches. The most careful and elaborate researches into the geological conformation of the country were made by Mr Darwin, who published the results in his work on the geology of South America. He points out evidences of a gradual upheaval of the plains of Patagonia and the Pampas, to the extent of 400 feet in the southern part of the former, and 100 feet in the latter district. The Pacific and Atlantic Oceans were once connected through what is at present the basin of the Santa Cruz river, in latitude 50° S. This latter district appears to have been upheaved at least 1400 feet before the period of the gradual upheaval above mentioned, as indicated by the present position of gigantic boulders, which have been transported on icebergs 60 and 70 miles from their parent rock. The enormous layers of gravel and sand, on the plains and even on the hills of eastern Patagonia, give evidence of its having at one time formed the bed of an ocean which rolled against the Andes or intervening ranges of mountains. The characteristic feature of the plains of Patagonia is gravel, whereas that of the Pampean formation, which includes the Chaco, is earth which, according to Mr Darwin's lucid arguments, has been deposited in the form of sand in the estuary of the River Plata, the position of which has been continually changing in consequence of the gradual upheaval of the country. This formation extends to the south-west and north-west from the present estuary, over an area at least 750 miles long and 400 miles broad, and the thickness of the deposit is from 30 to 100 feet. The hills of Tapalquen, Tandil, and Vulcan, composed of unstratified granular quartz, project through the eastern part of this Pampean formation. The higher range of the Sierra Ventana further south is also quartz. South of the Sierra Ventana, for a distance of 380 miles, crystalline rocks are seldom if ever met with on the east coast; and beyond that a porphyritic formation is found resembling the lowest stratified formation of the Andes.

"The highest peaks of the Cordillera," says Mr Darwin, "appear to consist of active, or more commonly, dormant volcanoes—such as Tupungato, Maypu, and Aconcagua, which latter stands 23,000 feet above the level of the sea, and many others. The next highest peaks are formed of the gypseous and porphyritic strata, thrown into vertical or highly inclined positions. . . . This grand range has suffered both the most violent dislocations, and slow, though grand, upward and downward movements in mass: I know not whether the spectacle of its immense valleys, with mountain masses of once-liquefied and intrusive rocks now bared and intersected, or whether the view of those plains, composed of shingle and sediment hence derived, which stretch to the borders of the Atlantic Ocean, is best adapted to excite our astonishment at the amount of wear and tear which these mountains have undergone."

We commend Mr Darwin's work to the attention of readers desirous of becoming better acquainted with the geological conformation of the Argentine Republic.

Climate. The great extent of this country in latitude makes its climate range through all diversities of temperature from that of Northern Europe and Canada to that of Egypt and Arabia. The climate of Southern Patagonia is less intemperate than that of Labrador at the same distance from the equator in the northern hemisphere, but colder than the Atlantic shores of Europe in the same latitude. As the difference of climate in the same latitude in the northern hemisphere is in a great measure attributed to the fact of the warm water from the equatorical regions drifting towards the shores of the north of Europe, whilst the cold water from the Arctic regions is constantly flowing southwards along the coast of Labrador, so also the intermediate nature of the climate of Patagonia is doubtless, in some measure, due to the tendency of the cold water of the Antarctic regions to flow northwards through the central parts of the Atlantic Ocean, as pointed out by Maury, thus throwing the warm water southwards along the coasts of Brazil and Patagonia. Argentine Patagonia might, not inaptly, be termed the Sweden, and Chilian Patagonia the Norway of the southern hemisphere. In the north of Patagonia and the southern part of the province of Buenos Ayres the climate, as regards temperature, resembles that of England; and northwards of this is the broadest part of the republic, which contains the city of Mendoza in the far west, and Buenos Ayres in the east, and enjoys one of the finest climates in the world, rivalling that of Southern France and Northern Italy. North of this the summer heat becomes too oppressive, and in the extreme north the climate is thoroughly tropical. In some parts of the north-west the altitude of the country gives it a cooler climate than that of the Chaco in the same latitude. Along the Argentine slopes of the Andes and the adjacent country the climate is remarkable for its dryness, because the prevalent westerly winds lose the moisture which they bring from the Pacific before crossing the mountains. This peculiarity is most marked in the southern part of the continent, where Chilian Patagonia is deluged with almost incessant rain, whilst Argentine Patagonia is dry and arid. In the east, as at Buenos Ayres, there is more rain, which, with southerly winds and occasional north-westerly storms, is often very heavy. The oppressive humidity which is characteristic of the northerly and north-easterly winds forms the most disagreeable and unhealthy weather experienced in that part of the country. The climate of Cordova, and also that of some of the more westerly districts, is found very suitable for consumptive patients.

History. The first Europeans who visited the River Plate were a party of Spanish explorers in search of a south-west passage to the East Indies. Their leader, Juan Dias de Solis, landed, in 1516, with a few attendants on the north coast



ARGENTINE
REPUBLIC
PACIFIC OCEAN
SOUTH ATLANTIC
FALKLAND ISLANDS
Strait of Magellan
PAMPAS
GRAN CHACO
PATAGONIA

between Maldonado and Monte Video, where, according to Southey, they were treacherously killed, and then cooked and eaten by the Charrua Indians in sight of their companions on board the vessels. The survivors at once abandoned the country and returned to Spain, reporting the discovery of a fresh-water sea. In 1519 Magalhaens, in the service of the king of Portugal, entered this fresh-water sea, or Mar Dulce, as it was then called, but finding no passage to the west, he left it without landing, and then achieved his famous voyage to the East Indies, passing through the strait which bears his name in 1520. After this Sebastian Cabot, already a renowned navigator, who, in the service of Henry VII. of England, had attempted to find a north-west passage to the East Indies, entered the service of Charles I. of Spain, and sailed in command of an expedition fitted out for the purpose of colonising the discoveries of Magalhaens in the East Indies. He, however, entered the River Plate in 1527, and anchored off the present site of the city of Buenos Ayres. He then ascended the Parana, and established a settlement, named San Espiritu, among the Timbú Indians in Santa Fé; and he succeeded in bringing that tribe of Indians to friendly terms with the colony. He continued the ascent of the Parana as far as the cataracts in Missiones, and afterwards explored the Paraguay, from which he entered the Vermejo, where his party suffered severely in a savage fight with the Agaces, or Payaguá Indians. Of this tribe a subdued remnant now lives on the delta of the Pilcomayo, opposite Asuncion, amalgamating neither with the Spaniards nor with the wild Guaycurus of the surrounding parts of the Chaco. The profusion of silver ornaments worn by these Indians, as well as by the Timbus and Guaranis, led him to give the name of Rio de la Plata, or Silver River, to the splendid stream which he had thus far explored. This name, rendered in English *River Plate*, is now applied only to the estuary below the junction of the Paraná and Uruguay. One of Cabot's lieutenants, detached on a separate exploring expedition up the Uruguay, was killed, together with a great part of his crew, by the Charrua Indians. And subsequently at San Espiritu, an attempt of the chief of the Timbus to obtain possession of one of the Spanish ladies in the settlement led to a treacherous massacre of the garrison. Before this latter occurrence Diego Garcia arrived in the river with an expedition fitted out in Spain, for the purpose of continuing the explorations commenced by De Solis; and Cabot returned to Spain, where he applied to Charles I. for the means of opening communications with Peru by way of the Vermejo. But the resources of the king were absorbed in his struggle as emperor (under the name of Charles V.) with Francis I. of France, so that he was obliged to leave the enterprise of South American discoveries to his wealthy nobles. In August 1534 Mendoza left Cadiz for the River Plate at the head of the largest and wealthiest expedition that had ever left Europe for the New World. In January 1535 he entered the River Plate, where he followed the northern shore to San Gabriel, and then crossing the river, he landed on the Pampas. The name of Buenos Ayres was given to the country by Del Campo, who first stepped ashore where the city of that name now stands, and where, on the 2d February, the settlement of Santa Maria de Buenos Ayres was founded; the smaller vessels having been safely harboured in the Riachuelo, half a league south of the settlement. Mendoza's captains then explored the country between Paraguay and Peru, in which latter country Pizarro had, in 1535, founded the city of Lima. Of one of these expeditions consisting of 200 men, who left Paraguay in February 1537, and are said to have reached the south-east districts of Peru, under Ayolas, every man was killed by the Payaguá Indians in the northern part of the Chaco whilst the expedition was returning laden with plunder. Ayolas had, on his way up the river, built and garrisoned a fort named Corpus Christi among the Timbus in Santa Fé, near the deserted settlement of San Espiritu; and in Paraguay, after three days' fighting with the Guaraní Indians, as narrated by Du Graty, he had, on the 15th August 1536, established a settlement where the city of Asuncion now stands. In the meantime the settlement of Buenos Ayres was attacked and burnt by the Indians; and after terrible sufferings from famine as well as attacks of the Indians, jaguars, and pumas, the Spaniards abandoned the place on the arrival of a fresh expedition from Spain, in company with which they ascended the river, first to Corpus Christi, and then to Asuncion, where, in 1538, Irala was elected captain-general. In 1542 Buenos Ayres was re-established by an expedition sent out from Spain for the purpose under Cabesa de Vaca. This able leader landed at Santa Catherina, in Brazil, and marched overland to Asuncion, from which he sent vessels to join the new expedition at Buenos Ayres, reaching that place, according to Southey, just in time to save the new comers from extermination by the Indians. Here the Spaniards again found themselves unable to withstand the incessant attacks of the savages, and the place was a second time abandoned on the 3d February 1543. At Asuncion the Spaniards were more successful in establishing themselves among the Guaraní Indians, who, after much severe fighting, finding themselves unable to vanquish the Spaniards, made alliance with them both offensive and defensive, and also intermarried with them. The events which transpired at Asuncion belong, however, to the history of Paraguay. In 1573 Garay, at the head of an expedition despatched from Asuncion, founded the city of Santa Fé near the abandoned settlements of San Espiritu and Corpus Christi. The expulsion of the Spaniards from the latter place had, according to the *Historia Argentina*, resulted from a wanton attack made by them on the Caracara Indians, slaughtering the men, and taking the women captive,—a mode of procedure which all Pampa Indians adopted, and have ever since acted on. It is unfortunate, both for the Indians and for the Spaniards, that the bold *conquistadores* were not always under the guidance of such high principled men as Cabot and Cabesa de Vaca. In 1580, when the new colony had been firmly established, Garay proceeded southwards and made the third attempt to establish Buenos Ayres, under the name "Cuidad de la Santissima Trinidad, Puerto de Santa Maria de Buenos Ayres;" and notwithstanding the determined hostility of the Querandi Indians, who were encouraged by the success of their two preceding wars, the Spaniards succeeded in holding the place. The settlement prospered, and the cattle and horses brought from Europe multiplied and spread over the plains of the Pampas. Whilst the Spaniards of the River Plate were thus engaged, Pizarro had effected the conquest of Peru; and his lieutenant, Almagro, had extended the conquest to the south of Chili, from which, in 1559, Hurtado de Mendoza crossed the Andes, and, having defeated the Araucanian Indians, founded the city of Mendoza. It is interesting to observe, that up to the present day the giant chain of the Andes has been a less effective barrier to trade than the rich plains of the Pampas. This state of affairs will, however, now soon be altered by the railway, for which Mr Clark has just obtained a concession, direct from Buenos Ayres to Mendoza. In 1550 the Spaniards from Peru entered the north-western provinces by way of Catamarca, and founded the city of Tucuman in 1565, and that of Cordova in 1573. It was only in 1873, just three hundred years after the cities were founded, that the boundary between the jurisdiction of Cordova and that of

Santa Fé was determined by the intervention of the national Government. In 1620 Buenos Ayres was separated from the authority of the Government established at Asuncion, and was made the seat of a Government extending over Mendoza, Santa Fé, Entre Rios, and Corrientes, but at the same time remained, like the Government at Asuncion and that of Tucuman, which latter included Cordova, subject to the authority of the viceroyalty of Peru.

After the vast expenditure of blood and treasure which was incurred by the Spaniards in establishing themselves on the River Plate as just described, the restrictive legislation of the home Government became a more effective hindrance to the development of its resources and the spread of civilisation over the country than the hostility of the Indian tribes. Cabot had urged the feasibility of opening an easier channel for trade with the interior of Peru through the River Plate and its tributaries than that by way of the West Indies and Panama; and, now that his views seemed about to succeed, the interests of the trade, which had in the meantime been established by the northern route, combined to crush the threatened development of that of the River Plate. Spanish legislation endeavoured to exclude all European nations except Spain from the trade by way of the West Indies, and to prevent any trade from being transacted by way of the River Plate, thus enacting most flagrant injustice towards the people it had encouraged to settle in the latter country. The hardy pioneers of European civilisation in these regions so far overcame the pernicious influences which acted upon Spanish legislation, that in 1602 they obtained permission to export two shiploads of produce a year. But, to prevent internal trade with Peru, a custom-house was established at Cordova, to levy a duty of fifty per cent. on everything in transit to or from the River Plate. In 1665 a relaxation of this system was brought about by the continued remonstrances of the people; and in 1774 free trade was permitted between several of the American posts. In 1776, with a view to better maintaining the country against the encroachments of the Portuguese in their colonies in Brazil, Buenos Ayres was decreed the capital of a viceroyalty, with jurisdiction over the territories of the present republics of Bolivia, Paraguay, Uruguay, and the Argentine Confederation. All this country was then opened to Spanish trade, even with Peru, and the development of its resources, so long thwarted, was allowed comparatively free play. From this time a succession of viceroys exercised jurisdiction over the whole of these territories. Velasco, however, was made governor of the semi-civilised Indians in the Jesuit settlements of Missiones on the Rivers Parana and Uruguay, subject only to the direct authority of the home Government; and in 1806 he became also governor of the province of Paraguay, under the authority of the viceroyalty of Buenos Ayres, and these offices he still held when the independence of the country was declared.

The authority of the viceroys was interrupted in the lower part of the River Plate during the wars between England and Spain. On the 27th June 1806 General Beresford landed with a body of troops from a British fleet under command of Sir Home Popham, and obtained possession of the city of Buenos Ayres. The viceroy, Sobremonte, retired to Cordova, where Liniers collected an army from all parts of the country, with which, on the 12th August, he assaulted the city, and Beresford with his troops surrendered. In the meantime Sir Home Popham had taken Maldonado; and in February 1807 Sir Samuel Auchmuty stormed and took the city of Monte Video. In May 1808 General Whitelock, with 8000 men, endeavoured to regain possession of Buenos Ayres; but the inhabitants had made great preparations for resistance, and as all the houses were at that time built with their windows opening on the streets, protected with strong iron railings like prison bars, and with flat roofs, each one was of itself a fortress: so that after suffering terrible slaughter in the long straight streets ot the city, the invading army capitulated, agreeing to abandon both banks of the River Plate within two months. Whitelock was brought before a court-martial appointed to inquire into the cause of the failure of the enterprise entrusted to him; the indignation excited against him in England. in consequence of his want of success, was as great as that excited on the River Plate against the viceroy, Sobremonte, in consequence of the first success of the English. The events which we have narrated tended to give self-confidence to the people of Buenos Ayres, who, on applying to the home Government for assistance against the English, had been told that they must protect themselves. But the disturbances which ultimately led to the separation of the country from Spain were initiated by the refusal of the Argentines to acknowledge the Napoleonic dynasty established at Madrid. Liniers, who was viceroy on the arrival of the news of the crowning of Joseph Buonaparte as king of Spain, was deposed by the adherents of Ferdinand VII.; and on the 19th July 1809, Cisneros became viceroy in the name of Ferdinand. In compliance with the urgent appeals of the people, he opened the trade of the country to foreign nations; and on the 25th May 1810, a council was formed, with his consent, under the title of the Provisional Government of the provinces of the Rio de la Plata. This has since been regarded as the commencement of the era of the political independence of the country. Of this council Mariano Morino, the secretary, was the most prominent member, and the people of the city of Buenos Ayres were for some time its only effective supporters An attempt of the Spanish party to make Cisneros president of the council failed, and he retired to Monte Video. On the 31st January 1813 a congress was assembled at Buenos Ayres, and Posadas was elected dictator of the republic. Monte Video still supported the cause of Spain, but was besieged by the revolutionary army of Buenos Ayres, and capitulated in 1814. A sanguinary struggle between the party of independence and the adherents of Spain spread over all the country of the River Plate; but on the 25th March 1816, a new congress of deputies elected by the people was assembled at Tucuman, where Payridon was declared president of the republic; and on the 9th July the separation of the country from Spain was formally declared, and a state of comparative order was re-established. Buenos Ayres was then declared the seat of government. The whole of the viceroyalty did not, however, acknowledge this Government. Bolivia, Paraguay, and Uruguay, established themselves each as a separate republic, after passing through scenes of disorder, whilst the city of Buenos Ayres was itself the scene of sanguinary disturbances. From this time, however, the struggle for independence became, as regards the Argentine Republic, more of a foreign than a domestic war. The combined forces of Buenos Ayres and Chili defeated the Spaniards at Chacabuco in 1817, and at Maypu in 1818; and from Chili the victorious General San Martin led his troops into Peru, where, on the 9th July 1821, he made a triumphal entry into the city of Lima, which had been the greatest stronghold of the Spanish power, having been, from the time of its foundation by Pizarro, the seat of government of the viceroyalty of Peru. A general congress was assembled at Buenos Ayres on the 1st March 1822, in the presence of ambassadors from all the liberated states, and a general amnesty was decreed, though the war was not ended until the 9th December 1824, when the republican forces gained the final victory of Ayacucho, in the Peruvian districts of the Amazon. The Spanish Government did not, however, formally acknowledge the independence of the country until the year 1842. On the 23d January 1825, a National Constitution for the federal states which form the present Argentine Republic was decreed; and on the 2d February of the same year, Sir Woodbine Parish, acting under the instructions of Mr Canning, signed a commercial treaty in Buenos Ayres, by which the British Government acknowledged the independence of the country. For details of the history of the country up to the time of independence the reader is referred to the work of Sir Woodbine Parish, and to the *Historia Argentina*, published in Buenos Ayres. These works have been followed in this short narrative, except when otherwise stated, or in unquestionable matters to which they do not allude.

Whilst the events already described were in progress, Buenos Ayres was involved in a war with Brazil, in consequence of the Government of the country having, in 1817, taken possession of the Banda Oriental, which, under the rule of Artigas, had become a scene of anarchy. Buenos Ayres, unassisted by the northern provinces, waged war with Brazil for the possession of the Banda Oriental, until, in the year 1827, by the mediation of England, that country was made independent of both powers. The origin and progress of that war are more connected with the history of the Oriental than with that of the Argentine Republic. Under the new régime, inaugurated as above described in 1825, Rivadavia, who was elected president, endeavoured to establish a strong central government; and his party obtained the name of Unitarians in contradistinction to their opponents the Federals, who endeavoured to keep each state or province as independent as possible of the National Government. At the expiration of Rivadavia's term of office his opponents triumphed in the election of Vicente Lopez as president; and he was followed in 1827 by Dorrego, another representative of the Federal party. The Unitarians, under the leadership of General Lavalle and his troops, relieved from the war in the Banda Oriental, rebelled against the administration, and in 1828 they defeated the Federals, under Dorrego and General Rosas, in a battle in which Dorrego was taken prisoner and afterwards shot. General Rosas then became chief of the Federal party. In 1829 he defeated Lavalle; and obtaining from Congress, during a "reign of terror," such extraordinary powers as enabled him to rule as dictator, he became as hostile to many members of the Federal party as to the Unitarians. In 1838, a dispute between Rosas and the French Government led to a blockade of the port of Buenos Ayres by the French fleet; and, encouraged by this occurrence, Lavalle, in 1839, returned to the country to rally the Unitarian party. In 1840 he invaded the province of Buenos Ayres at the head of troops raised chiefly in the province of Entre Rios; but he was routed by the Federal army under General Pacheco, and was chased as far as the city of Jujuy, where he was overtaken and shot by troops under the command of Oribe. The rule of Rosas was now one of terror and almost incessant bloodshed in Buenos Ayres, whilst his partisans, General Oribe and Colonel Mazza, endeavoured to exterminate the Unitarians throughout the province. This scene of slaughter was extended to the Banda Oriental by the attempt of Oribe, with the support of Rosas, and of Urquiza, governor of Entre Rios, to establish himself as president of that republic, whose existing Government was hostile to Rosas, and sheltered all political refugees from the country under his despotic rule. The siege of Monte Video by the forces of Rosas led to a joint intervention of England and France, and in 1845 the English minister plenipotentiary declared Buenos Ayres blockaded, and determined to establish direct communications with the Republic of Paraguay by ascending the Parana, the right of navigating which was denied to foreign flags by Rosas, who had always refused to acknowledge the separation of the Government of Paraguay from the authority of Buenos Ayres. At Point Obligado, just above the delta of the river, a severe fight occurred, in which the men of the combined squadrons landed and carried the batteries by storm, after Captain Hope of the "Firebrand" and his crew had succeeded in cutting a heavy iron chain which closed the river under their fire. The allied forces then proceeded to Paraguay, and proclaimed the navigation of the mighty river which forms the highway to that country free to all nations. Ineffectual attempts were made by the allies to induce the people of the River Plate, and more especially Urquiza, to rise against the despotic rule of Rosas; and finding the accomplishment of this impracticable without an army, they withdrew their several forces, and raised the blockade of Buenos Ayres in 1847. Brazil, whose alliance England and France had rejected in consequence of the opposition of that country to the English policy in the suppression of the slave trade, now came to terms with Urquiza; and the forces of Brazil, under Caxias, allied with those raised and commanded by Urquiza, invaded the province of Buenos Ayres, and routed the army of Rosas on the 3d February 1852 at Monte Caseros, about 10 miles from the city. Rosas escaped from the battlefield in disguise, and sought protection at the house of the English *chargé d'affaires*, by whom he was conveyed on board H.B.M. steamer "Locust," leaving the city in a delirium of joy at its sudden emancipation from his tyranny. A provisional Government was formed under Urquiza, and the Brazilian and Oriental troops retired. Urquiza then assembled all the provincial governors at San Nicholas, in the province of Buenos Ayres, and on the 31st May they proclaimed a new constitution, with Urquiza as provisional director of the Argentine nation. This constitution gave each province two representatives in the Senate or Upper Chamber of a Congress of Representatives, which was duly elected and met at Santa Fé; but the people of Buenos Ayres, considering that their political and commercial pre-eminence were not duly represented in the Congress, rose in rebellion against it on the 11th September. Alsina then became governor of Buenos Ayres; and in the new civil war which was now inaugurated might be regarded as the representative of the city, which was his chief support, in opposition to the peasantry, who throughout the country districts were chiefly partisans of Urquiza, or of Rosas. Alsina resigned office in face of a rising of the country districts, under Colonel Lagos, in favour of a restoration of Rosas; but Pacheco, who had defeated the Unitarian General Lavalle in 1840, rallied the city party, and with the support of the most influential citizens, proclaimed the aged General Pintos provisional governor, and the influence of the leading members of the foreign community was actively exerted in his favour. The defence of the city, now besieged by Lagos, was entrusted to General Hornos; and Urquiza, having been duly elected president by the other thirteen provinces, came to terms with Lagos, and took command of the army of the besiegers; and in April 1853 his fleet blockaded the port. In July the besiegers suddenly disappeared without awaiting an expected sally of the city forces under General Paz, now commander-in-chief. Urquiza signed, on board H.B.M. steamer "Locust," as representative of the thirteen provinces, a treaty with Sir Charles Hotham, by which the free navigation of the rivers was confirmed. The province of Buenos Ayres then became established as an independent state, and inaugurated an era of commercial and political development, with Obligado as constitutional governor, whilst Parana became the capital of the thirteen provinces under Urquiza. Differential duties imposed by the Confederation for the purpose of preventing the foreign trade of the confederated states from taking its ordinary course through Buenos Ayres caused great irritation in the latter province; but peace was, nevertheless, maintained until 1859, when Alsina again became governor of Buenos Ayres, and the numerous questions in dispute soon led to active hostilities between the Government at Parana and Buenos Ayres. The army of the latter, under General (then Colonel) Mitre, was defeated by the Confederate forces at Cepeda, in the province of Buenos Ayres, in October 1859; and Urquiza re-entered the city, when Alsina resigned his office of governor to Ocampo, and Buenos Ayres rejoined the Confederation, of which Urquiza resigned the presidency. Derqui was then elected president of the fourteen provinces, with the seat of government at Parana; whilst Urquiza became governor of Entre Rios, and Mitre governor of Buenos Ayres. Hostilities, however, recommenced in 1861, and the armies of the opposite parties, under Generals Urquiza and Mitre respectively, met at Pavon, in the province of Santa Fé. Mitre this time was victorious, and in 1862 he was elected president of the Argentine Confederation, of which, with the consent of the provincial Legislature, the city of Buenos Ayres became provisionally the capital. Urquiza retired to the province of Entre Rios, of which he continued to be governor. The history of these struggles is ably told by Mr Latham from a Buenos Ayrean point of view; and also, from the opposite side, by M. De Moussy, in his able and elaborate work dedicated to Urquiza.

In 1864 the Republic of Paraguay commenced war against Brazil, and on the 5th February 1865, President Lopez sent a despatch to the Argentine Government, requesting permission for the passage of a Paraguayan army through the province of Corrientes. This Mitre refused, the neutrality of the country having previously been declared. On the morning of the 13th April a Paraguayan fleet entered the port of Corrientes, and, without any previous warning of belligerent intentions, fired into and took possession of two vessels of the Argentine navy which were lying at anchor in the port, and also fired on the crew as they endeavoured to swim ashore to escape the unexpected slaughter. In the course of the following day a detachment of Paraguayan troops took possession of the city, whilst the main body of an invading army marched across the province, and, crossing the Uruguay, invaded Brazil. The sudden seizure of the vessels in the port of Corrientes was the first notification of war which reached the Argentine Government. The official declaration of war, which was dated the 29th March, and was based on a declaration passed in Congress on the 18th, did not reach the Argentine Government until the 3d May. The people of Buenos Ayres were thrown into a frenzy of indignation on the receipt of the news of the above-mentioned hostilities; and on the 1st May a treaty was signed between the Argentine Government, Brazil, and the Oriental Republic, by which these powers mutually bound themselves not to lay down their arms until they had abolished the Government of Lopez, but at the same time guaranteeing the independence of Paraguay. Thus the National Government established at Buenos Ayres was launched into a war which sorely tried its resources, both for the prosecution of the war itself, and for the suppression of the opponents of its policy in some districts. The war was soon carried into Paraguay; but the withdrawal of the main body of the Argentine army, under Generals Paunero and Arredondo, was necessitated by a rebellion in the north-west (January 1867), where the rebels, under Saa and Videla, had obtained control of several of the Provincial Governments. The rebel army was not able to cope with the veterans fresh from the battlefields of Paraguay, who drove them across the Andes into Chili, where they laid down their arms. These internal troubles made it requisite for Mitre to retire from the post of commander-in-chief of the allied forces in the field, which then devolved upon the Brazilian General Caxias. Urquiza, though nominally under the order of the National Government, having, on the outbreak of the war accepted from them the appointment of commander-in-chief of the forces of Entre Rios, virtually held that province in a state of neutrality throughout the war, which was ended by the shooting of Lopez on the 1st March 1870, after the extermination of his army and a large majority of the inhabitants of the country. Urquiza, at the outbreak of the war, was the most renowned and powerful chieftain in the country, and doubt regarding the course he might take was a source of anxiety in Buenos Ayres. He had accumulated immense estates and wealth in Entre Rios; and he was doubtless actuated by an earnest desire to preserve to his province the blessings of peace and commercial prosperity in the midst of the surrounding disturbances. The hope of obtaining support from him is, however, supposed to have encouraged the rebellion of the north-western provinces, which neutralised the reckless audacity with which the Argentine troops fought their first battle in Paraguay. In 1868, whilst the war was going on, Mitre's term of office as president expired, and Sarmiento was peacefully elected in his place. The close of the Paraguayan war did not bring permanent peace to the country; for, on the 12th April 1870, Urquiza was assassinated at his family residence by some well-known officers of his army, and the provincial Legislature immediately elected Lopez Jordan as governor in his place. The new governor, in his address to Congress on his installation, took upon himself the responsibility of the assassination, and the National Government refused to acknowledge him as governor of the province, on the ground of undue influence having been brought to bear on the members of the Legislature by which he had been elected. The National troops accordingly invaded the province, for the avowed purpose of affording protection for the free expression of opinion in a new election. This became the commencement of a civil war, which materially interfered with the former prosperity of the province, but which was fortunately brought to a conclusion in the end of January 1873, by the Entre-Riano army being completely routed by the National troops, armed with Remington rifles, under Colonel Gainza. The Entre-Riano leader, with about 40 followers, escaped across the Uruguay. Tranquillity has since that time prevailed in Entre Rios.

Whilst these events were in progress, a rupture between the Argentine Republic and Brazil regarding the settlement of the boundaries of Paraguay, was at one time imminent; but, by the influence of Mitre, who went as special envoy to Rio on the occasion, the friendly relations of the two Governments have, it is hoped, been placed on a secure basis.

The prosperity of the country received a temporary check in 1874, from a brief revolution initiated when President Avellanda was declared elected. The unsuccessful party, under Brigadier-General Mitre, incensed at their defeat, asserted that the elections had been gained by corrupt and fraudulent practices, and resolved to appeal to arms to overthrew the president-elect. The revolution was declared on 24th September. President Sarmiento, whose tenure of office was just expiring, took active measures to repress the revolt; and no collision of forces had taken place when the new president, Don Nicolas Avellanda, was constitutionally installed on the 12th October. The president followed up with energy the measures of his predecessor to suppress the revolution, and his efforts were crowned with success in two decisive victories over the insurgents by the Government troops;

whereupon Generals Mitre and Arredondo, with their forces, surrendered at discretion, and were made prisoners (Dec. 2). The revolution had lasted but seventy-six days. On the 17th December a state holiday was declared, and dedicated to rejoicings on the restoration of peace. The complete and absolute crushing of this revolution has great significance, as it has brought about the dissolution of a powerful and ambitious party, whose movements might have seriously affected the onward march of the country. Those who know the country believe that it will be long before any similar revolutionary attempts can be made with the slightest hopes of success, or the welfare of one of the most favoured countries in the world jeopardised by internal commotion.

Political divisions and population.

The following table gives the names of the fourteen provinces which form the Argentine Republic, together with the superficial area of the country as given by the Statistical Department of the National Government, and the population according to the census of the year 1869, the numbers given as the population of the Indian territory being the official estimate of that year. As regards the area, it must be observed that, according to the *Almanach de Gotha*, an estimate by the Geographical Institute of G. Perthes at Gotha, reduces that given in this table by about one-fourth:—

	Area in square miles.	Population in 1869.
The Riverine Provinces—		
Buenos Ayres	80,400	495,000
Santa Fé	43,700	89,000
Entre Rios	43,100	134,000
Corrientes	47,700	129,000
The Upper Provinces—		
Cordova	83,500	211,000
Santiago	42,000	133,000
Tucuman	59,900	109,000
Salta	24,000	89,000
Jujuy	36,000	40,000
Catamarca	92,900	80,000
La Rioja	42,000	50,000
The Provinces of Cayo—		
San Luiz	48,500	53,000
Mendoza	59,900	65,000
San Juan	39,600	60,000
	743,200	1,737,000
Indian Territories—		
The Chaco	240,000	45,000
The Central and Western Pampas, and Patagonia	636,300	48,000
	1,619,500	1,830,000

The Indian territories and the frontier districts.

The most remarkable features of the present state of the country, as shown by the foregoing table, are the vast extent of the Indian territory and the small number of its inhabitants. Excepting a comparatively narrow tract of land stretching from the southern part of the province of Santa Fé into that of Cordova, and dividing the Indians of the Chaco from those of the Pampas, the dominions of the Indians may be said to extend from the extreme south of the republic, over all the plains of Patagonia, the central parts of the Pampas, and through the Chaco, into the territories of Paraguay and Bolivia. The civilised districts of the west and north-west, which we have seen were settled, the former by way of Chili, and the latter by way of Peru, have now established means of communication with those of the east, except through the district just mentioned. In that district civilisation, of which the Central Argentine Railway is the chief representative, is rapidly establishing and extending itself; but even during the last few years warfare with the Indians on both sides of the line of railway has been almost incessant. In the neighbourhood of Frayle Muerto or Belleville, many Englishmen possessed of some amount of capital established themselves some years ago as cattle farmers, under the protection of modern rifles; but they have been obliged to turn their attention to sheep and agriculture, as offering less tempting plunder to the Indians. It is interesting to record that the city of Cordova, on the west of the Chaco, was founded on the same day, in 1573, as the city of Santa Fé, on the east of that region; and an exploring party from the latter city was saved from being exterminated by the Indians by the timely and unexpected assistance of another party of explorers from the city of Cordova. To the north of Belleville, the land lying between the cities just mentioned is now being peopled by families of Swiss, German, French, Italian, English, and Anglo-American immigrants, who are encouraged by liberal grants of land and assistance from the Provincial Government of Santa Fé; and they appear to be gradually establishing themselves in the country, notwithstanding the hardships they have suffered from the ravages of locusts and the hostility of the Indians. Some of the tribes of the Chaco are among the most savage and intractable in the territory of the republic, though even before the arrival of the Spaniards they supported themselves to some extent by agriculture, and were not so nomadic as the hunting tribes of the south. On the Pampas the Indians appear to be in larger tribes, and their warfare is more formal, since powerful chiefs of the different tribes have considerable control over them, and they in general conform themselves to the policy of peace or war determined on by their chiefs. For many years past the border lands between the Indians and the European settlers in the province of Buenos Ayres have been a scene of constant bloodshed; and some of the Indian invasions have been made on a very extensive scale by a combination of the different tribes. The relations of the Argentine Government with the Indians, it will thus be seen, are in a very unsatisfactory state; and in the midst of all this the condition of the Argentine peasant, or Gaucho, is most deplorable. He has constantly been subject to conscription for service in the army engaged in foreign or civil wars, leaving in the frontier districts his home defenceless against the depredations of the savages. It is true that the Gauchoes may be said to be the primary cause of the civil wars which have devastated the country; for, despising, or at least not appreciating, their constitutional influence, they have been accustomed to regard war as a normal means of subsistence, and to be used as such for its own sake. Nevertheless, in face of the peculiar hardship of the condition of these men, even though in the aggregate self-inflicted, it is scarcely surprising that immigrants are occasionally subjected to annoyances and dangers through a spirit of hostility engendered by feelings of envy, as the Gaucho is subjected to the conscription, whilst the foreigner is undisturbed in his industrious occupations. Families have fallen victims to the sudden outburst of animosity on the part of the Gauchoes, who when once roused have been as cruel as the Indians; and, though the arguments which might be pleaded in extenuation for the latter cannot be applied to the former, their condition is a practical evil, and enlightened legislation for these frontier districts is one of the most urgent necessities of the country. The war with Paraguay, and subsequently the war in Entre Rios, have exhausted the resources of the Government, leaving the Indian frontier almost undefended. The tribes of the Pampas have established settlements, from which they scour the country in pursuit of game; and it is not improbable that some of their recent raids upon the civilised districts have been forced upon them by the immediate necessities of their position, resulting from their improvident mode of living and the absence of agricultural pursuits among them. On the slopes of the Sierra Ventana, north of Bahia Blanca, many Englishmen have established themselves as sheep farmers, where the land stretches away into the Indian territories, without an armed force or a barrier of any sort intervening, and their protection from the savages lies in the respect the latter have for the Snider rifle, combined with the greater attraction which the cattle farms of the north have for the plunderers. On the Rio Negro English settlers are engaged in agricultural pursuits on a soil whose fertility for the production of wheat and other cereals may be said to be unrivalled. To the south of this the country to a great extent accords with the description erroneously applied to all the country south of the River Plate by Guerara, who says that it is a barren land without timber for building, without firewood, without water, without soil to receive seed, and without anything that a city requires for its maintenance. Nevertheless, in the country thus described, a Welsh colony has established itself on the Chupat River; and, though at first they suffered severe hardships, and were saved from starvation only by food supplied by the Tehuelche Indians in the first instance, and afterwards by similar supplies from the Argentine Government, there appears no reason now why it should not become a prosperous colony. In the far south, on the Santa Cruz River, the Argentine Government have a military establishment. The tribes of Patagonia do not appear to have any settled villages, but make the whole country a vast hunting ground. The different parties meet in their excursions either as friends or as foes, just as accident, the humour of the moment, or any occasion of enmity between the chieftains determines. The game on which they live is superabundant, and the chief impediment to an increase of the population seems to be the remorseless butchery which ensues on the meeting of hostile hunting tribes, which sometimes results in the extermination of one party or the other; and also the incessant slaughter resulting from sudden quarrels among members of the same party. Lieutenant Musters, of the Royal Navy, has recently traversed the country from the Strait of Magellan to the Rio Negro with one of the hunting tribes; his book may be commended to those who desire to be better acquainted with that wild country and its inhabitants. The Tehuelche Indians, with whom he travelled, average about 5 feet 10 inches in stature, but he describes the Araucanians as somewhat taller and equally athletic. All the Indian tribes have more or less of the peculiar characteristics of the red or copper-coloured race, and analogies in the languages of the numerous tribes also indicate an identity of origin. According to their traditions at the time of the discovery of the country by the Spaniards, as recorded by Guerara, their ancestors came from the north, and they also held confused traditions of the disasters of the deluge.

Government. The foregoing historical sketch will have given the reader some insight into the government of the country. The framers of the Constitution professed to be guided by that of the United States of North America, and freely adopted the liberal principles there embodied. The president is elected for a term of six years, and the president of the Senate, elected to that office by his fellow-senators, becomes ex-officio vice-president of the republic. The government is conducted by a ministry responsible to Congress, and an adverse vote of the Senate and deputies on any important question leads to the formation of a new ministry. The number of senators and deputies returned by each province is in proportion to the number of its inhabitants. Each province has its own independent form of government for all matters not expressly delegated to the National Government, and is supposed to have irresponsible jurisdiction in its own affairs so long as the articles of the National Constitution are not contravened. The city of Buenos Ayres, besides being the seat of the Government of the province, is also the seat of the National Government, having been so declared by the Constitution, until such time as a suitable site for a new capital for the republic may be determined on by the Legislature. Not only the Constitution itself, but also the spirit in which its enactments are carried out, is thoroughly liberal, and worthy of the magnificent country over which civilisation, under its enlightened regulation, is struggling successfully against barbarism. Fresh arrivals from Europe are not only cordially welcomed, but every effort is made by the authorities to induce foreigners to settle in the country. They are free either to naturalise themselves as Argentines, or to maintain their foreign nationality; in the latter case they have not the privilege of a vote in the government of the country, nor are they liable to the conscription for service in the army. In other respects the law is the same for all. Every one born in the country is by law an Argentine.

Inhabitants. The population of the city of Buenos Ayres is almost thoroughly European, nearly one-half being, in fact, foreigners born in Europe. But on passing from that city into the country the Mestizo race becomes more prominent; and in the northern provinces, as in Paraguay and Peru, the Mestizoes, with Indian blood predominating, form the majority of the population. The Negroes, or Mestizoes in whom Negro blood can be traced, do not form an important part of the population as they do in Brazil. The difference between the two countries in this respect is, in fact, very striking. Slavery was abolished during the war of independence; and the importation of Negroes, which had never been an extensive trade, then ceased; and the constant stream of immigration from Europe, which of late years has been steadily augmenting, is gradually changing the aspect of the population of the country. In 1858 the arrivals amounted to only 4600 persons; but they increased every year till they amounted to 29,000 in 1868, 37,000 in 1869, 41,000 in 1870, 20,000 in 1871, 40,000 in 1872, 80,000 in 1873, and about 90,000 in 1874. This constantly increasing stream of immigration has been absorbed into the various industries of the country as fast as the new arrivals reach its shores. As regards the nationalities of the immigrants, the Italians are the most numerous, then the French, Spaniards, Germans, English, and Swiss. During the above-mentioned years the new arrivals have almost always found their services eagerly sought for at wages of 8 to 10 shillings a day for the most ordinary employments, and at proportionally higher rates for skilled workmen. The comparatively small amount of the immigration in 1871 is due to the occurrence of the epidemic of yellow fever which decimated the population of the city of Buenos Ayres in the early part of that year, and caused the bulk of the emigrants from Europe on their way to the country to stop at the ports of Brazil and at Monte Video, and turned the tide of emigration from Europe in other directions at the close of the year. Though this terrible pestilence is said to have been imported from Brazil, its rapid spread in the city can clearly be ascribed to temporary causes which even the unrivalled salubrity of the climate was insufficient to neutralise. In the absence of any artificial drainage the cleanliness of the city had depended on its occasional scouring by the heavy rains, whilst an ever increasing number of cesspools have been accumulating filth beneath the houses; and up to the year 1870 the consumption of water, beyond the amount of rain-water accumulated in tanks in the houses of the wealthy, was limited by the cost of cartage from the river; but in that year new water-works were opened, by which a supply is pumped up from the river, and conveyed by pipes to all parts of the city, and the increased waste of water may, by leading to an unusual disturbance of the cesspools, have partly contributed to the spread of the epidemic. Though frightfully contagious in the city, the disease was not so in the country; and no instance could, it is believed, be recorded in which it was communicated to those who nursed patients that took the disease from the city, and sickened and died in the suburbs. It is hoped that the extensive drainage works which the Provincial Government is having constructed under the superintendence of Mr Bateman will obviate the risk of another outbreak of a plague, which whilst it lasted put a stop to commercial pursuits and almost disorganised society. The total number of foreigners in the Argentine Republic at the time of the last census, was, according to the *Almanach de Gotha*, 212,000. A recent writer, who has given particular attention to the subject, says, "There are about 40,000, between Irish, Scotch, and English settlers and their families, in quiet and undisputed possession of about two millions of acres of land in the province of Buenos Ayres alone; in the full enjoyment of all religious and social liberty. They own upwards of 35,000,000 sheep, besides horned cattle, horses, and valuable buildings . . . . The bulk of this vast property has been acquired in the country by men who on their arrival did not possess a sixpence."

Industries and foreign trade.

Excepting the mining districts in the north-west of the republic, the agricultural district of Chivilcoy, in the north of the province of Buenos Ayres, the agricultural colonies of Santa Fé, and the establishments of the English settlers in the north of Patagonia, the Argentine Republic is at present a pastoral country. The manufacturing and agricultural pursuits of the north-western provinces are not important items in the general wealth of the republic. The development of its vast resources as a mining and agricultural country has scarcely commenced; and its greatest wealth is at present represented by the herds of cattle and sheep which graze upon its fertile plains. The manufactures and luxuries imported into the country are paid for with the annual increase of these flocks and herds, though the latter are not so numerous as in an equal area of Central and Western Europe. The number of herd cattle in the country may be roughly estimated at from 15 to 18 millions; of which, in the year 1866, the province of Buenos Ayres contained 6,800,000; Entre Rios, 2,500,000; and Corrientes, 2,000,000. In the same year Buenos Ayres contained 60,000,000 sheep; and Entre Rios and Corrientes together, 7,000,000. The number of sheep in the whole country is estimated at 100,000,000.

The extent of the trade which the Argentine Republic carries on with different foreign countries is indicated in the subjoined tabular statement of values of the imports and exports of the whole country, for 1873. The amounts are given in hard dollars, of which the sterling equivalent is about 49 pence.

Argentine Trade Report for 1873.

	Imports.	Exports.
Great Britain	$19,344,143	$9,894,007
France	18,255,138	8,677,819
Belgium	2,967,586	13,891,508
United States	5,167,616	3,032,945
Italy	3,784,384	1,487,925
Spain	2,952,600	1,231,697
Chili	1,444,182	2,365,475
Brazil	2,968,953	769,464
Uruguay	2,735,293	992,949
Germany	3,228,015	449,597
Holland	1,611,616	226,204
Other countries	1,999,341	2,100,515
Hard dollars	$66,458,873	$45,122,105
Or about	£13,568,000	£9,200,000

The principal items of the import trade from Great Britain are as follows (the figures representing hard dollars as before):—Cotton goods, 2,359,000; woollen, 904,000; other textures, 3,364,000; clothing, 1,367,000, besides 951,000 in shoes; iron, 2,757,000; and railway materials, 1,706,000. France sends wines to the value of 4½ millions; textile fabrics, 2½; clothing, shoes, &c., 2½; hardware, fancy goods, &c., 6½. More than half the value of the United States imports (2,769,000) is in lumber. The whole import trade of the country in 1873 exceeded that of 1870 by 49 per cent.

The following table exhibits the amount, values, and principal destinations of the more important articles of export for 1873:—

Wool	185,000,000 lb	$19,600,000	whereof $10,000,000 to Belgium.
Tallow	85,000,000 lb	5,500,000	" 2,652,000 to England.
Sheepskins	55,000,000 lb	4,000,000	" 1,854,000 to England.
Dry Hides	1,700,000	5,140,000	" 1,353,000 to United States
Salted, do	1,300,000	4,500,000	" 2,720,000 to England.
Jerked Beef	88,000,000 lb	1,400,000	mostly to Brazil and West Indies.
Cattle	180,000	2,700,000	to other South American countries.

Other items of export are metals (copper and silver) of the value of 420,000 dollars; grain, 120,000; ostrich feathers, 150,000. The entire export trade of 1873 shows an increase of 55 per cent. on the trade of 1870.

The tonnage of the vessels that arrived and cleared during the four years 1870 to 1873 was as follows:—

	Steamers.	Sailing Vessels.	Gross Tonnage.
1870	808,000	712,000	1,520,000
1871	863,000	662,000	1,525,000
1872	1,190,000	960,000	2,150,000
1873	1,135,000	753,000	1,888,000

Of this tonnage the proportion returned for English vessels is no less than 30 per cent.; French vessels rank next, with 16 per cent.; then Argentine and Italian, 12 per cent. each. There are twelve lines of steamers constantly plying between Europe and Buenos Ayres. The passage occupies about twenty-nine days.

The advancement of the Argentine Republic has received a great impetus from the introduction of steam communication and telegraphy. The first railway was opened in 1857; and in 1874 there were more than 800 miles open for traffic, with about 1000 miles more in course of construction. A system of tramways was commenced in the city of Buenos Ayres in 1869. There are now about 80 miles within the city and suburbs, and this means of transit is being extended to all the smaller towns. There are in use within the republic above 7000 miles of telegraphic wires. Complete communication is now established with Europe, the first telegrams having been exchanged with London on 4th August 1874.

The province of Buenos Ayres is, in wealth and general importance, far in advance of all the other provinces of the Confederation. Under the enlightened administration of Señor Castro, the late governor, great improvements have been made in the means of communication throughout the province, which is the first step requisite for the due development of its resources. Besides railway extensions a great number of iron bridges have been imported from England and erected under the superintendence of Mr Coghlan, by order of the Provincial Government of Buenos Ayres. The National and Provincial Governments established in the city of Buenos Ayres are rivals in their efforts to promote the true welfare and prosperity of the country. Señor Acosta, the governor of the province, may be relied on to continue the policy of assisting the development of the resources of the country, which may almost be said to have been inaugurated by his predecessor. And his Excellency Señor Sarmiento, whose term of office as president of the republic expired in October 1874, must, from his unceasing exertions in the cause of education, be regarded as one of the greatest benefactors of the country.

The following are the returns of the national revenue

Finance.

collected in the years 1866 and 1872 respectively, the figures representing hard dollars as before:—

	1866.	1872.
Import Duties ...	6,686,000	14,464,827
Export ...	2,164,000	2,621,353
Warehousing	263,000	504,212
Stamp Duties	127,000	310,806
Post Office ...	57,000	137,434
Property Tax	196,000	62,226
Sundries ...	68,000	71,512
	9,561,000	18,172,379

The revenue, as shown by the above tables, is obtained chiefly from the Custom-House; and of the duties on the foreign trade of the country more than four-fifths are collected in Buenos Ayres. The ordinary expenditure for 1872 is returned as 7,419,832 dollars; but to this the interest of the national debt has to be added, with other extraordinary expenditure, raising the whole amount to 23,992,975 dollars. The deficit in 1872 was thus 5,820,596 dollars. Besides the expenses of the National Government, each province has its separate revenue. That of the province of Buenos Ayres amounted in 1871, as shown by the Report of the provincial minister of finance, to more than 5.000,000 hard dollars. The following statement of the national debt of the republic at the end of 1872, is taken from the *Almanach de Gotha* for 1875:—

		Hard Dollars.
English Loan of 1824, 6 and 3 per cent.	£1,770,100	8,672,590
Foreign Loans		1,757,645
English Loan of 1868	£2,209,100	10,824,590
English Loan of 1871, 6 per cent. interest, and 2½ per cent. amortisation	£5,885,900	28,840,910
Total amount of Foreign debt		50,095,735
Home debt, 6 per cent., and 1 per cent. amortisation		18,055,623
Home debt, 6 per cent., and 2½ per cent. amortisation		1,802,353
Roads and Bridges, 8 per cent. interest		1,033,000
Total of National debt		70,986,711
Buenos Ayres Provincial Debt:—		
6 per cent. interest, and 3 per cent. amortisation		636,000
9 per cent. interest, and 3 per cent. amortisation		910,000
Total (about £14,800,000 sterling)		72,532,711

Further information respecting the republic will be found under BUENOS AYRES and other headings. (W. L. J.)

ARGOL, the commercial name under which the crude tartar of commerce is known. It is a semi-crystalline deposit which forms on wine vats, and is either grey or red according to the colour of the wine from which it separates.

ARGONAUTS, in *Greek Legend*, a band of heroes who sailed in the ship "Argo" from Iolcus, in Thessaly, to Æa, in Colchis, on the further shore of the Black Sea, to fetch the golden fleece, which was there guarded by a dragon in a grove sacred to Mars. This task had been imposed on Jason that he might prove himself by a perilous adventure worthy of the throne of Iolcus, which he claimed from the usurper Pelias, at whose hands he and his father Æson had suffered persecution. To accompany him, Jason, when the "Argo" was ready, called upon the principal heroes of his own race, the Minyæ, whose distant voyages and colonisation in very early times seem to have suggested the legend of this expedition. Of these Acastus the son of Pelias, Admetus of Pheræ, Euphemus (represented as connected with the colonisation of Thera and Cyrene), Periclymenus, Erginus, and Tiphys the steersman, joined him. So far the crew appears well fitted to conduct the "Argo" to Colchis, leaving Jason to reserve his strength for the culminating act, in which also they had mostly, apart from their friendship for Jason, a special interest, because of previous events connected with the golden fleece, the story of which was as follows. Jason's uncle Athamas had by his wife Nephele two children, Phrixus and Helle. The mother died, and her place was taken by Ino, a daughter of Cadmus, who from hatred of her step-children persuaded Athamas, by means of a false oracle, to offer his son Phrixus as a sacrifice, in consequence of a famine which she had caused by having the grain secretly roasted before it was sown. But before the sacrifice the shade of Nephele appeared to Phrixus, bringing a ram with a golden fleece, on which he and his sister Helle were to escape over the sea. Helle fell off and was drowned in the strait, which thence took the name of Hellespont. Phrixus reached the other side, and proceeding on land to Colchis, sacrificed the ram, and hung up its fleece in the grove of Mars. With the family of Athamas the original crew of the "Argo" were more or less connected. But in the later versions of the story it is clear that such a voyage could not in after times be conceived without a variety of adventures, for which other and better known heroes had to be added. Of these the chief were Hercules, Castor and Pollux, Orpheus, Mopsus, and the sons of Boreas, Calaïs and Zetes. The outward course of the "Argo" was the same as that of the Greek traders, whose settlements as early as the 6th century B.C. dotted the southern shore of the Black Sea. The first landing-place was Lemnus, which the Argonauts found occupied only by women who, at the instigation of Aphrodite, had slain their husbands, fathers, &c. Here some stay was made, and Hypsipyle bore Jason a son, Euneos, who afterwards traded with the Greeks before Troy and with the Phœnicians. That the Minyæ had at a very early period formed settlements in Lemnus is known from Herodotus (iv. 145). They landed at Cyzicus next, and here occurred the incident of Hercules and Hylas. The former having broken an oar after they started, went into a wood to cut a new one, Hylas accompanying him to fetch water. Some nymphs admiring the beauty of the youth carried him off. Hercules followed his cries, but could not find him. Nor was he ever found, though the hero exacted hostages till this should be done. On reaching the modern Scutari, they again landed to get water, and were challenged by the king, Amycus, to match him with a boxer. Pollux came forward, and in the end overpowered his adversary, and bound him to a tree. At the entrance to the Black Sea they met Phineus, the blind and aged king whose food was being constantly polluted by the Harpies. He knew the course to Colchis, and offered to tell it, if the Argonauts would free him from the Harpies. This was done by the winged sons of Boreas, and Phineus now told them their course, and that the way to pass through the Symplegades—two cliffs which moved on their bases and crushed whatever sought to pass—was first to fly a pigeon through, and when the cliffs, having closed on the pigeon, began to retire to each side, to row the "Argo" swiftly through. His advice was successfully followed. The next place they landed at, and the last before reaching Colchis, was Heraclea, where the steersman Tiphys died. To the early Greeks Colchis was the eastern extremity of the earth, as the Pillars of Hercules were the western. Behind both was the Oceanus, into which the river Phasis flowed at Colchis. At Colchis was the rising of the sun, and Æetes the king was a son of Helios; while his daughter Medea was, by her knowledge of witchcraft, connected with the worship of the moon. Æetes required of Jason that he should first yoke to a plough his bulls which snorted fire and had hoofs of brass, and with them plough the field of Mars. That done, the field was to be sown with dragons' teeth, from which armed men were to spring. Successful so far by means of the mixture which Medea had given him as proof against fire and sword, Jason was next allowed to approach the dragon which watched the fleece; Medea soothed the dragon with another mixture, and Jason became master of the fleece. Then the voyage homeward began, Medea accompanying Jason, and Æetes pursuing them. To delay him and obtain escape, Medea dismembered her young brother Absyrtus, whom she had taken with her, and cast the limbs about in the sea for his father to pick up. In another report Absyrtus had grown to manhood then, and met his death in an encounter with Jason, in pursuit of whom he had been sent. Of the homeward course various accounts are given. In the oldest existing account, the "Argo" sailed along the river Phasis into the Oceanus, thence to the mythical lake Tritonis, after being carried twelve days over land through Libya, and thence again to Iolcus. Hecatæus of Miletus suggested that from the Oceanus it may have sailed into the Nile, and so to the Mediterranean. Others, like Sophocles, described the return voyage as differing from the outward course only in taking the northern instead of the southern shore of the Black Sea. Some supposed that the Argonauts had sailed up the river Tanais, passed into another river, and by it reached the North Sea, returning to the Mediterranean by the Straits of Gibraltar. And again, others laid down the course as up the Danube (Istros), from it into the Adriatic by a supposed mouth of that river, and on to Corcyra, where a storm overtook them. Next they sailed up the Eridanus into the Rhodanus, passing through the country of the Celts and Ligurians, and reaching the Tyrrhenian Sea and the island of Circe, who absolved them from the murder of Absyrtus. Then they passed safely through Scylla and Charybdis, past the Sirens, through the Planctæ, over the island of the Sun, Trinacria, and on to Corcyra again, the land of the Phæacians, where Jason and Medea held their nuptials. They had sighted the coast of the Peloponnesus when a storm overtook them and drove them to the coast of Libya, where they were saved from a quicksand by the local nymphs. The "Argo" was now carried twelve days and twelve nights to the Hesperides, and thence to lake Tritonis, whence Triton conducted them to the Mediterranean. At Crete the brazen Talos, who would not permit them to land, was killed by the Dioscuri. At Anaphe they were saved from a storm by Apollo. Finally they reached Iolcus, and the "Argo" was placed in a grove sacred to Neptune on the isthmus of Corinth. Jason's death, it is said, was afterwards caused by part of the stern giving way and falling upon him. (A. S. M.)

ARGONNE, a rocky and forest-clad plateau in the north-east of France, extending along the borders of Lorraine and Champagne, and forming part of the departments of Ardennes and Meuse. The famous defence of the French frontier by Dumouriez in 1792 is called the Argonne Campaign.

ARGOS. The most important city of this name was situated in the eastern part of the Peloponnesus, about 3 miles from the sea. By the Greeks themselves it was regarded as the most ancient of all their cities, and as the local habitation of many of their earlier heroes. Here Inachus and his descendants had reigned for many generations, until the arrival of Danaus the Egyptian, with his fifty daughters, whose dynasty, glorious with the names of Perseus the Gorgon-slayer, and Eurystheus the master of Hercules, held sway over Argos, and Tiryns, and Mycenæ, till it, in its turn, was succeeded by the still more important dynasty of Pelops. The Dorian invasion and conquest followed, and Argos became the head of a Dorian confederation, extending its authority over a large portion of the neighbouring territory. Between this region (Argolis) and Sparta, however, there were no natural boundaries, and a conflict arose between the two states about the border land of Cynuria. For a time, under the despotic management of Pheidon, Argos maintained its ground; but Sparta ultimately established its claim in spite of the dubious result of the famous duel of the 600, which was fought for the decision of the dispute, and the strength of the Argives was completely crushed by Cleomenes at the battle of Tiryns. A temporary ascendency of the serfs in Argos, an extension of the franchise, and a permanent adoption of a more democratic constitution, seem to have been the consequences of this national exhaustion and the subsequent reaction. During the Persian war Argos was indifferent and neutral, but in the contest for power which ensued between Athens and Sparta, the old antipathy against the latter was sufficient to make the Argives stanch allies of the former. In the 4th century B.C., the democratic constitution of the city degenerated into a reign of terror (Σκυταλισμός), which in its turn gave place to a series of tyrannies, from which escape was ultimately found in the Achæan League and the Roman domination. Pyrrhus perished in an unsuccessful attack on the city in 272 B.C. In the 13th century of our era, Argos fell into the possession of the Franks, from whom it passed into the hands of the Byzantine despots; and in 1463 it was taken by the Ottoman troops. Here in the darkest period of Greek ignorance lived one of the few representatives of the ancient learning, Theodosius Zigomali (Crusius's *Turcogræcia*). In the time of Pausanias the number of temples in Argos and its neighbourhood was remarkable, the most important of them being the Heræum, or temple of Hera, the ruins of which, visible from the acropolis of Argos, but nearer to Mycenæ, were discovered in 1831 by Colonel Gordon of Cairness (see plan in Leake's *Peloponnesiaca*, 1846). Within the city the greatest was the temple of Apollo Lyceus. Remains still exist of the cyclopean architecture of the acropolis, of the theatre, which was of great extent, and of an aqueduct which can be traced for miles to the north-west. In the 5th century B.C., Argos was the seat of a great school of statuary under Ageladas, but it did not contribute to the long roll of Greek literature more than the names of Telesilla and Sacadas, of whom the latter was better known as a musician. The limits of Argolis varied at different times, but it was only under the Romans that they were understood to embrace the districts of Phlius, Cleonæ, Epidaurus, Trœzen, and Cynuria.

ARGOSTOLI, the capital of Cephalonia, one of the Ionian islands, and the seat of a bishop of the Greek Church. It possesses an excellent harbour, a quay a mile in length, and a fine bridge. In 1870 the imports were of the value of 8,347,522 drachmas, or £296,941. Near at hand are the ruins of Cranii, affording fine examples of the military architecture of the Greeks; and at the west side of the harbour there is a curious stream, flowing *from* the sea, which is employed to drive mills. (Sir C. Fellows's *Journal of an Excursion in Asia Minor* in 1838, and Wiebel's *Die Insel Kephalonia und die Meermühlen von Argostoli*, Hamburg, 1873.) Shipbuilding and silk-spinning are carried on. Population, 9000.

ARGOVIE (Lat. *Argovia*), the French form of Aargau, the name of one of the Swiss cantons. See AARGAU.

ARGUIN, an island, perhaps Hanno's *Cerne*, off the west coast of Africa, in lat. 20° 25′ N., long. 16° 37′ W. It produces gum-arabic, and is the seat of a turtle fishery. There are two fairs held every year. Off the island, which was discovered by the Portuguese in 1452, are extensive and very dangerous reefs. There is a town of the same name on the neighbouring coast.

ARGUS, in *Greek Legend*, the son of Agenor or Arestor, or, according to others, an earth-born hero (Autochthon). He was called Panoptes (πανόπτης), All-seeing, from having a hundred eyes. After performing several feats of valour, he was appointed by Juno to watch the cow into which Io had been transformed. While doing this he was slain by Mercury, who, according to one account, stoned him to death, according to another, put him to sleep by playing on the flute, and then cut off his head. His eyes were transferred by Juno to the tail of the peacock.

ARGYLL, Earls and Dukes of. The rise of this family of Scottish peers, originally the Campbells of Lochow, first ennobled as Barons Campbell, and still retaining the family name Campbell, is referred to in the article Argyllshire (*q.v.*)

Archibald, the eighth earl and first marquis, was born in the year 1598, and educated in the principles of the Reformation, of which his ancestors had been zealous promoters. His father, however, renounced Protestantism, whereupon the young earl was put in possession of his patrimonial estates by order of Government, and quickly promoted to places of trust and power. From the commencement of his political career he espoused the cause of the Presbyterian party, and defended the Covenanters when summoned to London to give his opinion of their proceedings before the king. In 1638 he remained with the General Assembly after it had been dissolved by the king's commissioner, and with other nobility and gentry signed the Solemn League and Covenant. Having thus openly committed himself to the Presbyterian cause, he became its recognised leader both in political negotiations and in the field. He was created a marquis during the king's visit to Scotland in 1641. This mark of favour, intended probably to conciliate a powerful subject, did not prevent Argyll from leading an army against the royal troops in 1644. The campaign ended in his signal defeat by Montrose at Inverlochy on the 1st February 1645. In 1651 he placed the crown on the head of King Charles II. at Scone, having, like the rest of his party, been alienated from the republicans of England by the execution of Charles I. Having gone to London at the Restoration in 1660, he was arrested and thrown into prison. In the following year he was tried at Edinburgh for high treason, and, principally on ground of alleged treasonable correspondence with Monk, he was condemned to death, and executed on the 27th of May, dying with great firmness and calmness. He was the author of *Instructions to a Son, and Maxims of State* (1661).

Archibald, the ninth earl, son of the preceding, from his youth distinguished himself by his loyalty and attachment to the royal family. Though his father headed the Covenanters, he attached himself to the king's party. On the establishment of the Commonwealth he was committed to prison, and was jealously watched till the Restoration, when the king remitted his father's forfeiture, and created him earl of Argyll. He continued in high favour with the king and court till the passing of the Test Act in 1681, when, by opposing the exemption of princes of the blood from the oath, he drew down on himself the indignation of the duke of York. When called to take the test, Argyll refused, except with an explanation, which he believed to have been approved by the duke, to the effect that he took it only so far as it was consistent with itself and with the Protestant religion. The duke accepted the qualification, and Argyll was admitted to sit in council; but a few days afterwards he was committed to prison, and indicted for high treason. On being tried, three judges did not scruple to convict him of treason; a jury of fifteen noblemen gave a verdict against him; and the king ordered sentence to be pronounced, but the execution of it suspended till further orders. Argyll, however, seeing no reason to trust to the justice or mercy of his enemies, made his escape from prison, and concealed himself for some time in London, afterwards escaping to Holland, where he remained during the remaining part of the reign of Charles II. On the accession of James II. he took part in the rising of the duke of Monmouth, and returned to Scotland to command the forces raised there; but after a few unsuccessful skirmishes he was taken prisoner and carried to Edinburgh, where he was beheaded on his former sentence, June 30, 1685, submitting to death with heroic firmness.

Archibald, the first duke, son of the preceding, was an active promoter of the Revolution. He came over with the Prince of Orange, and was admitted into the Convention as earl of Argyll, though his father's attainder had not been reversed. Having been deputed, along with Sir James Montgomery and Sir John Dalrymple, to present the crown in name of the Scottish Convention to the Prince of Orange, and to tender to him the coronation oath, he was admitted a member of the Privy Council, and, in 1690, made one of the lords of the Treasury. In 1701 he was created duke of Argyll. He died in 1703.

John, the second duke (also duke of Greenwich), son of the preceding, was born on the 10th October 1678. He entered the army in 1694, and in 1701 was promoted to the command of a regiment. On the death of his father in 1703, he was appointed a member of the Privy Council, and at the same time captain of the Scotch horse guards, and one of the extraordinary lords of Session. In return for his services in promoting the Union, he was created a peer of England, by the titles of baron of Chatham and earl of Greenwich, and in 1710 was made a knight of the Garter. He first distinguished himself in a military capacity at the battle of Oudenarde, where he commanded as brigadier-general; and was afterwards present under the duke of Marlborough at the sieges of Lisle, Ghent, Bruges, and Tournay, and did good service at the battle of Malplaquet in 1709. Soon after this action he was sent to take the command in Spain; but being seized with a violent fever at Barcelona, and disappointed of supplies from home, he returned to England. Having a seat in the House of Lords, he censured the measures of the ministry with such freedom that all his places were disposed of to other noblemen; but at the accession of George I. he recovered his influence. On the breaking out of the Rebellion in 1715 he was appointed commander-in-chief of the forces in North Britain, and was principally instrumental in effecting the total extinction of the rebellion in Scotland without much bloodshed. He arrived in London early in March 1716, and at first stood high in the favour of the king, but in a few months was stripped of his offices. This disgrace, however, did not deter him from the discharge of his parliamentary duties; he supported the bill for the impeachment of Bishop Atterbury, and lent his aid to his countrymen by opposing the bill for punishing the city of Edinburgh for the Porteous riot. In the beginning of the year 1719 he was again admitted into favour, appointed lord-steward of the household, and, in April following, created duke of Greenwich. He continued in the administration during the remaining part of that reign, and, after the accession of George II., till April 1740, when a violent speech against the Government led again to his dismissal from office. He was soon restored, however, on a change of the ministry, but disapproving of the measures of the new administration, he finally resigned all his posts, and spent the rest of his life in privacy and retirement. He died on the 3d September 1743. A monument executed by

Roubillac, has been erected to his memory in Westminster Abbey.

ARCHIBALD, the third duke, brother of the preceding, was born at Ham House in Surrey, in June 1682. On his father being created a duke, he joined the army, and served for a short time under the duke of Marlborough. In 1705 he was appointed treasurer of Scotland, and in the following year was one of the commissioners for treating of the Union; on the consummation of which, having been raised to the peerage of Scotland as earl of Islay, he was chosen one of the sixteen peers for Scotland in the first parliament of Great Britain. In 1711 he was called to the Privy Council, and commanded the royal army at the battle of Sheriffmuir in 1715. He was appointed keeper of the privy seal in 1725, and was afterwards intrusted with the principal management of Scottish affairs. In 1734 he was made keeper of the great seal, an office which he held till his death. He succeeded to the dukedom in 1743. The duke was eminent not only for his political abilities, but for his literary accomplishments, and had collected one of the most valuable private libraries in Great Britain. He died suddenly on the 15th of April 1761.

ARGYLLSHIRE, or ARGYLESHIRE, a county on the west coast of Scotland, comprehending a large district on the mainland and a number of the Hebrides or Western Isles. The mainland portion lies between lat. 55° 15′ and 56° 55′ N., and between long. 4° 32′ and 6° 6′ W.; its greatest length being 115 miles, and its greatest breadth about 36 miles. It is bounded on the N. by Inverness-shire; on the E. by the counties of Perth and Dumbarton, Loch Long, and the Firth of Clyde; on the S. by the North Channel; and on the W. by the Atlantic. Its sea coast has been stated at 600 miles. If the various islands are included, the greatest breadth of the county is 68 miles, and its total area amounts to 3255 square miles, or 2,083,126 acres, which is more than a tenth part of the whole area of Scotland. It contains forty parishes, and has been variously divided at different times into a number of districts. The names of these at present in use are North and South Argyll, Cowal, Dunoon, Kintyre (or Cantyre), Tarbert, Lorn, Mull, Ardnamurchan, Morven, Islay, &c. The principal towns are Inveraray, Dunoon, Campbeltown, Oban, and Tobermory.

There are numerous mountain streams, but no navigable rivers. The two principal are the Orchy and Awe. The former flows from Loch Tulla through Glen Orchy, and falls into Loch Awe at its northern extremity; and the latter forms an outlet for the loch across the neck of land which lies between it and Loch Etive. The other streams are the Add, Aray, Coe or Cona, Creran, Douglas, Echaig, Etive, Euchar, Feochan, Finart, Fyne, Kinglas, Kinloss, Large, Leven, Nell, Ruel, Shiel, Shira, Strae, Talaken, Uisge-Dhu, &c. Most of these yield excellent salmon and trout fishing. There are also some good fishing streams in the islands. The county is remarkable for the numerous inlets of the sea with which it is deeply indented, the principal of them being Loch Long, with its branch Loch Goil; Loch Fyne, with Loch Gilp; Loch Etive; Loch Linnhe, with its branches Loch Creran, Loch Leven, and Loch Eil; and Loch Sunart. There is also a large number of inland lakes, the total area of which is about 25,000 acres. Of these the principal are Loch Awe, Loch Avich, Loch Eck, Loch Lyndoch (partly in Perthshire), and Loch Shiel.

The principal islands are Mull, Islay, Jura, Colonsay, Lismore, Tiree, Coll, Gigha, Muck, Rum, and Canna. Besides these there are the two small but interesting islands of Staffa and Iona—the one famous for its basaltic caves and rocks, and the other as the earliest seat of Christianity in Scotland.

The whole county is rugged and mountainous, and many of the peaks are among the loftiest in the kingdom; as Ben Cruachan (3689 ft.), Ben More, in Mull (3172), Ben Ima (3318), Buchael Etive (3345), and Ben Arthur, "The Cobbler" (2891), on the borders of Dumbartonshire. To the tourist it offers a rich variety of Highland scenery, culminating in the gloomy grandeur of Glencoe.

The situation and conformation of Argyllshire tend to produce a very abundant rainfall. At Oban, the average annual amount is 64·18 inches; in Glen Fyne, 104·11 inches; at the Bridge of Orchy, 113·62 inches; and at Upper Glencoe, 127·65; while at Edinburgh the average quantity is only 26·40 inches. The prevailing winds, as observed at Callton-More, near Crinan, are the S.W. and S.E., and next in frequency are the N.W. and N.E. The average temperature is 48° Fahr.

Geologically, the mainland consists principally of the metamorphic or so-called primary strata, covered in part by newer formations. In the portion west of Lochs Linnhe and Eil—the districts of Sunart, Ardgower, and Morven—gneiss is the prevalent rock, broken through by granite near Strontian, and by trap rocks in Ardnamurchan and Morven. In the other portion east of Loch Linnhe, the lower rocks are chiefly mica slate and clay slate, the continuation of the strata forming the great range of the southern Grampians. Mica slate is the most important and oldest of these formations, rising up into the wild and rugged mountains so conspicuous near Loch Long and Loch Fyne. In Appin it is partly replaced by quartz rock, remarkable for bare sterility, and on Loch Fyne by chlorite slates running down into Knapdale or the upper portion of the promontory of Kintyre. These slates form a good building stone, being readily cut even with a saw, and are the material of which the ducal castle at Inveraray is built. Mica slate again forms most of Kintyre south of Tarbert, with occasional beds of dark coloured limestone.

Clay slate is far less common on the mainland, but occurs near Dunoon and Toward Point on the Clyde. It has been long quarried extensively at Ballachulish, and again appears near Oban and further south, often as a dark coloured carbonaceous-looking rock. From this it extends into Kerrera, Seil, Easdale, Luing, and the other so called slate islands. It has everywhere a very marked cleavage, distinct from the stratification, and some of the beds furnish a very durable roofing slate, which has been long wrought in Easdale, and with which many houses in Scotland are covered. Cubical crystals of iron pyrites abound in all these slates, which, though no organic remains have yet been found in them, are probably the equivalents of the lowest Silurian formations.

To the same period may also be referred the quartz rock mentioned as occurring in Appin, specially near the lower part of Glencoe, and more extensively in Jura and Islay, along with the clay slate. From its hardness and indestructibility it would form a valuable building stone, but is little used. These properties also cause it to project in singularly sharp ridges and conical summits, of which the Paps of Jura are the best known.

The limestone associated with these older strata, though seldom in large masses, is yet widely spread. It has been wrought near Ballachulish and in various parts of Appin, in several places near the Crinan Canal, and along the whole peninsula of Kintyre as far as Campbeltown. The largest masses are found in some of the islands. Thus it covers the whole of Lismore and a large tract in the centre of Islay near Bowmore. A magnesian variety found on Iona, associated with serpentine, takes a good polish, and the red or flesh coloured marble of Tiree, often with embedded crystals of green hornblende, occurs in beds in the gneiss of that island.

Red sandstones, probably belonging to more than one period in the history of the earth, are found in different parts of Argyllshire. Some portions, resting conformably on the mica slate of Kintyre, may belong to the Torridon sandstone or Cambrian of the north-west coast, whilst other portions are of Devonian age. Some beds near Oban and on the Sound of Mull are probably Trias. True coal, a continuation of that in Ayrshire, has been wrought near Campbeltown. At various points on the coast of Mull, Morven, and Ardnamurchan, beds belonging to the Lias, Oolite, and even perhaps the Cretaceous formations, appear underlying the trap rocks. Though of much interest in a scientific point of view they have little influence on the general character of the county. More recent formations are the leaf beds, with remains of Miocene plants discovered in the trap tufa at Ardtunhead, in Mull, by the duke of Argyll in 1850. Raised beaches with fossil shells are also known on several parts of the coast, *e.g.*, at the Sound of Kerrera.

Of the igneous rocks, granite chiefly occurs in a large mass round the upper end of Loch Etive, extending south to Ben Cruachan near Loch Awe. Smaller masses appear near Ballachulish and at the Ross of Mull. In the latter place it has been extensively quarried and used for the magnificent lighthouse erected on the Skerry Vohr. Veins are common near these masses and in other places. Felspar porphyries in great variety of forms and colours, abound in Glencoe, in large masses in the mountains north of Loch Fyne below Inveraray, and again in Davar Island, and at other points near Campbeltown. Trap rocks—greenstones, dolerites, basalts, claystone porphyries, amygdaloids, and tufas—cover great extents both of the mainland and islands. In the west of Lorn they enclose the lower part of Loch Etive, stretching north to Loch Creran, and south nearly to Loch Awe and Loch Melfort. From this place, running westward through Kerrera, they form nine tenths of Mull and a wide tract on the opposite coast of Morven and Ardnamurchan. The islands of Muck, Eig, Rum, and Canna are more remote outliers of these formations to the north west, which also form the Treshinish Islands—Ulva, Gometra, and Staffa, with its far famed caves and beautiful columnar cliffs. From their relation to the stratified beds, these rocks evidently belong to a recent period in the history of the earth, many of them not older than the upper tertiary. At that time the west of this county, and especially the island of Mull, had formed the site of active volcanoes, rivalling in extent and activity any now known at least in Europe. The trap rocks in Kintyre connect them with those in central Scotland and the north of Ireland, whilst those in Skye are their continuation to the north.

Argyll is not rich in mineral products possessing an economic value. The lead mines of Strontian, in Sunart, produced in 1872 about twelve tons of lead ore. A vein of arsenical nickel was discovered in 1849 by the duke of Argyll near Inveraray. Fine specimens of the harmotome or cross-stone occur at Strontian, of the heliotrope or bloodstone in Rum, and of natrolite, siolezite, stilbite, and other zeolites in the trap-rocks of Mull, Morven, and Lorn.

Argyllshire was formerly interspersed with natural forests, remains of which—consisting chiefly of oak, ash, pine, and birch—are still visible in the mosses. But, owing to the clearance of the ground for the introduction of sheep, and the neglect of planting, the county is now remarkable for its want of wood, except in the neighbourhood of Inveraray, where there are extensive and flourishing plantations. A great part of the county is unfitted for agriculture; but many districts afford fine pasturage for the hill sheep; and some of the valleys—as Glendaruel—exhibit great fertility. The usual Scottish grains and roots are all more or less grown.

The chief branches of industry are the rearing of cattle and sheep, and the herring fishery. The cattle, though of small size, are equal, if not superior, to any other breed in the kingdom, and are in great demand in the markets of the south, to which they are sent in immense numbers. Dairy husbandry is practised to some extent in the southern parts of Kintyre, where there is a large proportion of arable land. In the higher tracts sheep have very advantageously been substituted for cattle. The black-faced is the species that is now almost universally reared.

Argyllshire is an attractive field for the sportsman, its deer forests, grouse-shootings, and salmon-fishings being among the best in Scotland. The rents derived from these sources have greatly increased during the last half century. As examples of these it may be stated, that the deer-forest of Blackmount is let for about £3000 a year, and the salmon-fishing of Ardnamurchan for upwards of £600. Loch Fyne is celebrated for its herring fishery; but during 1873 and 1874 the shoals have not advanced beyond the Sound of Kilbrannan.

The manufactures of Argyllshire are very limited, consisting solely of whisky and gunpowder; the former is produced at Campbeltown and in Islay, and the latter at Kames (Kyles of Bute), and at Melfort, Furnace, &c.

There were originally only military roads in Argyllshire, but these were gradually supplemented by others formed at the joint expense of Government (by a grant and maintenance) and the county, by means of assessment under the Road Commissioners—consequently there have never been any tolls. The Government grant was withdrawn about 1860, and the roads are now maintained solely by assessment, which is levied equally on landlords and tenants. By means of steamers there is regular intercourse between various parts of the extensive coast and the Western metropolis. In order to avoid the circuitous passage round the Mull of Kintyre the Crinan Canal was constructed, extending across the isthmus from Ardrishaig to Loch Crinan, a distance of 8 miles; and another canal unites Campbeltown with Dalavaddy. The Crinan is deep enough for vessels drawing 12 feet of water; its breadth at the surface is 66 feet, and at the bottom 30, and the passage is interrupted by fifteen locks. There are about twenty bank branches in the county. There are (1875) four weekly newspapers published in Argyllshire.

The antiquities of the county comprise monoliths, circles of standing stones, crannoges, and cairns. In almost all the burying grounds—as at Campbeltown, Keil, Soroby, Kilchousland—there are specimens of sculptured crosses and slabs, many of which are figured in *The Sculptured Stones of Scotland*, vol. ii., published by the Spalding Club, and *Archæological Sketches in Kintyre*, by Capt. T. P. White. For other subjects of archæological interest see *The Proc. of Antiq. Soc. of Scotland*, vols. iv. vi. viii. Besides the famous ecclesiastical remains at Iona, there are ruins of a Cistercian priory in Oronsay, and of a church founded by Somerlid at Saddel. Among castles may be mentioned Dunstaffnage, Ardtornish, Skipness, Kilchurn, Ardchonnel, Dunolly, Dunderaw, and Carrick.

The earliest recorded event in the history of Argyllshire is the settlement in the 4th or 5th century of a body of Irish Scots, under the leadership of Erc, who soon extended their power and established a dynasty. The most famous of their kings was Aidan, the friend of Columba. In the 8th century the district fell into the hands of Norwegian adventurers, and continued for five or six hundred years under Norwegian control, till the rise of a deliverer called Somerlid. Along with the Hebridean Isles, all the western parts of Argyll came to the Scottish monarchs by conquest in the 14th century. Some time after, Macdonald, the representative of this region, obtained leave from the Scottish crown to hold his possessions as a feudatory to that kingdom; but his turbulent spirit involved him and his family in repeated rebellions. These were at last punished by the forfeiture of the estates, which, along with the titles, were bestowed on the Campbells of Lochow, who have ever since retained them. Colin, second Lord Campbell, was created earl of Argyll in 1457; Archibald, second earl, fell at Flodden; Archibald, fourth earl, was the first nobleman in Scotland who declared himself a Protestant; Archibald, fifth earl, is famous as the supporter of Queen Mary; Archibald, the eighth earl, and other prominent holders of the titles, are noticed in the article immediately preceding. The tenth earl was raised to the dukedom of Argyll in 1701. The title is now (1875) held by a member of the same family, George Douglas Campbell, eighth duke.

Like other parts of the Highlands of Scotland, this county was the seat of several clans, of which the principal were the Campbells, the Macleans, the Stewarts of Appin, the Macdonalds of Glencoe, the Macquarries, and the Macdougalls; and the number of Campbells is still a striking feature of the personal nomenclature of the county. Gaelic is still to a considerable extent the vernacular dialect. The chief proprietors are the duke of Argyll and earl of Breadalbane, whose estates are respectively 168,000 and 179,000 acres in extent. The other principal estates, according to extent, are those of Poltalloch (183,000 acres), Islay (67,000), Jura (55,000), Ardnamurchan (55,000), Sunart (54,418), Kildalton (54,250), and Ardkinglass (51,670). The total number of owners of land possessing one acre or upwards was, in 1872–73, 581, and of owners who had less than one acre, 2283.

The valued rent of the county for 1874–75 is (exclusive of burghs and canals) £416,543. The valuation of the burghs is—Campbeltown, £20,624; Oban, £11,763; Inveraray, £3323. The county returns one member to parliament, and had in 1873–74 a constituency of 3010. Inveraray, Campbeltown, and Oban are contributory burghs to Ayr. It is governed by a lord-lieutenant and high-sheriff, about 48 deputy-lieutenants, a sheriff, and four substitutes. The justiciary circuit-court for the counties of Argyll and Bute is held at Inveraray in spring and autumn. Sheriff-courts are held at Inveraray, Tobermory, Campbeltown, and Fort William; and courts for small-debt actions, four times a year, at Oban, Lochgilphead, Dunoon, and Bowmore, in Islay. There are three prisons (at Campbeltown, Inveraray, and Tobermory), five poorhouses, an asylum at Lochgilphead for the Argyllshire and Bute district, sea-side homes for convalescents at Dunoon and at Kilmun, and a county militia barracks at Campbeltown. The ecclesiastical statistics of the county are as follows:—The Established Church of Scotland has a synod, 6 presbyteries, 40 parish and 18 *quoad sacra* churches, and 14 chapels of ease. The Free Church has a synod, 5 presbyteries, and 46 churches. The United Presbyterians have 8 churches connected with 2 presbyteries. The Episcopalians have a bishopric (Argyll and the Isles), a dean, and 17 clergymen; and the Roman Catholics have 5 priests. In 1871 there were 79·18 per cent. of the children between 5 and 13 years of age receiving education—Argyllshire in this respect standing above ten counties, but 7·36 below the highest, Perth. The population of Argyll has been decreasing since 1831, from the extensive emigration that has been going on, principally to Canada. The following is the state of its population since the commencement of the present century—1801, 81,277; 1811, 86,541; 1821, 97,316; 1831, 100,973, 1841, 97,371; 1851, 89,298; 1861, 79,724; 1871, 75,679.

ARGYRO-CASTRO (*Ergir Castri*), a town in the valley of the Drino, in the province of the Avlona, in Albania (*Epirus*). It has been variously identified with Hadrianopolis and Antigonea, and is supposed to preserve the name of the ancient Argyrini. It is the focus of the Mussulman aristocracy of Epirus, and contains the ruins of an imposing castellated fort. There is a considerable manufacture of a fine kind of snuff, called *Fuli*. Hobhouse and Holland estimated the inhabitants at 20,000; but in 1814 the town was almost depopulated by a plague, and the number has sunk to 6000.

ARGYROPULUS, or ARGYROPULO, JOHN, a learned Greek who lived during the 15th century. He appears to have crossed over to Italy about 1434, and in 1442 was made rector of the university at Padua. About 1456 he was invited to Florence by some of the Medici, and was there appointed professor of Greek in the university. Fifteen years after he removed to Rome, where he continued to act as professor of Greek till his death, which took place probably soon after 1489. His principal works were translations of the following portions of Aristotle:—*Categories*, *De Interpret.*, *Analyt. Post.*, *Physics*, *De Cœlo*, *De Anima*, *Metaphysics*, *Nicom. Ethics*, *Politics*. His only original published writing is an *Expositio Ethicorum Aristotelis*. Several of his writings exist still in manuscript.

ARIADNE (Ἀριάδνη = Ἀριάγνη, the Cretan form of ἁγνός being ἀδνός), in *Greek Mythology*, a personification of the return of Spring, at which period took place, it was believed, Ariadne's marriage with Dionysos (Bacchus), who also, after an absence throughout the winter, was thought to return amid the rejoicings of spring. This marriage was the great feature in her worship, which appears to have originated in Crete, and to have been mostly confined to that island and to Naxus, where annually it was celebrated by the people with dances and a festival called *Theodaisia*. But though married to Dionysos, and sometimes called his wife (ἄκοιτις, Hesiod, *Theogony*, 948), she did not generally appear in this character. On the contrary, in the *Odyssey* (xi. 321–325), it is said that Artemis slew her, with the consent of Dionysos, at Dia (near Cnossus), before she could reach Athens with Theseus. Her death would thus seem a punishment for her infidelity. But in the current legend her connection with Dionysos did not begin till he found her asleep in Naxus after her despair at being abandoned by Theseus, with whom she had escaped from Crete after assisting him against her father, the fierce Minos, to slay the Minotaur. She had given Theseus a clue by means of which, while she retained the other end, he could find his way through the labyrinth, in which he had to fight that monster with human body and bull's head. In the *Iliad* (xviii. 591) she is spoken of as the fair-haired Ariadne, for whom Dædalus had skilfully made a dancing-place (χορός) in Cnossus, and it is probable that the reference here is to the dances with which her marriage was celebrated in Crete. Possibly also the description of her as a daughter of Minos, which is as early as the *Odyssey* (xi. 321), was not founded in the belief of the Cretans, to whom she was a goddess, but arose elsewhere from observation of her peculiarly local character. Another form of her name in Crete, Ἀριδήλα (= φανερά), refers to her as a being connected with the return of a bright season in nature. In works of art her marriage with Dionysos, and her abandonment by Theseus in Naxus, are known to have been frequently the subject of representation. Examples of both still exist on the vases and in mural paintings. The scene where she holds the clue to Theseus occurs on a very early vase in the British Museum.

ARIANO, a town of Italy, in the province of Avellino, about 38 miles N.E. of Naples, situated 2500 feet above the level of the sea, on a steep and rocky hill, between the rivers Calore and Tribaldo. Founded by the Greek governors of Apulia, it continued to be an important military post for several centuries, and was frequently taken and retaken during the various dynastic struggles of southern Italy. A parliament was held here by Roger I. in 1140, and in 1648 the town was pillaged by the duke of Guise. It is still a bishop's see, and the chief town of a *circondario*, with a cathedral, and a large number of churches. Earthenware is manufactured, and there is some trade in wine and butter. The most peculiar feature of the town is the multitude of troglodytic dwellings, in which the poorer classes reside. The district is highly volcanic, and the town has suffered severely from earthquakes (1456, 1732), and only 7 miles distant is the lake of Amsanctus (*Mofete*), remarkable for its suffocating exhalations. Population, 14,347. (See Vitate, *Storia della Città d' Ariano*, Rome, 1794.)

ARIANS. See ARIUS.

ARIAS MONTANUS, BENEDICTUS, one of the most learned Oriental scholars of his time, and the editor of the Antwerp Polyglott, was born at Frescenal de la Sierra, in Estremadura, in 1527. After studying at the university of Alcala, he joined the Benedictine order. In 1562 he accompanied the bishop of Segovia to the Council of Trent. After a few years spent in retirement at Aracena he went to Antwerp, at the request of Philip II., to edit the Polyglott Bible that had been projected by Plantin the printer. The work appeared in 8 volumes folio, between 1568 and 1573. The Jesuits founded on it several charges of heresy against Arias, from which he succeeded in clearing himself, though only after several visits to Rome. He declined the offer of a bishopric from the king, but after some time spent in retirement at Aracena, became librarian at the Escorial. The closing years of his life were passed at Seville, where he died in 1598.

ARICA, a sea-port of Peru, in the department of Moquegua, in lat. 18° 28′ S., and long. 70° 10′ W. It was at one time a city of 30,000 inhabitants, and had a large export trade in wool, copper, and silver; but in consequence of civil war (1821) and earthquakes (1832, 1868), it has greatly declined; of late, however, it has shared in the general revival of Peru. The Government has taken measures for the improvement of the port, which is connected by railway with Tacna, about 38 miles inland, where many of the merchants reside. Population, about 4000.

ARIEGE, a department of France, bounded on the S. by Spain, W. by Haute-Garonne, N.E. by Aude, and S.E. by Pyrénées Orientales. It embraces the old countship of Foix, and a portion of Languedoc and Gascony, and has an area of 1889 square miles. The southern part is occupied by the Pyrenees, which here contain some of the highest peaks in France, as, Pic d'Estats (which is 10,811 feet above the level of the sea), Montcalm (10,512), Font-argente, and Montleon. Communication with Spain is afforded by a large number of *ports* or *cols*, which are, however, for the most part difficult paths, and only practicable for a few months in the year. The northern portion consists of a kind of plateau, broken by beautiful and fertile valleys. Ariège belongs to the Garonne basin, and is watered by the Salat, the Arize, and the Ariége, with their tributaries. The climate is mild in the south, but naturally very severe among the mountains. The country affords excellent pasture, and a considerable number of cattle, sheep, and swine are reared, but there is little arable land, and what exists is broken up into small crofts. There is abundance of minerals—lead, copper, manganese, and especially iron, being largely obtained. Alum is found at Mas-d'Azil, alabaster among the mountains, building-stone at Pamiers, marble at Belesta, &c. Warm mineral springs are common. The preparation of woollen cloths, the forging of iron, and manufacture of steel are the principal industries, while soap, paper, and wooden wares are likewise produced. Among the celebrated men of the department are Gaston de Foix, Pope Benedict XII., and Pierre Bayle. The chief town is Foix, the arrondissements, Foix, St Girons, and Pamiers. Population, 244,798.

ARION (pronounced *Ari'on*), a celebrated poet and cithara player, a native of Methymna, in Lesbos. As he is said to have been the friend of Periander, tyrant of Corinth, he must have flourished about 625 B.C. Several of the ancients ascribe to him the invention of the dithyramb and of dithyrambic poetry; it is probable, however, that his real service was confined to the organisation of that verse, and the conversion of it from a mere drunken song, used in the Bacchic revels, to a measured antistrophic hymn, sung by a trained body of performers. Nothing more is known of the life of Arion, with the exception of the beautiful story first told by Herodotus, and afterwards elaborated and embellished by many subsequent writers. According to Herodotus, Arion had become desirous of exhibiting his skill in foreign countries, and, leaving Corinth, had travelled through Sicily and parts of Italy, where he gained great fame, and amassed a large sum of money. At Tarentum he embarked for his homeward voyage in a ship belonging to Corinth. The sight of his treasure roused the cupidity of the sailors, who resolved to possess themselves of it by putting him to death. In answer to his entreaties that they would spare his life, they insisted that he should either die by his own hand on shipboard, or cast himself into the sea. Arion chose the latter, and as a last favour begged permission to sing a parting song. The sailors, desirous of hearing so famous a musician, consented, and the poet, standing on the deck of the ship, arrayed in the rich garments in which he was accustomed to be habited, sang a dirge accompanied by his lyre. He then threw himself overboard, but instead of perishing, as the sailors imagined, he was miraculously borne up in safety by a dolphin, supposed to have been charmed by the music. Thus he was conveyed to Tænarus, whence he proceeded to Corinth, arriving before the ship from Tarentum. Immediately on his arrival Arion related his story to Periander, the tyrant of Corinth, who was at first incredulous, but eventually learned the truth by a stratagem. Summoning the sailors, he demanded what had become of the poet. They affirmed that he had remained behind at Tarentum; upon which they were suddenly confronted by Arion himself, arrayed in the same garments in which he had leapt overboard. The sailors confessed their guilt, and were punished. Herodotus and Pausanias both refer to a brass figure at Tænarus, which was supposed to represent Arion seated on the dolphin's back. But this story is only one of several in which the dolphin appears as saving the lives of favoured heroes. Among others, it is curious that Taras, the mythical founder of Tarentum, is said to have been conveyed in this manner from Tænarus to Tarentum. On Tarentine coins a man and dolphin appear, and hence it may be thought that the monument at Tænarus represented Taras, and not Arion. From the frequent appearance of the dolphin in mythical stories of voyages, it has been conjectured that it was looked upon as in some way the preserver of those at sea, and votive offerings would therefore be given to it by those who had escaped the perils of the deep. At the same time, the connection of Apollo with the dolphin must not be forgotten. Under this form the god appeared when he founded the celebrated oracle at Delphi, the name of which commemorates the circumstance. He was also the god of music, the special preserver of poets, and to him the lyre was sacred. The story of Arion seems, therefore, to be but one of the many and varied forms of the wide-spread myth of Apollo. Among the numerous modern versions of it, particular mention may be made of the pretty *Romanze* "Arion" by A. W. Schlegel.

ARIOSTO, LODOVICO, one of the greatest poets of Italy, was born at Reggio, in Lombardy, on the 8th Sept. 1474. His father was Niccolo Ariosto, commander of the citadel of Reggio. He showed a strong inclination to poetry from his earliest years, but was obliged by his father to study the law—a pursuit in which he lost five of the best years of his life. Allowed at last to follow his inclination, he applied himself to the study of the classics under Gregorio da Spoleti. But after a short time, during which he read the best Latin authors, he was deprived of his teacher by Gregorio's removal to France as tutor of Prince Sforza. Ariosto thus lost the opportunity of learning Greek, as he intended. His father dying soon after, he was compelled to forego his literary occupations to undertake the management of the family, whose affairs were embarrassed, and to provide for his nine brothers and sisters, one of whom was a cripple. He wrote, however, about this time some comedies in prose and a few lyrical pieces. Some of these attracted the notice of the cardinal Ippolito of Este, who took the young poet under his patronage, and appointed him one of the gentlemen of his household. This prince usurped the character of a patron of literature, whilst the only reward which the poet received for having dedicated to him the *Orlando Furioso*, was the question, "Where did you find so many stories, Master Ludovic?" The poet himself tells us that the cardinal was ungrateful; deplores the time which he spent under his yoke; and adds, that if he received some niggardly pension, it was not to reward him for his poetry, which the prelate despised, but to make some just compensation for the poet's running like a messenger, with risk of his life, at his eminence's pleasure. Nor was even this miserable pittance regularly paid during the period that the poet enjoyed it. The cardinal went to Hungary in 1518, and wished Ariosto to accompany him. The poet excused himself, pleading ill health, his love of study, the care of his private affairs, and the age of his mother, whom it would have been disgraceful to leave. His excuses were not received, and even an interview was denied him. Ariosto then boldly said, that if his eminence thought to have bought a slave by assigning him the scanty pension of 75 crowns a year, he was mistaken and might withdraw his boon—which it seems the cardinal did.

The cardinal's brother, Alphonso, duke of Ferrara, now took the poet under his patronage. This was but an act of simple justice, Ariosto having already distinguished himself as a diplomatist, chiefly on the occasion of two visits to Rome as ambassador to Pope Julius II. The fatigue of one of these hurried journeys brought on a complaint from which he never recovered; and on his second mission he was nearly killed by order of the violent Pope, who happened at the time to be much incensed against the duke of Ferrara. On account of the war, his salary of only 84 crowns a year was suspended, and it was withdrawn altogether after the peace; in consequence of which Ariosto asked the duke either to provide for him, or to allow him to seek employment elsewhere. A province, situated on the wildest heights of the Apennines, being then without a governor, Ariosto received the appointment, which he held for three years. The office was no sinecure. The province was distracted by factions and banditti, the governor had not the requisite means to enforce his authority, and the duke did little to support his minister. Yet it is said that Ariosto's government satisfied both the sovereign and the people confided to his care; and a story is added of his having, when walking out alone, fallen in with a party of banditti, whose chief on discovering that his captive was the author of *Orlando Furioso*, humbly apologised for not having immediately shown him the respect which was due to his rank. Although he had little reason to be satisfied with his office, he refused an embassy to Pope Clement VII. offered to him by the secretary of the duke, and spent the remainder of his life at Ferrara, writing comedies, superintending their performance, as well as the construction of a theatre, and correcting his *Orlando Furioso*, of which the complete edition was published only a year before his death. He died of consumption on the 6th of June 1533.

That Ariosto was honoured and respected by the first men of his age is a fact; that most of the princes of Italy showed him great partiality is equally true; but it is not less so that their patronage was limited to kind words. It is not known that he ever received any substantial mark of their love for literature: he lived and died poor. He proudly wrote on the entrance of a house built by himself,

> "Parva, sed apta mihi, sed nulli obnoxia, sed non
> Sordida, parta meo sed tamen ære domus;"

which serves to show the incorrectness of the assertion of flatterers, followed by Tiraboschi, that the duke of Ferrara built that house for him. The only one who seems to have given anything to Ariosto as a reward for his poetical talent was the Marquess del Vasto, who assigned him an annuity of 100 crowns on the revenues of Casteleone, in Lombardy; but it was only paid, if ever, from the end of 1531. That he was crowned as poet by Charles V. seems untrue, although a diploma may have been issued to that effect by the emperor.

The character of Ariosto seems to have been fully and justly delineated by Gabrielle, his brother:—

> Ornabat pietas et grata modestia Vatem,
> Sancta fides, dictique memor, munitaque recto
> Justitia, et nullo patientia victa labore,
> Et constans virtus animi, et clementia mitis,
> Ambitione procul pulsâ, fastûsque tumore."

His satires, in which we see him before us such as he was, show that there was no flattery in this portrait. In these compositions we are struck with the noble independence of the poet. He loved liberty with a most jealous fondness. His disposition was changeable withal, as he himself very frankly confesses in his Latin verses, as well as in the satires.

> "Hoc olim ingenio vitales hausimus auras,
> Multa cito ut placeant, displicitura brevi.
> Non in amore modo mens hæc, sed in omnibus impar
> Ipsa sibi longa non retinenda mora."

Hence he never would bind himself, either by going into orders, or by marrying, till towards the end of his life, when he espoused Alessandra, widow of Tito Strozzi. He had no issue by his wife, but he left two natural sons by different mothers.

His Latin poems do not perhaps deserve to be noticed: in the age of Flaminio, Vida, Fracastoro, and Sannazzaro, better things were due from a poet like Ariosto. His lyrical compositions show the poet, although they do not seem worthy of his powers. His comedies, of which he wrote four, besides one which he left unfinished, are avowedly imitated from Plautus and Terence; and although native critics may admire in them the elegance of the diction, the liveliness of the dialogue, and the novelty of some scenes, few will feel interest either in the subject or in the characters, and none would now approve the immoral passages by which they are disfigured, however grateful these might be to the audiences and patrons of theatrical representations in Ariosto's own day.

Of all the works of Ariosto, the most solid monument of his fame is the *Orlando Furioso*, the extraordinary merits of which have cast into oblivion the numberless romance poems which inundated Italy during the 15th, 16th, and 17th centuries.

The popularity which an earlier poem on the same theme, *Orlando Innamorato*, by Boiardo, enjoyed in Ariosto's time, cannot be well conceived, now that the enthusiasm of the Crusades, and the interest which was attached to a war against the Moslems, have passed away. Boiardo wrote and read his poem at the court of Ferrara, but died before he was able to finish it. Many poets undertook the difficult task of its completion; but it was reserved for Ariosto both to finish and to surpass his original. Boiardo did not, perhaps, yield to Ariosto either in vigour or in richness of imagination, but he lived in a less refined age, and died before he was able to recast or even finish the poetical romance which he had written under the impulse of his exuberant fancy. Ariosto, on the other hand, united to a powerful imagination an elegant and cultivated taste. He began to write his great poem about 1503, and after having consulted the first men of the age of Leo X., he published it in 1516, in only 40 cantos (extended afterwards to 46); and up to the moment of his death never ceased to correct and improve both the subject and the style. It is in this latter quality that he excels, and for which he had assigned him the name of *Divino Lodovico*. Even when he jests, he never compromises his dignity; and in pathetic description or narrative, he excites the reader's deepest feelings. In his machinery he displays a vivacity of fancy with which no other poet can vie; but he never lets his fancy carry him so far as to omit to employ, with an art peculiar to himself, those simple and natural pencil-strokes which, by imparting to the most extraordinary feats a colour of reality, satisfy the reason without disenchanting the imagination. The death of Zerbino, the complaints of Isabella, the effects of discord among the Saracens, the flight of Astolfo to the moon, the passion which causes Orlando's madness, teem with beauties of every variety. The supposition that the poem is not connected throughout is wholly unfounded; there is a connection which, with a little attention, will become evident. The love of Ruggero and Bradamante forms the main subject of the *Furioso;* every part of it, except some episodes, depends upon this subject; and the poem ends with their marriage.

The first complete edition of the *Orlando Furioso* was published at Ferrara in 1532, as noted above. The edition of Morali (Milan, 1818) follows the text of the 1532 edition with great correctness. Of editions published in England, those of Baskerville (Birmingham, 1773), and Panizzi (London, 1834), are the most important. The indifferent translations into English of Harrington and Hoole have been superseded by the spirited rendering of Rose.

ARISTÆUS (from ἄριστος, best), a divinity whose worship was widely spread throughout Greece, but concerning whose origin and career the myths are somewhat obscure. The account most generally received connects him specially with Thessaly. Apollo carried off from Mount Pelion the nymph Cyrene, daughter or granddaughter of Peneus (Peneius), and conveyed her to Libya, where she gave birth to Aristæus. From this circumstance the town of Cyrene took its name. The child was at first handed over to the care of the Hours, or, according to another version, to the nymph Melissa and the centaur Chiron. He afterwards left Libya and came to Thebes, where he received instruction from the Muses in the arts of healing and prophecy, and married Autonoe, daughter of Cadmus, by whom he had several children, among others, the unfortunate Actæon. He is said to have visited Ceos, where, by erecting a temple to Zeus Icmæus (the giver of moisture), he freed the inhabitants from a terrible drought. The islanders worshipped him, and occasionally identified him with Zeus, calling him Zeus Aristæus. After travelling through many of the Ægean islands, through Sicily, Sardinia, and Magna Græcia, everywhere conferring benefits and receiving divine honours, Aristæus came to Thrace, where he was initiated into the mysteries of Dionysos, and finally disappeared near Mt. Hæmus. While in Thrace he is said to have caused the death of Eurydice, who was bitten by a snake while fleeing from him. Aristæus was essentially a benevolent deity; he was worshipped as the first who introduced the cultivation of bees, and of the vine and olive; he was the protector of herdsmen and hunters (and was therefore called νόμιος and ἀγρεύς); he warded off the evil effects of the dog-star; he possessed the arts of healing and prophecy. In ancient sculptures and coins he is represented as a young man, habited like a shepherd, and sometimes carrying a sheep on his shoulders. Occasionally he is accompanied by a bee or a dove.

ARISTANDER, the favourite soothsayer of Alexander the Great, who consulted him on all occasions. After the death of the monarch, when his body had lain unburied for thirty days, Aristander procured its burial by foretelling that the country in which it was interred would be the most prosperous in the world. He is probably the author of a work on prodigies, which is referred to by Pliny and Lucian.

ARISTARCHUS, of Samothrace, the most famous of the Greek grammarians and critics, flourished about 160 B.C. He spent the greater part of his life at Alexandria, where he studied in the school of Aristophanes of Byzantium. He acquired the highest reputation for critical skill, and founded a school for philology, which long flourished at Alexandria and afterwards at Rome. Ptolemy V. (Epiphanes) and Ptolemy VII. (Physcon) are said to have been among his pupils. During the reign of Physcon, who exercised great cruelty towards the learned men in his capital, Aristarchus withdrew to the isle of Cyprus, where, it is said, he suffered from dropsy, and voluntarily starved himself to death. Aristarchus commented on Pindar, Archilochus, Æschylus, Sophocles, Aristophanes, and Ion: but his great fame rests on his recension of Homer. His principal object was to secure a thoroughly accurate text, and he carefully removed all supposed interpolations, marking with an obelus lines considered by him to be spurious, and with an asterisk those that seemed particularly beautiful. His edition was highly valued, and has been the basis of all subsequent recensions. The criticism of Aristarchus was not merely verbal; he attended carefully to metre; he arranged the Iliad and Odyssey in books, as we now have them; and he wrote elaborate commentaries, entering into all questions of mythology and geography. He is also said to have been the first to apply accents to the Homeric poems. Of his numerous commentaries, and his longer treatises, particularly that *On Analogy*, only a few fragments have come down through the later scholiasts. See Matthesius, *Disputatio de Aristarcho Grammatico;* Villoisson, *Proleg. ad. Hom. Il.;* F. A. Wolf, *Proleg. in Hom.;* Lehrs, *De Aristarchi Studiis Homericis.*

ARISTARCHUS, a Greek astronomer of Samos, who lived about 280–264 B.C. He is famous as being the first to maintain that the earth moves round the sun. No mention, indeed, is made of this doctrine in his only surviving work, Περὶ μεγεθῶν καὶ ἀποστημάτων, which treats of the *Magnitudes and Distances of the Sun and Moon;* but Archimedes, in his *Arenarius*, quotes from a work written by Aristarchus as a refutation of astrology, which renders it certain that the Samian astronomer had clearly anticipated the grand discovery of Copernicus. That the latter was unacquainted with the doctrine of Aristarchus is equally certain from the fact that the *editio princeps* of Archimedes had not appeared till after Copernicus's death. The method given by Aristarchus of estimating the relative lunar and solar distances is geometrically correct, though the instrumental means of observation at his command rendered his data erroneous. His work has been published in Latin by G. Valla, Venice, 1498, folio; in Greek and Latin, with the commentary of Pappus, by Wallis, Oxford, 1688; and in a French translation by Fortia d'Urban, Paris, 1823, 8vo. See Delambre, *Hist. de l'astronomie ancienne.*

ARISTEAS, a somewhat mythical personage, said to have been a native of Proconnesus, an island in the Propontis. He travelled extensively, under the inspiration of Apollo, through the countries north and east of the Euxine, and visited the Hyperboreans, Issedines, and Arimaspi. His date is uncertain; Suidas places him in the period of Crœsus and Cyrus, others before the time of Homer. Herodotus and those who write of him regarded him as a magician, whose soul could enter and leave his body at pleasure. At Proconnesus he is said to have entered a shop and died there. While the owner of the shop was informing his family of the event, a stranger from Cyzicus told them that he had met and spoken with Aristeas. On going to the shop they did not find him, either dead or alive. Seven years after, he returned, wrote his poem, the Arimaspea, and again disappeared; 340 years later, he is said to have appeared at Metapontum, and commanded the inhabitants to raise an altar to Apollo, and a statue to himself. Of his poem, about a dozen lines are preserved by Longinus and Tzetzes. It appears to have contained geographical details. Some writers—Dionysius of Halicarnassus, for instance—do not believe that Aristeas was the author of this poem.

ARISTIDES, surnamed the Just, was the son of Lysimachus, a native of Athens, of the tribe Antiochis. His family appears to have been of noble descent; at least it is known that Callias, the torch-bearer at the Eleusinian mysteries, and reputedly the wealthiest man in Athens, was a cousin or near kinsman. Plutarch maintains, in opposition to Demetrius Phalereus, that Aristides was very poor, and never enriched himself at the expense of the state. His poverty, however, seems scarcely reconcilable with the fact that he was made archon at a time when the possession of a certain amount of property was an indispensable qualification for that office. But extremely little is known of his early life. So far as political tendencies went, he had been a companion and follower of Clisthenes, and it is also told that he had a great veneration for the character and legislation of Lycurgus. He, therefore, naturally took the aristocratic side in questions of state policy, and consequently found himself incessantly opposed to the great democratic leader, Themistocles. Plutarch relates many anecdotes of the constant opposition between the two, but in several points his account must be inaccurate.

The first certain appearance of Aristides in history was at the battle of Marathon, 490 B.C., where he was one of the ten generals, and led his own tribe, Antiochis. He is said to have been second in command to Miltiades. According to custom each of the ten generals had supreme command of the whole army for one day; Aristides saw the disadvantages of this system, which totally prevented any fixed plan being carried out, and by his advice and example prevailed on the other generals to relinquish their right in favour of Miltiades. This prudent measure contributed largely to the success of the battle, in which also, according to Plutarch, much was due to the valour of Aristides. He was left with one tribe to collect the spoil from the field of battle, while Miltiades marched to Athens to protect the city from the Persian fleet. He discharged the duty intrusted to him with the most scrupulous honesty. Next year he was made archon eponymus, and his reputation for justice appears to have been increased by the manner in which he performed the duties of his office. But his great rival, Themistocles, who had been meanwhile increasing his own power, grew jealous, and gradually raised a strong feeling against him by representing how dangerous it was for a democracy that any individual should be allowed to gain such influence as that of Aristides. The Athenians, uneasy at this idea, banished him by ostracism in 483. It is said that, on this occasion, an ignorant fellow, who did not know Aristides, came up to him, and, giving him his shell, desired him to write upon it the name of Aristides. The latter asked in surprise if Aristides had done him any wrong. "No," was the reply, "and I do not even know him, but it irritates me to hear him everywhere called *the just*." Aristides made no answer, but took the shell and wrote his own name on it.

On the night before the battle of Salamis, Aristides, who was still in exile, made a perilous journey through the enemy's fleet, and reached the tent of Themistocles. He told him that he had come to bury in oblivion their former differences; that he had learned his plan for giving battle to the Persian fleet in the narrow straits of Salamis, and highly approved of it; and that he would assist him to the utmost of his ability. By his influence the other generals were induced to assent to the plans of Themistocles, of whom they were somewhat jealous. On the day of battle, Aristides collected some Athenian volunteers, and made a descent on the little island of Psyttalea, which was filled with the forces of the enemy. These he routed and almost annihilated. After the victory of Salamis he dissuaded Themistocles from his ambitious plan of conquering Asia by destroying the bridge which the Persians had built over the Hellespont, and thereby cutting off their communications.

About this time his sentence of exile appears to have been revoked, for in 479 he was general of the Athenians in the campaign against Mardonius, and shared with Pausanias the glory of the victory at Platæa. By his prudent counsels before the battle, he settled a dangerous dispute with the Tegetæ; and after the victory, when the Athenians and Lacedæmonians were contending as to the right of erecting the trophy, he prevailed on the Athenians to give up their claim. The Lacedæmonians immediately followed this example, and the honours of the day were given to the Platæans. He also instituted yearly sacrifices and quinquennial games at Platæa, to celebrate the victory over the barbarians and the liberation of Greece. On his return to Athens, Aristides introduced the famous measure by which the archonship was thrown open to all classes of citizens. In 477, he was sent along with Cimon, over whom he had great influence, to take command of the Athenian contingent, under the general command of Pausanias the Lacedæmonian. The haughtiness and oppressive conduct of the Spartans had disgusted the allies, who were completely won over by the mildness and prudence of Aristides and Cimon. In a body the allied Greeks threw off the hegemony of Sparta, and formed a confederation under the Athenians. To Aristides was committed the task of drawing up the laws for this confederacy, and settling the amount of tribute which should be paid by each state. This duty he discharged to the complete satisfaction of the allies, who were delighted to be assessed at only 460 talents. The first instalment of the tax was paid into the national treasury, then situated on the sacred island of Delos, but afterwards transferred to Athens, a measure which Aristides is said to have declared unjust but expedient.

The time and place of his death are uncertain. It is known, at least, that he survived the banishment of Themistocles, for his generous conduct towards his fallen rival is commemorated by Plutarch. He died, probably, about 468 B.C., according to some at Athens, according to others at Pontus. He is said to have died in such poverty that he did not leave enough to defray his funeral expenses, but had a tomb erected to him with funds from the public treasury. This tomb at Phalerum was still to be seen in the time of Plutarch. His daughters received marriage portions from the state, and his son, Lysimachus, was granted a sum of money and a portion of land. Such was the respect of the Athenians for the memory of their great statesman, that even his remote descendants are said to have received assistance from the public treasury.

ARISTIDES, ÆLIUS, surnamed Theodorus, a distinguished Greek rhetorician or sophist, was the son of Eudæmon, a priest of Zeus, and was born at Adriani, in Mysia. The date of his birth is given by some as 129 A.D., by others, with more probability, as 117. He studied with great assiduity, and early manifested an uncommon aptitude for all that pertained to the art of rhetoric. He travelled extensively through Greece, Italy, Egypt, and Asia, and acquired such renown for eloquence that monuments were erected to him in several of the towns through which he passed. A record of his journeys has been preserved by himself, and his vanity appears to have been increased to an inordinate extent by his success. Shortly after his return to Italy, he was seized with a peculiar illness, which lasted for 13 years, and the nature of which has been the subject of some speculation. It is described very fully in his six *Sacred Discourses*, along with a mass of details regarding visions, dreams, and wonderful cures. His account of these cures has excited considerable attention, from the similarity between them and the effects produced by Mesmerism or Hypnotism, *i.e.*, nervous sleep. Aristides meanwhile had settled at Smyrna, whither he had gone for the sake of his health. In 178, when the city was partially destroyed by an earthquake, he wrote an eloquent account of the misfortune to the Emperor Aurelius, with whom he was a great favourite, and prevailed on him to give assistance to the citizens. The Smyrnæans, out of gratitude for this service, called Aristides the founder of their city, and erected a brazen statue to him. He declined the other honours which they would have heaped upon him, and would only accept the office of priest of Æsculapius, which he held till his death, about 189 A.D.

The extant works of Aristides consist of two small and unimportant treatises on rhetoric, and of fifty-five orations or declamations. In several of these he selects the same subjects as had been treated by Demosthenes and Isocrates, and puts himself in direct competition with them. His contemporaries ventured to compare him with Demosthenes, but modern criticism does not confirm this judgment. The style of Aristides is good, sometimes terse and elegant, but occasionally laboured, and there is a total want of the vigorous energy of thought and practical skill that give so much power to the orations of Demosthenes. No doubt this is in great measure due to the fact that the subjects selected by Aristides were to him fictitious, and that, consequently, his whole attention must have been concentrated on the diction and manner of treatment; in the cause itself he could have had no living interest. A complete edition of his works was published by Dindorf, *Aristidis Opera*, 3 vols., Leipsic, 1829.

ARISTIDES of THEBES, a celebrated Greek painter, was an older contemporary of Apelles, and flourished about 350 B.C. He is said by Pliny to have been the first to express in his paintings character and passion; but this is probably an exaggeration. Several of his paintings are recorded in which there was manifested extraordinary mastery of expression. His colouring is said by Pliny to have been hard.

ARISTIDES, QUINTILIANUS, author of a valuable treatise on music, lived probably in the first century of our era. According to Meibomius, in whose collection (*Antiq. Musicæ Auc. Septem*, 1652) this work is printed, it contains everything on music that is to be found in antiquity.

ARISTIPPUS, the founder of the Cyrenaic school of philosophy, was the son of Aritadas, a wealthy merchant of Cyrene, in Africa. Nothing is known of the early part of his life, but he appears to have been sent by his father on a voyage to Greece, and while there, attending the Olympic games, he was attracted by the fame of the Socratic teaching. He immediately proceeded to Athens, united himself to the circle of followers who surrounded Socrates, and continued with him till his death in 399. He did not, however, accept without essential modification the teaching of his master, and his conduct, in many points, was displeasing both to Socrates and to other members of the Socratic band. He had probably brought with him from the wealthy city of Cyrene habits of luxury and ostentation, which contrasted forcibly with the homely and temperate life of his master. Xenophon, in the *Memorabilia*, reports his conversation on the nature of temperance, in which he defends his life of ease and self-indulgence. Plato also somewhat significantly states that he was absent in the island of Ægina on the day when Socrates died. Another feature of his character, which rendered Aristippus objectionable to the other Socratics, was his tendency to adopt the theory and practice of the Sophists, among whom he is expressly included by Aristotle (*Met.*, ii. 2). It is more than probable that in Cyrene he had been already introduced to the doctrines of Protagoras, of whose influence his own theory shows manifest traces. We are further told that he opened his school before the death of Socrates, who blamed him for receiving payment from his scholars. This story is probably inaccurate as to the time when he began to teach, but it is undoubtedly true that he took money for his lectures, and defended the practice. Aristippus resembled the Sophists in another particular; like them, he avoided the duties and ties of citizenship by wandering from city to city. He was a professed cosmopolitan. The records of his travels, particularly of his visit or visits to the court of Syracuse, and his hostile relations with Plato there, are not in all points consistent, and rest on but slender authority. He appears to have settled finally in his native city, and seems to have died there. Although nothing is known with certainty as to the dates of his birth and death, 435 B.C. for the one, and about 356 B.C. for the other, may be accepted as probably accurate. The life of Aristippus is the best exemplification of his principles. True temperance, according to him, consists not in abstaining from pleasure, but in being able to enjoy it with moderation. He therefore indulged in good living, rich clothing, splendid dwellings, and in the society of the accomplished hetæræ. But in all these pleasures he remained thoroughly master of himself; he possessed them, and was not possessed by them. At any moment he could relinquish pleasure, for he had attained an equanimity that rendered him happy under any circumstances. To make the most of life, reasonably to enjoy the present moment, and to drive off care, reflection, and forethought, were the practical precepts by which he guided himself. As might naturally be expected, Aristippus left no definite system of philosophy; indeed, according to some accounts, he wrote nothing at all. Diogenes Laërtius certainly gives a list of works ascribed to him, but some of these were no doubt spurious, and none have survived. His daughter Arete, who had received the spirit of his teaching, continued the school after his death, and in turn instructed her son, the younger Aristippus (hence called μητροδίδακτος), to whom is attributed the systematic representation of the Cyrenaic doctrines, the fundamental principles of which, however, are due to the elder Aristippus.

In the Socratic theory of morals, virtue had appeared as the only human good, and reason as the indispensable condition of right action; but there was at the same time a utilitarian side to this teaching. Ethical virtues had been tested by their consequences; proof of the virtuous quality of an action had been drawn from its tendency to give pleasure; happiness or utility had been, in a certain sense, laid down as the end of action. This one-sided aspect of the Socratic theory was accepted by Aristippus, and by him carried out to its full extent. He refused altogether to consider those speculative elements, which, though in some degree rejected by Socrates himself, were nevertheless inherent in the Socratic system. Logic and Physics he thought unnecessary, for they contained nothing which bore upon the end of action, and for the same reason, as Aristotle tells us, he rejected mathematical study. But although Logic and Physics, as separate disciplines, received no attention from the Cyrenaics, yet they were admitted as supports to their ethical theory. According to Aristippus, knowledge is sensible perception; all that we know of anything is the impression made by it on us. These impressions are motions,—changes in our mental states; and each mental state is a purely subjective phenomenon, from which we can deduce nothing as to the constitution of external reality. Nor can we compare our knowledge with that of others; each one's sensations are peculiarly his own, and can be known only by himself. General names or conceptions, and, consequently, general propositions or truths, are meaningless and absurd. Individual feeling is the sole criterion of truth. From this it follows at once that such feeling is the only means by which we can determine our actions; feeling becomes the standard both of truth and of action. Now the only difference among feelings, in their relation to action, is their pleasurable or painful quality. The change effected in us by any object is either a violent, a gentle, or a perfectly tranquil motion. The first is painful, the second pleasant, the third indifferent. The end of life, as is manifest also from experience, is the attainment of pleasure, which must be positive or real, not merely absence of pain, as the Epicureans afterwards held. Further, future pleasure, as a gentle motion not yet effected, and past pleasure, as a gentle motion completed and done, cannot possibly enter into our estimate of happiness. Immediate gratification, the pleasure of the moment (μονόχρονος), is the end of life; real happiness consists of a succession of moments of intense pleasure. The conception of a life in which, on the whole, pain is over-balanced by pleasure, may certainly be formed, but can never furnish a satisfactory end of action. Varieties of pleasure were, of course, admitted by Aristippus, but his decided opinion seems to have been that bodily pleasures and pains are the most potent factors in human happiness or misery. As to the causes of pleasure, the means by which it was to be attained, these are in themselves indifferent; an action which gives pleasure is good, whether or not it be opposed to the religion or laws of the country. The predicates, good and bad, attached to actions independently of their consequences, are merely conventional, and not founded in nature. Yet Aristippus was compelled to admit that some actions which give immediate pleasure entail more than their equivalent of pain. This fact, he thought, was the true ground of the conventional distinction of right and wrong, and in this sense regard ought to be had to custom and law. But there is quite another side of the Cyrenaic doctrine, which appears as strongly in the theory as in the practice of Aristippus. Man must not give up himself as a slave to pleasure; he must be superior to it. True happiness can only be obtained by rational insight, prudence (φρόνησις), or wisdom. Only through this prudence, which is in truth virtue, can man make a proper use of the good things in his power, and free himself from those superstitions and violent passions that stand in the way of happiness. Through this wisdom we are enabled to preserve the mastery of pleasure, to rise superior to past, future, or even present happiness, and make ourselves independent of circumstances. True freedom of soul, real self-sufficiency, is given by wisdom, by mental cultivation. It is evident that at this point Aristippus approximates more closely to Socrates and the Cynics; and it is a suggestive fact that his followers, who pushed his principles to their logical consequences, landed in a theory of the negation of pleasure, nearly identical with the later Cynic views.

(Wendt, *De Phil. Cyrenaica*, 1841; H. v. Stein, *De Phil. Cyren.*, pt. i., "De Vita Aris.," 1855; Mullach, *Frag. Phil. Græc.*, ii. 397–438.)

ARISTO, or ARISTON, of Chios, a Stoic philosopher and pupil of Zeno, flourished about 250 B.C. He differed from Zeno on many points, and approximated more closely to the Cynic school. He was very eloquent (and was therefore sometimes called the Siren), but was controversial in tone. He despised logic as useless, and rejected the philosophy of nature as beyond the powers of man. Ethics alone he considered worthy of study, and in that only general and theoretical questions. He rejected altogether Zeno's doctrine of things desirable and intermediate between virtue and vice. According to him, there is no medium; everything that is not virtuous (*e.g.*, external conditions, fortune, health), is absolutely indifferent. There is only one virtue—a clear, intelligent, healthy disposition of mind. Aristo is frequently confounded with another philosopher of the same name, Ariston of Julis, in Ceos, who, about 230 B.C., succeeded Lyco as scholarch of the Peripatetics. He appears to have been a man of no weight or originality of mind.

ARISTOBULUS of CASSANDRIA, one of the generals who accompanied Alexander the Great, and who afterwards, when very aged, wrote a history of the expedition. This work was much used by Arrian, who praises it highly. Only a few fragments remain; these are given in Müller's *Hist. Græc. Frag.*

ARISTOBULUS, a Jew of Alexandria, and a philosopher of the peripatetic school, flourished about 160 B.C., in the reign of Ptolemy Philometer. He is the first representative of the Jewish-Alexandrian philosophy, the aim of which was to reconcile and identify Greek philosophical conceptions with the Jewish religion. Only a few fragments of his work, entitled *Commentaries on the Writings of Moses*, are quoted by Clement, Eusebius, and other theological writers, but they suffice to show its object. He endeavoured to prove that early Greek philosophers had borrowed largely from some parts of Scripture which had become known to them; in support of this view, he quoted from Linus, Orpheus, Musæus, and others, passages which strongly resemble the Mosaic writings. These passages, however, were mere forgeries, and it is surprising that any of the Alexandrian scholars should have been deceived by them.

ARISTOPHANES. The birth-year of Aristophanes is uncertain. He is known to have been about the same age as Eupolis, and is said to have been "almost a boy" (σχεδὸν μειρακίσκος) when his first comedy was brought out in 427 B.C. The most probable conjecture places his birth in or about the year 448 B.C. His father Philippus was a landowner in Ægina. Aristophanes was an Athenian citizen of the tribe Pandionis, and the deme Cydathenê. The stories which made him a native of Cameirus in Rhodes, or of the Egyptian Naucratis, had probably no other foundation than an indictment for usurpation of civic rights (ξενίας γραφή) which appears to have been more than once laid against him by Cleon. His three sons—Philippus, Arârôs, and Nicostratus—were all comic poets. Philippus, the eldest, was a rival of Eubulus, who began to exhibit in 376 B.C. Arârôs brought out two of his father's latest comedies,—the Côcalus and the Æolosicôn, and in 375 began to exhibit works of his own. Nicostratus, the youngest, is assigned by Athenæus to the Middle Comedy, but belongs, as is shown by some of the names and characters of his pieces, to the New Comedy also.

Plato's *Symposium*—in which Aristophanes has a place at the side of Socrates—shows that Plato bore no more ill-will than his master would have borne to the author of the *Clouds*. At the end of that banquet, "Aristodêmus said that Eryximachus, Phædrus, and others went away; he himself fell asleep, and as the nights were long, took a good rest; he was awakened towards daybreak by a crowing of cocks, and when he awoke, the others were either asleep or had gone away; there remained awake only Aristophanes, Socrates, and Agathon, who were drinking out of a large goblet which they passed round, and Socrates was discoursing to them. Aristodêmus did not hear the beginning of the discourse, and he was only half awake; but the chief thing which he remembered was Socrates insisting to the other two that the genius of comedy was the same as that of tragedy, and that the writer of tragedy ought to be a writer of comedy also. To this they were compelled to assent, being sleepy, and not quite understanding his meaning. And first of all Aristophanes fell asleep; and then, when the day was already dawning, Agathon."

Although tragedy and comedy had their common origin in the festivals of Dionysus, the regular establishment of tragedy at Athens preceded by half a century that of comedy. The Old Comedy may be said to have lasted about 80 years (470–390 B.C.), and to have flourished about 56 (460–404 B.C.) Of the forty poets who are named as having illustrated it the chief were Cratinus, Eupolis. and Aristophanes. The Middle Comedy covers a period of about 70 years (390-320 B.C.), its chief poets being Antiphanes, Alexis, Plato Comicus, Theopompus, and Strattis. The New Comedy was in vigour for about 70 years (320-250 B.C.), having for its foremost representatives Menander Philemon, and Diphilus. The Old Comedy was possible only for a thorough democracy. Its essence was a satirical censorship, unsparing in personalities, of public and of private life—of morality, of statesmanship, of education, of literature, of social usage—in a word, of everything which had an interest for the city or which could amuse the citizens. Preserving all the freedom of banter and of riotous fun to which its origin gave it an historical right, it aimed at associating with this a strong practical purpose—the expression of a democratic public opinion in such a form that no misconduct or folly could altogether disregard it. That licentiousness, that grossness of allusion which too often disfigures it, was, it should be remembered, exacted by the sentiment of the Dionysiac festivals, as much as a decorous cheerfulness is expected at the holiday times of other worships. This was the popular element. Without this the entertainment would have been found flat and unseasonable. But for a comic poet of the higher calibre the consciousness of a recognised power which he could exert, and the desire to use this power for the good of the city, must always have been the uppermost feelings. At Athens the poet of the Old Comedy had an influence analogous, perhaps, rather to that of the journalist than to that of the modern dramatist. But the established type of Dionysiac Comedy gave him an instrument such as no public satirist has ever wielded. When Molière wished to brand hypocrisy he could only make his Tartuffe the central figure of a regular drama, developed by a regular process to a just catastrophe. He had no choice between touching too lightly, and using sustained force to make a profound impression. The Athenian dramatist of the Old Comedy worked under no such limitations of form. The wildest flights of extravagance were permitted to him. Nothing bound him to a dangerous emphasis or a wearisome insistence. He could deal the keenest thrust, or make the most earnest appeal, and at the next moment—if his instinct told him that it was time to change the subject—vary the serious strain by burlesque. He had, in short, an incomparable scope for trenchant satire directed by sure tact.

Aristophanes is for us the representative of the Old Comedy. But it is important to notice that his genius, while it includes, also transcends the genius of the Old Comedy. He can denounce the frauds of a Cleon, he can vindicate the duty of Athens to herself and to her allies, with a stinging scorn and a force of patriotic indignation which make the poet almost forgotten in the citizen. He can banter Euripides with an ingenuity of light mockery which makes it seem for the time as if the leading Aristophanic trait was the art of seeing all things from their prosaic side. Yet it is neither in the denunciation nor in the mockery that he is most individual. His truest and highest faculty is revealed by those wonderful bits of lyric writing in which he soars above everything that can move laughter or tears, and makes the clear air thrill with the notes of a song as free, as musical, and as wild as that of the nightingale invoked by his own chorus in the *Birds*. The speech of Dikaios Logos in the *Clouds*, the praises of country life in the *Peace*, the serenade in the *Ecclesiazusæ*, the songs of the Spartan and Athenian maidens in the *Lysistrata*, above all, perhaps, the chorus in the *Frogs*, the beautiful chant of the Initiated,—these passages, and such as these, are the true glories of Aristophanes. They are the strains, not of an artist, but of one who warbles for pure gladness of heart in some place made bright by the presence of a god. Nothing else in Greek poetry has quite this wild sweetness of the woods. Of modern poets Shakespeare alone, perhaps, has it in combination with a like richness and fertility of fancy.

Fifty-four comedies were ascribed to Aristophanes. Forty-three of these are allowed as genuine by Bergk. Eleven only are extant. These eleven form a running commentary on the outer and the inner life of Athens during 36 years. We will notice them briefly in the order of their dates. They may be ranged under three periods. The first of these periods, extending to 420 B.C., includes those plays in which Aristophanes uses an absolutely unrestrained freedom of political satire. The second period ends with the year 405. Its productions are distinguished from those of the earlier time by a certain degree of reticence and caution. The third period, down to 388 B.C., comprises two plays in which the transition to the character of the Middle Comedy is well marked, not merely by disuse of the parabasis, but by general self-restraint.

I. *First Period.*

(1.) 425 B.C. *The Acharnians.*—Since the defeat in Bœotia the peace party at Athens had gained ground, and in this play Aristophanes seeks to strengthen their hands. Dicæopolis, an honest countryman, is determined to make peace with Sparta on his own account, not deterred by the angry men of Acharnæ, who crave vengeance for the devastation of their vineyards. He sends to Sparta for samples of peace; and he is so much pleased with the flavour of the Thirty Years' sample that he at once concludes a treaty for himself and his family. All the blessings of life descend on him; while Lamachus, the leader of the war party, is smarting from cold, snow, and wounds.

(2.) 424 B.C. *The Knights.*—Three years before, in his *Babylonians*, Aristophanes had assailed Cleon as the typical demagogue. In this play he continues the attack. The Dêmos, or State, is represented by an old man who has put himself and his household into the hands of a rascally Paphlagonian steward. Nicias and Demosthenes, slaves of Dêmos, contrive that the Paphlagonian shall be supplanted in their master's favour by a sausage-seller. No sooner has Dêmos been thus rescued than his youthfulness and his good sense return together.

(3.) 423 B.C. *The Clouds* (the first edition; a second edition was brought out in 422 B.C.)—This play would be correctly described as an attack on the new spirit of intellectual inquiry and culture rather than on a school or class. Two classes of thinkers or teachers are, however, specially satirised under the general name of "Sophist" (v. 331)—1. The Physical Philosophers—indicated by allusions to the doctrines of Anaxagoras, Hêracleitus, and Diogenes of Apollônia. 2. The professed teachers of rhetoric, belles lettres, &c., such as Protagoras and Prodicus. Socrates is taken as the type of the entire tendency. A youth named Pheidippides—obviously meant for Alcibiades—is sent by his father to Socrates to be cured of his dissolute propensities. Under the discipline of Socrates the youth becomes accomplished in dishonesty and impiety. The conclusion of the play shows the indignant father preparing to burn up the philosopher and his hall of contemplation.

(4.) 422 B.C. *The Wasps.*—This comedy, which suggested *Les Plaideurs* to Racine, is a satire on the Athenian love of litigation. The strength of demagogy, while it lay chiefly in the ecclêsia, lay partly also in the paid dicasteries. From this point of view the *Wasps* may be regarded as supplementing the *Knights.* Philocleon (admirer of Cleon), an old man, has a passion for lawsuits,—a passion which his son, Bdelucleon (detester of Cleon) fails to check, until he hits upon the device of turning the house into a law-court, and paying his father for absence from the public suits. The house-dog steals a Sicilian cheese; the old man is enabled to gratify his taste by trying the case, and, by an oversight, acquits the defendant. In the second half of the play a change comes over the dream of Philocleon; from litigation he turns to literature and music, and is congratulated by the chorus on his happy conversion.

(5.) 421 B.C. (Curtius, *Hist. of Greece*, vol. iii. p. 275, transl. Ward.) *The Peace.*—In its advocacy of peace with Sparta, this play, acted at the Great Dionysia shortly before the conclusion of the treaty, continues the purpose of the *Acharnians*. Trygæus, a distressed Athenian, soars to the sky on a beetle's back. There he finds the gods engaged in pounding the Greek States in a mortar. In order to stop this, he frees the goddess Peace from a well in which she is imprisoned. The pestle and mortar are laid aside by the gods and Trygæus marries one of the handmaids of Peace.

II. *Second Period.*

(6.) 414 B.C. *The Birds.*—Peisthetærus, an enterprising Athenian, and his friend Euelpides persuade the birds to build a city—"Cloud-Cuckoo-borough"—in mid air, so as to cut off the gods from men. The plan succeeds; the gods send envoys to treat with the birds; and Peisthetærus marries Basileia, daughter of Zeus. Some have found in the *Birds* a complete historical allegory of the Sicilian expedition; others, a general satire on the prevalence at Athens of headstrong caprice over law and order; others, merely an aspiration towards a new and purified Athens—a dream to which the poet had turned from his hope for a revival of the Athens of the past. In another view, the piece is mainly a protest against the religious fanaticism which the incident of the Hermæ had called forth. It can hardly be doubted that both this fanaticism and the part taken by Alcibiades in promoting the Sicilian expedition were present to the mind of Aristophanes; but in what proportions, and tempered with what other elements, the very form of the comedy makes it idle to inquire.

(7.) 411 B.C. *The Lysistrata.*—This play was brought out during the earlier stages of those intrigues which led to the Revolution of the Four Hundred. It appeared shortly before Peisander had arrived in Athens from the camp at Samos for the purpose of organising the oligarchic policy. The *Lysistrata* expresses the popular desire for peace at any cost. As the men can do nothing, the women take the question into their own hands, occupy the citadel, and bring the citizens to surrender.

(8.) 411 B.C. *The Thesmophoriazusæ.*—This came out three months later than the *Lysistrata*, during the reign of terror established by the oligarchic conspirators, but before their blow had been struck. The political meaning of the play lies in the absence of political allusion. Fear silences even comedy. Only women and Euripides are satirised. Euripides is accused and condemned at the female festival of the Thesmophoria.

(9.) 405 B.C. *The Frogs.*—This piece was brought out just when Athens had made her last effort in the Peloponnesian war, eight months before the battle of Ægospotami, and about fifteen months before the taking of Athens by Lysander. It may be considered as an attempt to distract men's minds from public affairs. It is a literary criticism. Æschylus and Euripides were both lately dead. Athens is beggared of poets; and Dionysus goes down to Hades to bring back a poet. Æschylus and Euripides contend in the under-world for the throne of tragedy; and the victory is at last awarded to Æschylus.

III. *Third Period.*

(10.) 393 B.C. *The Ecclesiazusæ.*—The women, disguised as men, steal into the ecclesia, and succeed in decreeing a new constitution. At this time the demagogue Agyrrhius led the assembly; and the play is, in fact a satire on the general demoralisation of public life.

(11.) 388 B.C. *The Plutus.*—The first edition of the play had appeared in 408 B.C., being a symbolical representation of the fact that the victories won by Alcibiades in the Hellespont had brought back the god of wealth to the treasure-chamber of the Parthenon. In its extant form the *Plutus* is simply a moral allegory. Chremylus, a worthy but poor man, falls in with a blind and aged wanderer, who proves to be the god of wealth. Asclêpius restores eyesight to Plutus; whereupon all the just are made rich, and all the unjust are reduced to poverty.

Among the lost plays, the following are the chief of which anything is known:—

1. *The Banqueters* (Δαιταλεῖς), 427 B.C. — A satire on young Athens. A father has two sons; one is brought up in the good old school, another in the tricky subtleties of the new; and the contrast of results is the chief theme.

2. *The Babylonians*, 426 B.C.—Under this name the subject-allies of Athens are represented as "Babylonians" —barbarian slaves, employed to grind in the mill. The oppression of the allies by the demagogues—a topic often touched elsewhere—was, then, the main subject of the piece, in which Aristophanes is said to have attacked especially the system of appointing to offices by lot. The comedy is memorable as opening that Aristophanic war upon Cleon which was continued in the *Knights* and the *Wasps*.

The Merchantmen, *The Farmers*, *The Preliminary Contest* (*Proagôn*), and possibly the *Old Age* (*Gêras*), belonged to the First Period. The *Gêras* is assigned by Süvern to 422 B.C., and is supposed to have been a picture of dotage similar to that in the *Knights*. A comedy called *The Islands* is conjectured to have dealt with the sufferings imposed by the war on the insular tributaries. The *Triphales* was probably a satire on Alcibiades; the *Storks*, on the tragic poet Patrocles.

In the *Æolosicôn*—produced by his son Arârôs in 387 B.C.—Aristophanes probably parodied the *Æolus* of Euripides. The *Côcalus* is thought to have been a parody of the legend, according to which a Sicilian king of that name slew Minôs.

A sympathetic reader of Aristophanes can hardly fail to perceive that, while his political and intellectual tendencies are well marked, his opinions, in so far as they colour his comedies, are too indefinite to reward, or indeed to tolerate, analysis. Aristophanes was a natural conservative. His ideal was the Athens of the Persian wars. He disapproved the policy which had made Athenian empire irksome to the allies and formidable to Greece; he detested the vulgarity and the violence of mob-rule; he clave to the old worship of the gods; he regarded the new ideas of education as a tissue of imposture and impiety. How far he was from clearness or precision of view in regard to the intellectual revolution which was going forward, appears from the *Clouds*, in which thinkers and literary workers who had absolutely nothing in common are treated with sweeping ridicule as prophets of a common heresy. Aristophanes is one of the men for whom opinion is mainly a matter of feeling, not of reason. His imaginative susceptibility gave him a warm and loyal love for the traditional glories of Athens, however dim the past to which they belonged; a horror of what was ugly or ignoble in the present; a keen perception of what was offensive or absurd in pretension. The broad preferences and dislikes thus generated were enough not only to point the moral of comedy, but to make him, in many cases, a really useful censor for the city. The service which he could render in this way was, however, only negative. He could hardly be, in any positive sense, a political or a moral teacher for Athens. His rooted antipathy to intellectual progress, while it affords easy and wide scope for his wit, must, after all, lower his intellectual rank. The great minds are not the enemies of ideas. But as a mocker—to use the word which seems most closely to describe him on this side—he is incomparable for the union of subtlety with riot of the comic imagination. As a poet, he is immortal. And, among Athenian poets, he has it for his distinctive characteristic that he is inspired less by that Greek genius which never allows fancy to escape from the control of defining, though spiritualising, reason, than by such ethereal rapture of the unfettered fancy as lifts Shakespeare or Shelley above it,—

> "Pouring his full heart
> In profuse strains of unpremeditated art."

Best recent editions, &c.—(1.) *Text.*—Bergk, 2 vols., Teubner, 1867; Holden (expurgated edition), Bell, 1868. (2.) *Commentaries.*—Acharnenses, Equites, Nubes, Vespæ, W. C. Green, in the *Catena Classicorum*, Rivingtons, 1870; Nubes and Ranæ, A. Sidgwick (for beginners), Rivingtons, 1872. (3.) *Translations.*—Mitchell (Acharn., Knights, Clouds, Wasps), 2 vols., 1822; J. H. Frere (Acharn., Knights, Birds, Frogs, Peace) being 2d vol. of his works, Pickering, 1871; B. H Kennedy, The Birds (with an excellent introduction), Macmillan, 1874. (R. C. J.)

ARISTOPHANES of BYZANTIUM, one of the most famous of the Alexandrian critics, flourished about the middle of the 3d century B.C. He studied under Eratosthenes and Zenodotus, and himself founded a school for grammar and criticism, of which the most distinguished pupil was the great Aristarchus of Samothrace. He was afterwards appointed to the superintendence of the Alexandrian library. Aristophanes, like his great pupil, was celebrated as an Homeric critic, but little is known of the results of his labours on that poet. He seems, however, to have been particularly occupied with the consideration of questions of authenticity. He arranged and commented on the works of Hesiod, Alcæus, Pindar, Anacreon, Callimachus, Plato, and Aristotle; he also explained and wrote arguments to the plays of Aristophanes and the tragic poets. He is justly celebrated as the inventor of the Greek system of punctuation, accent, and breathing. To him, also, is due in great measure the foundation of the well-known Alexandrian Canon.

The fragments of his works have been collected and published by A. Nauck, *Aristophanis Byzantii Fragmenta*, 1848. See also, Kreuser, *Griech. Accentlehre*; Villoisson, *Proleg ad. Hom. Il.*; F A. Wolf, *Proleg. in Hom*

ARISTOTLE

IN the history of European thought and knowledge, down to the period of the revival of letters, the name of Aristotle was, without a rival, supreme; and this supremacy arose from no false estimate or unwarranted preference. Aristotle, speaking generally, treated of every subject which came within the range of ancient thought, and if we regard matter, and not form or literary style, he treated of each of these subjects better than any one else. He also initiated many new branches of inquiry, dependent on observation and induction, and thus not only represented in himself the culmination of Greek speculative philosophy, but was also, as far as possible, the forerunner of modern science. Therefore, the sense of mankind recognised him gradually (after many vicissitudes of appreciation) as the strongest of the ancients. It even came to pass that, for a long period, all secular writings but those of Aristotle had dropped out of notice in Europe. His works may almost have the credit of having saved men from relapsing into barbarism. All sought in Aristotle the basis of knowledge. Universities and grammar schools were founded in Aristotle. Dante only justly expresses this predominance, when he speaks of Aristotle[1] as "the master of those that know," and depicts him as centre and head of the philosophic family. Of the influence which he has exercised over the minds of men we have evidence, not only in the vast literatures connected with his system, which exist in all great libraries, but also in the traces which that system has left in all the modern languages of Europe. The number of Aristotelian "fossils"[2] existing in our everyday language is quite remarkable. If it had not been for the system of Aristotle, we should have had to express many of our ordinary thoughts differently

The thought of Aristotle takes its start out of two separate sets of elements previously existing in Greece: the one purely philosophical, the other scientific. In Plato were summed up and remoulded all the former results of logical, metaphysical, psychological, ethical, and political speculation in Greece. And Aristotle was, in the first place, thoroughly imbued with Plato, and all the purely philosophical side of his writings was conceived in close relation to Plato's works, the results of which he may be said to have codified, reducing into expository form what Plato had left scattered up and down, rather as hints and suggestions, in his brilliant dramatic dialogues. Partly, then, Aristotle adopted the results of Plato, and made them available for the world in general; partly he dissented from some of the Platonic doctrines, and carried on a polemic against them. To compare the Platonic dialogues with the works of Aristotle, and to trace the agreements and disagreements between them, forms an interesting study in the history of philosophy. But on the whole, the difference between Aristotle and Plato is one of aims rather than of doctrines. Aristotle's aim, almost from first to last, is to be scientific, and to reduce even philosophy to science. He wishes to deal with what can be known for certain, and to express this in exact language. Plato's aim was, in one sense, greater than this; in another sense it was inferior to it. Plato stood apart from dogmatic systematising; he seems to have regarded truth as too great and many-sided to be capable of being submitted to such a process; he was content to develop various aspects of the truth, on all the highest questions, as they appeared to different minds, or to the same mind at different periods. To do this he chose the vehicle of the dramatic dialogue, in which nothing was positively announced beyond the views arrived at for the moment by the particular speakers. He was a poet at the same time

[1] *Inferno*, canto iv 130, *sqq.*

[2] The Aristotelian words in modern use come chiefly through Latin renderings of his phraseology. Some of them are.—*Maxim* = a major premiss; *principle*, from *principium*, the translation of Aristotle's ἀρχή, has the same meaning. *Subject* (τὸ ὑποκειμένον) comes from the doctrine of the four causes. So does *matter* from *materies* (timber), the Latin for ὕλη. So *form*, *end*, *final cause*, &c. *Motive* is a fossilised confusion, as it should stand for the efficient cause (ἀρχὴ κινήσεως), whereas it really denotes the final cause of action. *Faculty* (in Universities) represents Aristotle's δύναμις = art. *Energy* is of purely Aristotelian origin, though not quite keeping its philosophic sense. *Actually* is from the Latinised form of the same term. So, too, in *category* and *predicament* (*e.g.*, "an unpleasant predicament") we preserve both the Greek and Latin form of an Aristotelian term. *Habit* (in morals) varies a little in meaning from ἕξις. We have also another *habit* (*i.e.*, "dress") from ἔχειν (see note 2, p 515). The *mean* and the *extremes* still live in modern parlance, and so does the *quintessence*, or fifth substance beyond the four elements of which the outer heaven, according to Aristotle, was composed. *Metaphysics* is derived from the name given by his followers to his last treatise, and *natural history* from his "*Histories*," or investigations "about animals."

that he was a philosopher, and his works exhibit that true note of poetry which consists in constant attention to form, so that no part is a mere means to a final result; but each part is treated as an end in itself, and contains its own beauty and perfection. His dialogues are thus masterpieces of consummate literary art, though somewhat indefinite in their conclusions, and not without a tinge of imaginative mysticism. To all these Platonic tendencies in the treatment of philosophy Aristotle was totally opposed. He disregarded form in all his extant works; he thought of matter alone, and his main care was to be definite and exhaustive. In adopting results from Plato he first stripped them of the poetry with which they had been surrounded. We shall revert below to some of the points on which he controverts Plato, but the real contrast between them is in their attitude; the one is essentially a dialectician, though of the highest and noblest type, the other more and more tends to be a man of science. Following out his proper bent, Aristotle, in many of his works, strikes on a path in which Plato had not been his precursor. In these works he lays the foundation for the sciences of Natural Philosophy, Mechanics, Physiology, and Natural History. In these branches of thought he stands related, not to Plato, but to the early Greek writers on physical subjects, the inquirers on special questions, the medical writers, and the travellers, whose works he often mentions,[1] though they are all now lost. If we possessed them, we should probably only see how meagre had been these beginnings of science, and what great things Aristotle achieved in the accumulation and systematising of knowledge, and in preparing the way for its future development.

Aristotle's complete neglect of artistic form (in his extant works), and his adherence "to essential naked truth," induced Wilhelm von Humboldt[2] to say that Aristotle was un-Greek in the character of his mind; that he was deeper and more earnest than the Greeks, but was wanting in Greek fancy and grace, and spiritual freedom of treatment. This may be so; but in point of descent Aristotle was purely Hellenic.[3] His family, however, had been settled for some generations on the Macedonian frontier, and it was there that Aristotle was born, at the town of Stageira,[4] a Greek colony, on the Strymonic gulf. This place was not far from Pella, the residence of the Macedonian king, Amyntas, whose physician Nicomachus, the father of Aristotle, became. Intercourse with the Macedonians may have, to some extent, influenced the manners of this family. But it is to be remembered that they belonged to the race of the Asclepiads, or supposed descendants of Æsculapius, and it is more natural to attribute the scientific tendencies of Aristotle's mind to the inherited character and traditions of this race than to any influence which he can have received from the Macedonians. Among those traditions it is said[5] to have been one, that "from father to son they learned the art of dissection, as regularly as others learn to read and write." The best biography of Aristotle, hitherto written, is that given by Grote in his posthumous work referred to in note 3. The chief ancient authority on the subject is Diogenes Laertius, a compiler[6] and anecdote-monger, perhaps of the 3d or 4th century A.D. His life of Aristotle contains, amid many worthless, gossiping statements, two fragments of antiquity which are of the greatest value. One of these is an extract from the chronology (χρονικά) of Apollodorus (140 B.C.), giving the dates of the chief events of Aristotle's career; the other is a catalogue of "the books which he left behind him," to the number of 146. The following are the statements of Apollodorus:—That Aristotle was born 384 B.C. That he joined Plato and passed twenty years with him, thirteen of them consecutively, and that he came to Mitylene 345 B.C. That in the first year after the death of Plato he went to Hermeas, and abode with him three years; that he came to Philip 343 B.C., when Alexander was fifteen years old; that he came to Athens 335 B.C. That he held a school in the Lyceum thirteen years, and then went to Chalcis 322 B.C., where he died of a disease, about sixty-three years old. This skeleton of the life of Aristotle is probably authentic;[7] and if so, we know as much about him as could possibly be expected. It is easy to fill up, to some extent, the details: he must have been in his seventeenth year when he came to Athens to put himself under Plato; twenty years afterwards, when Plato died, he was, on account of his great divergencies of mind from Plato, not appointed head of the school, and he, therefore, retreated to the court of his philosophical friend, Hermeas, ruler of Atarneas, in Asia Minor; he married the niece of Hermeas, who was a eunuch, and had been a slave. On his death Aristotle went to live in retirement in Mitylene, whence, in his forty-second year, he was summoned by Philip of Macedon to undertake the tuition of Alexander the Great, then fifteen years old. Seven years later Philip was assassinated and Alexander became king of Macedonia, and was immediately absorbed in plans for the conquest of the East. Aristotle now came to Athens and spent the last thirteen years of his life there, and it is these years which have the most interest for us, for in them, in all probability, he composed all those of his works[8] which still remain. In rivalry to the Platonic school which had been established in the gardens of the "Academia" on the west side of Athens, he set up his own school in the covered "walks" (περίπατοι) round the temple of the Lycean Apollo, on the east side of the city, and from this circumstance his philosophy got the appellation of "Peripatetic." His mind and the general features of his system were now mature; he had before him the task, on the one hand, of reducing to writing for the world the results of his reflections in philosophy, on the other hand, of accumulating fresh materials for those sciences of observation of which he was laying the foundation. He set himself simultaneously to writing and to teaching, and there is reason to believe that he employed

[1] See Bonitz's Index to *Aristotle*, in the 5th vol. of the edition of the Prussian Royal Academy (Berlin, 1870), under the words φυσικός, φυσιολόγος, Philosophus Incertus, περίοδοι (books of travels), ἱστορία, Ἱπποκράτης, &c., where the references to passages are given.

[2] In a letter to F. A. Wolf, dated 15th June 1795. See his works, v. 125.

[3] See *Aristotle*, by George Grote, &c. (1872), vol. i. p. 3, note.

[4] Hence his frequent appellation by the Greek commentators of ὁ Σταγειρίτης. This in English is often mis-spelt as "Stagyrite."

[5] Galen, *De Anatomicis Administr.*, ii. 1. It is a doubtful and interesting question whether Aristotle ever dissected the human subject. This would have been much opposed to Greek prejudices. See *Aristotle: a Chapter from the History of Science*, &c., by George Henry Lewes (London, 1864), pp. 159–170. We know that the school of Galen contented themselves with dissecting the lower animals; the same may generally have been the case with Aristotle. But he appears to have dissected the human fœtus, and in one place, at all events, he seems to indicate acquaintance with dissections of the adult human subject (*De Part. Animal*, i. v. 7). But his knowledge of anatomy, as compared with that of modern times, was superficial.

[6] See his *Lives of the Philosophers*, v. i.

[7] Niebuhr considered Apollodorus to be a trustworthy chronologist. Valentine Rosé, however, *De Aristotelis Librorum Ordine et Auctoritate Commentatio* (Berlin, 1854), pp. 112–119, thinks that the date of Aristotle's death can alone be relied on, and that all the other particulars are filled in, going backwards from this, on conjecture. Rose believes that the account of Aristotle's connection both with Plato and with Alexander is a mere fiction, and, in short, that we know nothing about the life of Aristotle. This is an extreme of scepticism.

[8] These works all seem to belong to the same epoch of the author's mind. They all presuppose a certain generally completed system of philosophy and a certain previously settled phraseology. But considerable development of particular thoughts can be traced as having occurred during the actual writing of the books.

his school to some extent, in co-operation with himself, to work out details, and to assist in a subordinate way in the construction of the great philosophical and scientific edifice which he had in view. The period of the zenith of Aristotle was coeval with the astonishing career of his pupil, Alexander. There is a tradition that Alexander[1] furnished him with funds for his physical and zoological researches. However this may have been, it appears certain that Aristotle was identified in Athens with the Macedonian cause, and that when, in the summer of 323 B.C., the startling news of the sudden death of Alexander was spread through Greece, Aristotle was involved in the temporary fall of a political party, and those who, from different causes, were his enemies, made an attack upon him which caused him to fly from Athens. Grote has well drawn out the various elements of enmity existing against Aristotle, and to his account we refer. Aristotle retired to Chalcis in Eubœa, a place garrisoned by the Macedonians, and there shortly afterwards closed, in an illness, his life of unsurpassed activity and achievement. His will, preserved by Diogenes, would seem to indicate a kind, just, and generous disposition; of the genuineness of this document we cannot be sure, but there is nothing recorded of Aristotle with any certainty which would lead us to think of him personally otherwise than with respect.[2]

After his death his works had a strange and remarkable history. His library, containing all his own autographs, many of them being MSS. of unpublished and unfinished treatises, was bequeathed to Theophrastus, his chief disciple, who, dying thirty-five years later, bequeathed them in turn, together with his own books and writings, to Neleus, a Peripatetic scholar. Neleus took the whole precious collection with him to his home at Scepsis, in Asia Minor, and his heirs concealed it in a vault to prevent its being seized by the king of Pergamus, who was then levying contributions for his royal library. The Aristotelian MSS. were thus lost to the world for 187 years. About the year 100 B.C. they were brought out of their hiding-place and sold to a wealthy book-collector, named Apellicon, who carried them back to Athens. In the year 86 B.C., on the taking of Athens by Sulla, the library of Apellicon was seized and brought to Rome. There some learned Greeks obtained access to it; Tyrannion, the friend of Cicero, arranged the MSS.; and Andronicus of Rhodes undertook the task of furnishing a correct text, and a complete edition of the philosophical works of Aristotle, out of the materials at his disposal. He arranged the different treatises and scattered fragments under their proper heads, and published what was henceforth received as the authorised edition of the works of Aristotle.[3] It seems reasonable to believe with Grote[4] that "our Aristotle," that is, the collection of writings which under this name has come down to modern times, is none other than the edition of Andronicus, and thus dates from about the year 50 B.C. For the first generation after the death of Aristotle, his scholars,[5] Theophrastus, Eudemus, Phanias, Straton, &c., were engaged partly in editing, partly in paraphrasing, sometimes in endeavouring to improve upon his mostly unfinished works. But the Peripatetic school very rapidly declined; all the philosophic ability round the shores of the Ægean threw itself into one or other of the two new rival schools which had arisen, the Stoic and the Epicurean. The Peripatetics could not keep up to their master's level; they soon lost interest in the higher parts of his system; they took to writing monographs[6] on small separate questions, and moral platitudes[7] dressed up in rhetorical form. We may hesitate to affirm that, during 187 years, there were absolutely no copies of Aristotle's greatest works extant besides those hidden in the vault of Scepsis, for the Stoical ethics and logic both bear traces of a knowledge of Aristotle. But, at all events, for the time, the world had lost its interest in all that we most prize in Aristotle's thought. Strabo[8] says expressly that "all his writings, except a few of a more popular character," had been lost; and in accordance with this, Cicero[9] says that "even philosophers know nothing of Aristotle, though they ought to have been attracted by the incredible sweetness of his diction." The latter part of this remark may seem surprising, for it is not in the least applicable to any of the works of Aristotle which have come down to us. But Cicero is evidently referring to the Dialogues,[10] which were read, admired, and attributed to Aristotle in the days before the edition of Andronicus became known. The question has been raised, especially by Valentine Rose,[11] whether these dialogues, and other short, unsystematic works which passed under the name of Aristotle, were all forgeries, or were in any case genuine. On the one hand it is urged that the dialogic, or artistic, mode of exposition, was alien from Aristotle's turn of mind. On the other hand, it may be said that Aristotle in his youth may very probably have tried his hand at imitating the Platonic dialogues. And, indeed, unless he had done so, it is difficult to understand how even the forgers could have ventured to publish dialogues bearing his name. Very likely, after his death and the loss of the main bulk of his works by their removal to a vault in Asia Minor, a crop of forged Aristotelian writings sprung up, and imitations of his earlier and more popular works were among the number. But still, it appears safest to believe that Aristotle did at one time endeavour to make the dialogue his vehicle for philosophy. In the years that followed the death of Plato, he probably felt within himself a reaction and repugnance against this mode of writing, and when he returned to Athens as the leader of a school, he utterly renounced it, and set himself henceforth to the statement of the naked truth in the directest and most scientific terms which he could find. Whether the dialogues which Cicero and his contemporaries read and admired were early works of Aristotle himself, or were forgeries, there is no means of knowing. But the fragments[12] of these works, which a search of all ancient literature has brought together, show us nothing worthy of Aristotle in his best days, nothing that contributes any light to his philosophy. And it is remarkable that all works of this kind seem to have been excluded from the edition of Andronicus. Owing to that exclusion they are all now lost, and thus the tables are turned, for whereas before the edition of Andronicus the

[1] Athenæus, ix. 398. Pliny, *H. N.*, viii. c. 16.

[2] See some remarks in the *Edinburgh Review*, No. 278, page 525.

[3] The authorities for this story are Strabo (who was the pupil of Tyrannion), xiii. 609; Plutarch, *Sulla*, c. xxvi.; Porphyry, *Vita Plotini*, p. 117. It has been much criticised by Stahr, Brandis, Zeller, Bernays, Rose, &c. For the last remarks on the subject see Grote (*l. c.*), and Sir A. Grant's *Ethics of Aristotle, illustrated with Essays and Notes, 2d edition* (London, 1874), essay i. pp. 5–18.

[4] *Aristotle*, vol. i. pp. 57–62.

[5] See Brandis, *Scholia in Arist.*, p. 28, note.

[6] See Rose, *Aristoteles Pseudepigraphus* (Leipsic, 1863), pp. 20–22, where a list of many such productions falsely ascribed to Aristotle is given.

[7] Strabo, xiii. 609, says that all they did was θέσεις ληκυθίζειν.

[8] *Ibidem.*

[9] *Topica*, i. 1–3.

[10] See Cicero, *Epist. ad Famil.*, t. ix. 23, where he speaks of his three books *De Oratore* as "a dialogue in the style of Aristotle," and *Epist. ad Atticum*, xiii. xix., where he says that he has copied Aristotle "who in his dialogues always assigns to himself the leading part in the conversation." This shows that the dialogues of Aristotle were very different from those of Plato, and were probably expository and dogmatic, and not at all dramatic.

[11] *Arist. Pseudepigraphus*, pp. 23–26.

[12] These fragments are given collectively in the 5th volume of the Prussian Royal Academy's edition of Aristotle (Berlin, 1870).

world had forgotten all about Aristotle, except so far as he was represented by his own youthful and lighter productions, or by spurious imitations of these, it came to pass later that all except his solid and great philosophical treatises passed into oblivion.

Turning now to the catalogue of the works of Aristotle which has been preserved by Diogenes Laertius, we find that it contains 146 different names, not one of which[1] seems to correspond with any of the forty works which make up "our Aristotle." This is very striking, and suggests the question, Did Aristotle really write all these works enumerated in the catalogue, and if so, how is it that they are all lost? Did he really write over and over again on the same subject, as the catalogue, taken together with our edition, would indicate? Or is the catalogue virtually a list of forgeries, published under the name of Aristotle at the time when the unique MSS. of many of his greatest works were shut up underground and forgotten? Neither hypothesis can be accepted absolutely, but the last mentioned contains, probably, by far the nearest approximation to the truth. It seems credible that the catalogue in question was taken from the backs of rolls in the Alexandrian library, and that it was made by Hermippus, pupil of Callimachus, the chief librarian, between the years 240 and 210 B.C.[2] It found its way into some biography, and was thence mechanically copied by Diogenes. If this be so, it represents the kind of books which were being received by the world as Aristotle's at a time when the real Aristotle was buried out of sight. The books enumerated in the catalogue strike us at once as peculiar in character: first we meet with the names of several dialogues (such as "Nerinthus," "Gryllus, or on Rhetoric," "Menexenus," "Symposium," "the Lover," &c.); afterwards there are the names of apparently short treatises or monographs on separate subjects;[3] without any trace of that organic unity of each of the great branches of philosophy which we find in Aristotle as we know him. This organic unity has not been superinduced by the editorial labours of Andronicus, for we see by the openings of the *Metaphysics*, *Ethics*, *Politics*, and other existing works, taken in connection with their succeeding parts, that Aristotle conceived a grand and comprehensive plan for each main branch of philosophy and science; that he proposed to follow this out so as to produce in each case a complete whole, but that most of his multifarious designs were arrested by death, so that much that he has left bears the character of a mighty fragment. But the Peripatetic school seem to have abandoned his comprehensive views, and to have only followed him in that other side of his method which consisted in working out the details of special and subordinate questions. This tendency resulted in the production of small separate treatises and essays, and it is the names of such as these that are recorded in the catalogue. The Peripatetic school seem to have worked on a sort of co-operative principle. Aristotle, during his own lifetime, probably encouraged them to work up separate points for incorporation into his philosophy, and if so, they would have less scruple in affixing his name to works written after his death, but which they conceived to represent, or, perhaps, a little to improve upon, his views. Whatever may have been the literary morality of this procedure, we can hardly doubt that it existed as a fact. Even the works of Aristotle, as we possess them, show clear traces of it. Take, for instance, the four different ethical treatises which are found among these works. Of these the first is the *Nicomachean Ethics*,[4] the main bulk of which is the genuine writing of Aristotle. It is conceived on a comprehensive plan, and the beginning and end are complete, but the middle part was probably never written. The name of this treatise was, perhaps, given to it for the sake of distinguishing it from the other ethical works in the Peripatetic school library, the MS. of this having been to some extent revised and edited by Nicomachus, the son of Aristotle. The second is the *Eudemian Ethics*, a paraphrase of the work of Aristotle, written by Eudemus, one of his scholars, with a slight divergence in some points from the original doctrines. Three books from the *Eudemian* treatise, on Justice, on the Relation of the Intellect to Morality, and on Weakness of the Will, were afterwards incorporated by some editor into the *Nicomachean Ethics*, so that in modern times they have always formed part of both treatises, and their authorship has been much disputed.[5] The third is called the *Great Ethics*,[6] and is the work of a later Peripatetic; it is a *résumé* of morals, made up chiefly out of the work of Eudemus, but with some of its conclusions taken directly from that of Aristotle, and with some matter introduced from another source, perhaps the ethical writings of Theophrastus. The fourth is a little tract *On Virtues and Vices*, which is not even Aristotelian in doctrine, though it shows an acquaintance with the Aristotelian system. It is chiefly characterised by some small points of physiognomical observation, such as are found in the *characters* of Theophrastus. These four works well illustrate the growth of an ungenuine Aristotelian literature. We begin with a genuine work of Aristotle himself, though even into this a spurious element has been introduced; we go on to a paraphase, and then to the paraphrase of that paraphrase, we end with a light essay written for the sake of one or two observations on character which the writer had made, and yet all stands under the name of Aristotle.[7] This instance which we have before our eyes, and the proportion of the ungenuine to the genuine which it presents, may enable us to form a conception of the nature of those works, the 146 names of which make up the catalogue of Diogenes. Far be it from us to say that none of the works so enumerated were written by Aristotle himself, but probably much the greater portion of them were not written by him. And without denying that many works of Aristotle, and even some works by him of interest and value, have been lost, we may say with confidence that the "lost works"[8] of Aristotle were of no importance in comparison with what has been preserved,

[1] With the exception of "*Categories*, in one book," and "*On Interpretation*, in one book." "*Great Posterior Analytics*, in two books," may stand to the *Post. Anal.* of Aristotle as the *Great Ethics* do to *Eth. Nicomach.* Titze, Michelet, and other writers, have endeavoured to identify some of the monographs of the catalogue with *parts* of Aristotle's extant works, *e.g.*, works *On the Voluntary*, *On Friendship*, *On Pleasure*, with parts of *Eth. Nic.*; the book *On the Various Senses of Words*, with part of the *Metaphysics*, &c. But, as Grote says, vol. i. p. 61, note, "the identification is not convincing." In fact, the theory is untenable.

[2] Heitz, *Die Verlorenen Schriften des Aristoteles* (Leipsic, 1865), pp. 45–52; Grote, *Ar.*, vol. i. pp. 48, 49.

[3] *E.g.*, *On Suffering* (περὶ τοῦ πάσχειν), one book; *On Contraries*, one book; *On Science*, one book; *Feelings*, one book; *Art*, one book; *On Unproductiveness*, one book; *Signs of Storms*, one book; *Proverbs*, one book; *Select Dissections*, one book, &c.

[4] See Grant's *Ethics of Aristotle*, vol. i. essay 1.

[5] See Spengel, "Ueber die unter dem Namen des Aristoteles erhaltenen ethischen Schriften" (in *Abhandl. der Philos.-philo Klasse der K. Bay. Akad.*, 1841), and Grant's *Ethics*, l.c.

[6] This name may have been due to the vanity of the compiler. We have seen in the Catalogue of Diogenes the name *Great Posterior Analytics*. See above note 1.

[7] Whether all stood thus in the edition of Andronicus, or whether some of these works were added in subsequent editions, we have no means of knowing. If the former, Andronicus must have aimed at giving a collected body of Aristotelian doctrine, rather than an edition of Aristotle's own undoubted writings. We know that Andronicus pronounced the treatise *On Interpretation* to be spurious, and yet we find it in our edition of Aristotle.

[8] See above, note 1, and compare Valentine Rose, *Arist. Pseudepigraph.*, where the fragments are commented upon.

and that the greatest and most valuable of his achievements, incomplete as he left them, but subsequently edited to some extent and touched up, remain for us, and contain the essence of his thought.

In eight passages of the works which we possess under his name, there is a reference to "exoteric discourses" (ἐξωτερικοὶ λόγοι).[1] This phrase has attracted a wonderful amount of notice, and a whole literature[2] has been composed in support of the different meanings which have been attributed to it. But the question is now reduced to a very small one. The word "exoteric" suggests the opposite term "esoteric," in the sense of secret; and the writers of the later empire,[3] who were accustomed to the idea of mystical and hierophantic teachings, as professed by the neo Pythagorean and neo-Platonic schools, took up the notion that Aristotle had two forms of doctrine: the one "esoteric," —containing his real opinions, and confined to the circle of his initiated scholars,—the other "exoteric," containing superficial truth with which the profane vulgar might be put off and satisfied. After the Renaissance the idea of a double doctrine in Aristotle was exploded, and it was acknowledged that "exoteric" in the passages above mentioned is not opposed to "esoteric" or "secret," but denotes the external, non-philosophical, non-scientific treatment of a subject, as opposed to the strictly scientific treatment of it (οἰκεῖος λόγος). The only question, then, which remained is this,—Does Aristotle, when he refers to "the exoteric discourses," mean to refer directly to his own more popular writings, or does he make general reference to popular discussions on philosophical subjects, including not only his own and other people's popular writings, but also the ordinary debates and discussions on such subjects, rife enough in Athenian society, and, of course, unscientifically conducted? Powerful supporters are to be found for either view, and Bernays[4] especially, in an elegant and learned monograph, has endeavoured to prove that each of the passages in which "the exoteric discourses" are mentioned refers especially to some one of the lost dialogues of Aristotle, the character and contents of which Bernays seeks to gather from the scanty fragments of them preserved by the ancients. It appears to us, however, that this attempt is infelicitous in its results, and that there are many reasons for thinking that Aristotle did not appeal to his own popular writings for conclusions in philosophy, but merely said, occasionally, that the popular views on some questions of philosophy were sufficiently accurate and might be accepted.

Of the works that have come down to us as Aristotle's, the following are undoubtedly genuine:—1. *Topics.* 2. *Prior Analytics.* 3. *Posterior Analytics.* 4. *On Sophistical Refutations.* 5. *Art of Rhetoric.* 6. *Nicomachean Ethics.*[5] 7. *Politics.* 8. *On the Art of Poetry.* 9. *A Physical Discourse.*[6] 10. *On the Heavens.* 11. *On Generation and Destruction.* 12. *Meteorologics.* 13. *Researches*[7] *about Animals.* 14. *On Soul.* 15. Appendices to the preceding work—(a.) *On Sense and Sensible Things.* (b.) *On Memory and Recollection.* (c.) *On Sleep and Waking.* (d.) *On Dreams and Prophesying in Sleep.* (e.) *On Longevity and Shortlivedness.* (f.) *On Youth and Old Age.* (g.) *On Life and Death.* (h.) *On Respiration.* 16. *On Parts of Animals.* 17. *On Locomotion of Animals.* 18. *On Generation of Animals.* 19. *The Metaphysics.*[8]

The following works attributed to Aristotle are almost undoubtedly spurious:—1. *On Rhetoric; addressed to Alexander.* 2. *Eudemian Ethics.* 3. *Great Ethics.* 4. *On Virtues and Vices.* 5. *Economics.* 6. *On Colours.* 7. *Physiognomics.* 8. *On Plants.* 9. *On Strange Statements.* 10. *Mechanics.* 11. *On Indivisible Lines.* 12. *On Xenophanes, Zeno, and Gorgias.* 13. *On the Universe; addressed to Alexander.* 14. *On Motion of Animals.* 15. *On Breath.* 16. *Problems.*[9]

The following two works are of doubtful genuineness:— 1. *Categories;* 2. *On Interpretation.* None, however, of the so-called works of Aristotle have been more commented on or studied than these two. They stand as the two first of the six logical treatises, or *Organon,*[10] of Aristotle, and thus had particular attention directed to them in the Middle Ages,[11] when the logical writings were solely or chiefly studied. The separate way in which these two short treatises are written, without any preface or other connection with the main body of analytic (*i.e.,* demonstrative logic), seems peculiar and unlike Aristotle. We may safely say that they were not composed at the same time as the *Analytics,* to which they have been prefixed. Either they were earlier works written before the time of Aristotle's final residence in Athens, or else they are the productions of unknown and probably later Peripatetics. There is an important difference of doctrine between the *Categories* and works known to be by Aristotle. For in the *Categories*[12] it is laid down that "the first essence" (πρώτη οὐσία) is the individual, and that the class, genius, or species, is a "second essence," that is, that it has an existence derived from and secondary to the individuals of which it is composed. In the *Metaphysics,*[13] on the other hand, we are told that the "first essences" are universals, genera, or species. The former is the doctrine of nominalism, the

[1] See Bonitz's Index, *sub voce,* for the references.

[2] All recent German commentators have touched upon the question. Most of the leading opinions upon it have been referred to by Grote, *Ar.,* vol. i. chapter 2. See also Grant's *Ethics,* vol. i. appendix B.

[3] *E.g.,* Aulus Gellius, xx. 4.

[4] *Die Dialoge des Aristoteles, in ihrem Verhältniss zu seinen übrigen Werken,* von Jacob Bernays (Berlin, 1863).

[5] With the exception of books v. vi. vii. See Grant's *Ethics.*

[6] The title cannot with certainty be attributed to Aristotle. In some MSS. it stands as Φυσικὴ ἀκρόασις, ἢ περὶ ἀρχῶν. Ἀκρόασις indicated a scientific, as opposed to a popular, lecture or discourse.

[7] Περὶ τὰ ζῷα ἱστορίαι. Ἱστορία means a "record of investigations." Aristotle sometimes uses the word simply in the sense of "history," but it was a mistranslation to call his work on animals *Historia Animalium.* Out of this the term "Natural History" has grown into modern usage.

[8] Τὰ μετὰ τὰ φυσικά. The name merely means "The writings which come after the Physics." It was given not by Aristotle himself, but by his posthumous editors. Out of it the name of "Metaphysics" grew for that science, which Aristotle himself called "First Philosophy," "Wisdom," or "Theology." See Bonitz, *Metaphysica* (Bonn, 1849), 2d part, pp. 3–6. The work is composite, with a spurious admixture. See below.

[9] An interesting paper by Karl Prantl (*Abhandl. der Philosoph.-philol. Klasse der K. Bayer-Akad.* 1852) discusses the thirty-eight books of "Problems" attributed to Aristotle, in which questions on all conceivable subjects are proposed and answered. Prantl shows the contradictory and often anti-Aristotelian character of many of the answers given. His conclusion is that, though Aristotle certainly set the example of starting and endeavouring to answer "problems" as a contribution to science, and though there may be a small nucleus of Aristotle's own writing here, yet the great mass of the contents of these books is the production of the Peripatetic school, after the time of Aristotle. The *Problems,* among other characteristics, exhibit strongly the materialistic tendencies of the Peripatetics.

[10] This name is said to have been given to the collective logical treatises by Andronicus, to indicate that they were not a *part* of philosophy, being neither "practical," "productive," nor "speculative," but that they contained the organ or *instrument* of philosophy, in the theory of reasoning. Aristotle himself uses the phrase about Dialectic, —οὐ μικρὸν ὄργανον πρὸς γνῶσιν, *Topics,* viii. 14, 3. See Grote, vol. i. p. 78, and Brandis, *Scholia,* p. 140, a. 47, p. 259, a. 48.

[11] During the 9th, 10th, and 11th centuries, a war was furiously waged between Peripatetics and Platonists, *i.e.,* between Nominalists and Realists. But all this time the Peripatetic library of Western Europe seems to have been restricted to Latin translations (by Boëthius) of the *Categories* and *Interpretations,* together with a Latin translation of Porphyry's *Introduction* to the *Categories.* The whole question of Nominalism and Realism was started by Porphyry's *Introduction.* See Hauréau, *Histoire de la Philosophie scolastique,* 2d. ed., i. (Paris, 1874).

[12] *Categ.,* v. 1.

[13] *Metaph.,* vi. 7, 4; 11, 18, &c.

latter that of realism. If Aristotle wrote the *Categories* long prior to the *Metaphysics* (which, if he wrote the book at all, he must have done), then we must suppose that at the outset of his independent career as a philosopher he began with an exteme reaction against the realism of Plato, and that in later life he returned from this to approximation towards Plato's views. The other hypothesis possible is, that a bias towards physical research and experiment and the collection of facts naturally led the Peripatetic school in the direction of nominalism, till at last some member of that school gave expression to this tendency by writing this little treatise called the *Categories*, derived, indeed, mainly from Aristotle's doctrines and teaching, but laying it down far more dogmatically than he would have done that the concrete individual is the unit of knowledge.[1] Considerations of style are insufficient to enable us to pronounce in favour of one hypothesis or the other. For the school of Aristotle copied, and obtained a close resemblance to, their master's style. But whether this treatise was written by Aristotle or not, it has had a great influence. It led the world not only to think that Aristotle was a decided nominalist, but also that he classified existence under ten "categories" or *summa genera*. But this doctrine would hardly have been gathered from the undoubted writings of Aristotle. In his logical researches he naturally much busied himself with the different relations which the predicate of a sentence can bear to the subject. And in the earliest of his extant works (*Topics*, i. 9), he enumerates "the classes of predications" (τὰ γένη τῶν κατηγοριῶν) as ten,[2] and gives the same list as that given in the *Categories;* but the object of this enumeration is merely logical, in order to show what must be meant by the word "same" when it is predicated of any subject. Elsewhere, Aristotle does not adhere to the number ten; he mentions[3] in one place eight, in another six, in another five, in another four, and very often three, κατηγορίαι, or modes of predication. There is no trace of his mapping out to himself the "Cosmos" under the divisions of ten or any other number of categories. In *De Anima*, i. 1, 7, he says that "it will be necessary, in discussing the soul, to define which of the categories it belongs to, and again whether it is a potentiality or an actuality." But, having said this, Aristotle does not further advert to the categories, while he obtains his whole definition of the soul by considering it as an "actuality." In fact, "Potentiality and Actuality," or "Matter, Form, and Deprivation," were the ontological "categories" of Aristotle, far rather than that logical list of ten kinds of predication, on which mediæval and modern thinkers have laid so much stress. That they have done so is perhaps mainly due to this little work called the *Categories*, which (whether it was an early production of Aristotle himself, or was the compilation of some peripatetic follower) has had undue prominence given to it in relation to Aristotle's system. It has caused Aristotle to be misunderstood, severely criticised, and sneered at. At the same time it has given an impulse to philosophers, from the Stoics[4] to Kant and J. S. Mill, to endeavour to frame an ultimate classification of all that exists or can be thought.

The treatise *On Interpretation* (*i.e.*, the expression of the thoughts in language) was pronounced spurious by Andronicus Rhodius. This we learn from some interesting discussions given by Brandis in his *Scholia* to Aristotle, p. 97. The opposite view seems to have been taken by Ammonius, Alexander of Aphrodisias, and Boethius. The arguments, however, both *pro* and *con* are inconclusive. Whether this treatise was by Aristotle or not, it contains a very full statement of the Peripatetic logic, so far as the Proposition, with its various characteristics, is concerned. It quotes the treatise *On Soul*,[5] and, therefore, was written later than Aristotle's undoubted logical works, more probably by one of his school than by himself. It is the source of much of the matter of the elementary logic of modern times, and contains many distinctions, at one time novel, but essential to clearness of thought,—on Affirmation and Negation, the Different Ways in which the Negative Particle may be used, Contrary and Contradictory Opposition, the Truth or Falsehood of Propositions, Modality of Assertion, &c. Grote's[6] account of the contents of this work has opened it for the English reader.

We now come to the undoubted works of Aristotle. These, as before said, were probably all actually written during his last thirteen years, but they must have, to a great extent, been prepared during the previous course of his life, during which he had thought out the divisions, the method, and the terminology of philosophy and science. The order of composition of these works, so far as it can be determined at all, must be determined by internal evidence. This internal evidence does not consist merely in references from one book to another (for these are not always reliable—in some cases they are almost certainly interpolated), but still more in comparison of the thought in different books, and the various degrees of maturity exhibited by the same conception occurring in different books. For instance, in the first chapter of the *Analytics* the *Topics* are referred to; therefore, either the *Topics* were written first, or else this reference is spurious. But the doctrine of the syllogism is worked out with far more precision in the *Analytics* than in the *Topics*, therefore the former hypothesis must be accepted. A similar combination of verbal and real internal evidence would seem to show[7] that the *Topics* (with the exception of the eighth book) were first written of all the extant works of Aristotle, next the *Analytics* (*Prior* and *Posterior*), next the eighth book of the *Topics*, next the *Rhetoric*, and then the *Sophistical Refutations*, and the same canon of criticism would lead us to believe that Aristotle next in order wrote the *Nicomachean Ethics*, and then (perhaps after an interval) the *Politics* and the treatise on *Poetry*. The above order of books may be considered as established with tolerable certainty. But the reasons seem rather far fetched which induce Valentine Rose[8] to lay down that Aristotle, in his 55th year, commenced a second series of writings with the *Physical Lectures*, which were followed by the works *On the Heavens*, *On Generation and Destruction*, and the *Meteorologics;* and afterwards a third series, with the *Researches about Animals*, followed by the work *On Soul*, and his other psycholo-

[1] In *De An.*, i. 1, 7, there is an apparent assertion of Nominalism τὸ δὲ ζῷον τὸ καθόλου ἤτοι οὐθέν ἐστιν ἢ ὕστερον), but Torstrik points out (Ar. *De An.*, p. 113) that Aristotle is here referring to the views of others, not stating his own.

[2] Substance, quantity, quality, relation, place, time, posture (κεῖσθαι), habit (or dress, ἔχειν), action, passion. Such a list would form a strange classification of all things in the universe. Some of these categories have an easily traceable affinity with the parts of speech, thus showing the relation between logic and grammar. But this is not their only source. As the individual man may sometimes be the subject of predication, his "dress" and "posture" were admitted among the classes of categories. *Habit*, from the Latinised form of ἔχειν, survives in modern languages, *e.g.*, to be "habited" is to be dressed, a lady's riding-"habit," *habit* (in French) = a coat.

[3] See Bonitz's Index to Aristotle, in the Berlin edition (1870), *sub voce* κατηγορίαι. where the references are given.

[4] See Grote's *Aristotle*, vol. i. p. 144. Trendelenburg, *Kategorienlehre*.

[5] *De Interpret.*, i. 3.

[6] *Ar.*, vol. i. pp. 155–199.

[7] See *Aristotle on Fallacies; or, the Sophistici Elenchi, with a Translation and Notes*, by E. Poste (London, 1866), page 103, note 4.

[8] *Arist. Pseudepigraph.* p. 3; *cf. De Ar. Lib. Ord. et Auct.*, p. 204, *sqq.*

gical and physiological writings. Granting that the work *On Soul* was written later than most of the other works of Aristotle, it seems to us safest to say that, in all probability, many of his works were simultaneously "on the stocks" up to the time of his death, and this makes their precise order difficult to assign.

We shall now proceed briefly to indicate, we cannot attempt more, the leading features of the contents of Aristotle's undoubted works, as they have come down to us. The books of the *Organon* (see note 10, p. 514) form together a connected whole. Of these the *Topics* appear to have been written first, but the sequence of thought between the books is that the *Prior Analytics* stand first, as containing the theory of the syllogism, a necessary preliminary to reasoning of all kinds; and then growing out of this root we have two divergent treatises: the *Posterior Analytics*, on demonstrative reasoning, or the logic of science; and the *Topics*, on dialectic, or the art of discussing subjects in which demonstration is impossible. For the details contained in these treatises we must refer the reader to Grote's (see note 3, p. 511) generally[1] excellent account. The matter of the *Prior Analytics* has become the common property of all modern books on logic. And scarcely anything[2] has had to be detracted from or added to what Aristotle wrote upon the syllogism. His was the proud distinction of having discovered and fully drawn out the laws under which the mind acts in deductive reasoning. That in deduction the mind proceeds from some universal proposition, and how it proceeds—these were the first things which Aristotle had to tell the world. The modern attempts to impugn these principles, and to show that the mind does not reason from universals, are a failure. They confuse inductive with deductive reasoning, and ignore both the case of a science like geometry, which is all deduction, and also the numerous cases where the mind, having unduly assumed a universal principle, rests in it afterwards and makes deductive applications of it. Granting that there is such a thing as deductive reasoning (and surely life is full of it), it is a great matter to have the laws of this so clearly ascertained, that about the process itself there can no longer be doubt, and any flaw in the process can instantly be detected. This was the service that Aristotle rendered in drawing out the laws of the syllogism. Men, of course, reasoned deductively by means of "the syllogism" before Aristotle had appropriated this name[3] to indicate the formula for deductive reasoning, and before he had discovered and stated the laws under which the mind acts in deductive reasoning. They did so, however, unconsciously and by instinct, just as men wrote and talked grammatically before any idea of a science or an art of grammar existed. In Aristotle deductive reasoning became conscious of itself. Unfortunately for his reputation, this merely preliminary part of his labours, in which the principles and rules of syllogistic inference were drawn out, occupied almost exclusively the minds of thinkers in the Middle Ages. The errors of modern Aristotelians were imputed to Aristotle, and hence arose the notion that Aristotle explained nature by means of the syllogism. Nothing could be further from the truth; Aristotle was not only one of the most inquiring and encyclopædical, but also one of the most thoroughly sensible, of all writers, and no one would have repudiated more strongly than himself the idea that the formula of the syllogism can be used to test or explain anything beyond the process of reasoning from certain premisses possessed or assumed, and he is never tired of telling us that the only means of obtaining premisses is by experience and observation of facts. While discussing the syllogism itself, he says,[4]—"This is the case in astronomy, which is based on the observation of astronomical phenomena, and it is the case with every branch of science or art. When the facts in each branch are brought together, it will be the province of the logician to set out the demonstrations in a manner clear and fit for use." It is true that Aristotle did nothing towards the logic of Induction, that is to say, towards elucidating the methods by which the mind legitimately arrives at general facts or laws of nature. This was left to be worked out by the moderns, by Galileo, and Bacon, and Whewell, and J. S. Mill. Aristotle, indeed, made a cursory attempt[5] to put the inductive process into syllogistic form, thus:—"A, B, and C draw iron; A, B, and C are (or represent) all magnets; therefore all magnets draw iron." It is clear that this syllogism does not explain the inductive process, it only records in the minor premiss a previous induction. The real question is, do A, B, and C here properly represent all magnets? To answer this, verification would be required. The syllogism, then, does not explain the inductive process, but only calls attention to what is implied in it. Leaving unattempted the question how the minor premiss in the Inductive syllogism is to be obtained, and how tested,—what Aristotle really works out is the logic of Deductive Science (in the *Post. Analytics*) and the logic of Deductive Probability (in the *Topics*). Under the former head he draws the ideal of a perfect science, and recounts the conditions necessary to its existence. Interesting discussions[6] are introduced by him on Causation, Hypotheses, Axioms, Ultimate Laws, Definition, and the Apprehension of Primary Truths. In all this there is little which might not be accepted by a man of science of the present day. The *Topics*, on the other hand, treat of a subject which possesses rather an antiquarian than a living interest, namely, the conduct and regulation of Dialectic as practised in Athenian society.

In the Middle Ages men made a business[7] of propounding, attacking, and defending theses, but this was a lame imitation of the spontaneous disputations of lively Athens, and from its utter profitlessness has long fallen into desuetude. The *Dialogues* of Plato may serve to give us an idea of a society possessed with an insatiate appetite for discussion and controversy, and always delighted to take part in, or assist at, an intellectual game or fencing match between two opponents. And it is the object of the *Topics* of Aristotle to lay down the rules for the game of Dialectic, and to establish it as a highly salubrious and necessary intellectual art. Dialectic, properly speaking, is discussion with a view to probable truth, and so far is worthy of the attention of a philosopher. But it may easily emerge into Eristic, which is discussion with a view to victory. Even under this aspect Aristotle does not think it ought to be neglected. Drawing on his vast and methodised observation of life, he gives rules and hints for the conduct of Eristic. The name *Topics* means "On Common-places;" the chief contents of this treatise consist of "heads" useful in arguing for or against a proposition. All this is wearisome to read in eight books. Much more readable are the *Sophistical Refutations*, which form a conclusion to the

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[1] See some criticisms upon Grote's account of the *Organon*, *Edinburgh Review*, No. 278, pp. 546–9.

[2] "Both Kant and Hegel acknowledge that from the time of Aristotle to their own age, logic had made no progress" (Stahr, in Smith's *Dict of Greek and Roman Biography*). The fourth figure was added to the syllogism (uselessly); and Sir W. Hamilton introduced the quantification of the predicate. *Voilà tout.*

[3] In Plato συλλογισμός meant a "computation" generally. By Aristotle a special and technical meaning was given to the word.

[4] *Analyt. Prior*, i. 30, 3.

[5] *Ibid.*, ii. 23, 2–4. See a criticism on this in Professor Bain's *Inductive Logic* (London, 1870), chap. i. § 2.

[6] See *The Logic of Science; a Translation of the Post Analyt. of Aristotle, with Notes and Introduction*, by E. Poste (Oxford, 1850

[7] See, *e.g.*, the achievements, in this way, attributed to "The admirable Crichton," so late as about 1580 A.D.

Topics. The intellectual tendencies of Athenian society had given scope to a class, which gradually arose, of professional and paid disputants, or professors and teachers of the art of controversy. This professional class, under the name "Sophists," got a bad name in antiquity,[1] and Aristotle treats them disparagingly as mere charlatans. Thus, while Eristic is arguing for victory, he describes Sophistry as arguing for gain. The Sophist, according to Aristotle, tried to refute by means of fallacy, in order that he might be thought clever, and so get pupils and make money. Aristotle collects, classifies, and exposes these fallacious refutations; and so exhaustive is he in one short book, that the human mind has hardly invented any fallacious argument since which may not be brought under some head of the *Sophistical Refutations.* The theory of fallacy was a proper wind up to the *Organon*, as containing the theory of reasoning in all its branches. Aristotle concludes this part of his system with words full of a just pride in his achievements. It is almost[2] the only place in his writings in which any reference to his own personality can be traced. He says,[3] "In regard to the process of syllogising I found positively nothing said before me; I had to work it out for myself by long and laborious research."

Greece at this time was full of Dialectic and Rhetoric, and the two were closely connected; and it was quite natural for Aristotle (whose aim was to take up and carry out to perfection all that the intellect of his countrymen had assayed), next in order after Logic and Dialectic, to deal with Rhetoric. We have already seen (p. 515) that he probably wrote his *Rhetoric* immediately after the main books of the *Organon*, but before the *Sophistical Refutations.* But a distinction must here be added, for it seems pretty plain that, after he had written the two first books of his *Rhetoric*, there was an interval, and that he did not add on the third book[4] for some time afterwards. Many treatises on the same subject had previously been composed, an account of which has been given by Spengel in his *Artium Scriptores*,[5] or *Writers of Arts of Rhetoric*, a work professing to replace, as far as might be, the lost book called Συναγωγὴ τεχνῶν, attributed, rightly or wrongly, to Aristotle. It is a curious fact that one of these earlier systems of Rhetoric has been preserved for us among the works of Aristotle, having been long attributed to him on account of a spurious letter prefixed to it, and purporting to be from Aristotle to his former pupil, Alexander the Great. Hence the treatise got its name of *Rhetoric, addressed to Alexander.* But the investigations of scholars[6] show conclusively that this work could not have been written by Aristotle, that with great probability it may be attributed to Anaximenes, the historian and rhetorician, and that it was written between 340 and 330 B.C., only a few years before the composition of Aristotle's treatise. The work itself is representative of the school of the Sophistical Rhetoricians, and abounds in those tricks of procedure[7] which gained their bad name for the Sophists, and which drew forth the reprobation both of Plato and Aristotle. Plato,[8] indeed, identified rhetoric with trickery, and refused to countenance the study of it. Aristotle, who often exhibits less moral earnestness, but greater intellectual breadth than Plato, thought it necessary that this, like other intellectual fields, should be exploited. He thought,[9] amongst other reasons, that unless this were done, truth and justice would sometimes be left deprived of proper representation and support. He repudiates the practice of the earlier rhetoricians, who had based their "Arts" entirely on appeals to the passions; and in a large and manly way he proceeds to develop all the various points which an orator must keep in view, and to indicate all the kinds of knowledge which he must acquire in order to be master of his profession. In so doing, Aristotle has displayed his extraordinary power of exhausting any subject to which he gave his mind. Hardly anything of importance on the subject of Rhetoric has been added to what he wrote. Take the most powerful and subtle specimens of modern oratory,—for instance, Shakspeare's speech of Mark Antony over the body of Cæsar,—and you will find the *rationale* of every telling point set forth by anticipation in the *Rhetoric* of Aristotle. His work contains some few Greek technicalities,—for instance, the doctrine of the Enthymeme,[10] or rhetorical syllogism,—on the precise nature of which commentators are not agreed. But the main bulk of the treatise consists of a rich collection of remarks on human nature and life, applicable to all periods. In the wisdom and knowledge of the world which it exhibits, Aristotle's *Rhetoric* might be compared with the *Essays* of Lord Bacon. And it might be compared with them also in this respect, that a bad and Machiavelian use might certainly be made of some of the suggestions which it contains, though Aristotle professes only to give them to be employed in the interest of truth and justice. The third book, on Style, is excellent so far as it goes, but it is less exhaustive and universally applicable than the former books, which treat of the matter of speeches.

Rhetoric was said by Aristotle[11] to be allied, on the one hand to Dialectic, on the other hand to Ethics; and, accordingly, he seems to have gone next to the exploration of the latter subject. At all events he wrote the *Nicomachean Ethics* later than the *Rhetoric.* When we compare the two treatises together we are struck with the growth of mind which has taken place between them. The *Rhetoric* is full of ethical definitions of happiness, pleasure, virtue, friendship, and the like. But in the *Ethics* these are all remodelled, and made far deeper and more exact.

The *Nicomachean Ethics* was, perhaps, the first of Aristotle's extant works which entered upon the matter of knowledge, as distinct from the theory of the reasonings by which knowledge is obtained, and from the theory of the statement by which knowledge may be best set forth. The moral system herein contained differs from the ethics of Plato, *first*, in its more accurate psychological analysis, in distinguishing the will from the intellect, and in making virtue to consist in a formed state of the will, rather than

[1] A controversy on the justice of the reproaches of Xenophon, Plato, Aristotle, &c., against the Sophists, was initiated by Grote in vol. viii. of his *History of Greece*, and continued in his subsequent works on Plato and Aristotle. On the other side, see Prof. Jowett's *Dialogues of Plato translated* (vol. iii. p. 449, *sqq.*)

[2] Another exception is in *Eth. Nic.* i. 6, where he refers to the fact of Plato having been his friend.

[3] Mr Poste, in his *Aristotle on Fallacies*, p. 95, translates the words, περὶ τοῦ συλλογίζεσθαι, as if they meant "on dialectic" generally. But the general opinion is, that Aristotle was here referring to his having worked out the forms of the syllogism.

[4] Book iii. opens with the same words with which book ii. had concluded. This looks as if Aristotle had returned to the subject after an interval, having forgotten the exact form of what he had before written. This book (c. i. § 10) quotes the treatise *On Poetry*, which must have been written in the meantime.

[5] L. Spengel, Συναγωγὴ τεχνῶν, *sive Artium Scriptores*, &c. (Stuttgart, 1828).

[6] See *An Introduction to Aristotle's Rhetoric*, by E. M. Cope, &c. (London, 1867), pp. 401-414, where the evidence on this point is briefly summed up.

[7] *Ib.*, p. 457, *sqq.*

[8] *Gorgias*, p. 465, &c.

[9] *Rhet.*, i. 1, 12.

[10] The Enthymeme is a rhetorical (*i.e.*, non-demonstrative) syllogism. Its premisses are "signs" and "probabilities." Its province is to show likelihood, not certainty. The question with scholars is, whether it is essential to the Enthymeme that one of its premisses should be left unexpressed. See Sir W. Hamilton, *Lectures on Logic*, vol. i. p. 386, *sqq.*; Mr Cope's *Introduction*, p. 103, *sqq.*, and Grote's *Ar.*, vol. i. p. 291, *sqq.*

[11] *Rhet.*, i. 2, 7.

in wise insight; *secondly*, in being disconnected from any assumption, or theory, of the immortality of the soul,—from all that we should call "Faith." Whether or not Aristotle denied a future life is another question to be considered later. But at all events he constructed ethics independently of such a doctrine. On the other hand, his system differs from the modern point of view, in that he asks, not, What is right? what is our duty? or what is the ground of moral obligation? but, What is the chief good for man? In order to answer this question, he calls in the aid of his metaphysical forms of thought,[1] such as the doctrine of the Four Causes, and of Actuality and Potentiality. From these he deduces that the chief good for man must consist in something which is an End in itself, and that it must be found in the actuality of the human powers. It is a weak point in the system that, instead of at once recognising the law of moral obligation as the deepest thing in man, it introduces[2] the idea of virtue and morality in a dry logical way, saying that the chief good for man must be the actuality of his powers according to their own proper law of excellence (κατὰ τὴν οἰκείαν ἀρετήν). Having in this colourless and neutral way brought in the term ἀρετή = excellence or virtue, Aristotle divides it, in relation to man, into moral and intellectual. The part of his work which treated of intellectual excellence is lost, or was left unwritten. His discussion on moral excellence or virtue is full of interest. Its salient points are—*first*, the doctrine of the formation of habits or states of mind; *second*, the doctrine of "the mean," as the essential determinator of virtue; *third*, a brilliant analysis of the qualities and characters which were reckoned either as cardinal or secondary virtues in Greece. On Aristotle's doctrine of "the mean" a word must be said. Objection has been made to it in modern times, on the ground that it sets up a merely quantitative difference between virtue and vice. But Aristotle's point of view was thoroughly Greek, it was based on the analogy of Art. When we speak of actions being "right" or "wrong" the Greeks spoke of them as being "beautiful" (καλά) or "ugly" (αἰσχρά). In all Greek art and literature the great aim was to avoid the "too much" and the "too little," and in this way to attain perfection. Aristotle only followed Greek feeling, and the lead of Plato,[3] in applying the same idea to morals. It might, indeed, be urged that this idea of "the mean," of "neither too much nor too little," is a negative and merely regulative conception, and that it does not suffice to explain the moral beauty of the phenomena which Aristotle had in view. For instance, he describes the brave man[4] consciously meeting death for a worthy object, and consciously sacrificing life and happiness, and much that he holds dear, because he feels that it is "beautiful" to do so. But, so far as we can learn from Aristotle, the "beauty" here consists in exhibiting neither too much nor too little boldness, but the exact mean. In this there is obviously something inadequate; but the fault seems to lie, not so much in laying down "the mean" as the law of beauty, but rather in not going beyond the identification of the morally admirable with the beautiful. This leaves each moral action, or course of conduct, to be judged of as a work of art. The proportions in each case are relative, but he who can judge aright will feel the harmony or otherwise of the details. With this artistic and somewhat superficial conception of morality, Aristotle is, in his own way, an intuitionist. He thinks[5] that we have a sense (αἴσθησις) for moral beauty, but that this sense exists in perfection in the wise man (φρόνιμος), to whom in all cases must be the ultimate appeal.

But the whole question of man's moral nature is really subsidiary in the *Ethics* of Aristotle. His question is, What is the chief good for man? and the answer to this question is, It must consist in the evocation and actuality of man's highest faculty, namely, the Reason. Thus, the highest happiness is to be found in contemplation and speculative thought; the joys of the philosopher are beyond compare. A satisfaction of an inferior kind is to be found in the exercise of the moral virtues. Such is, in brief, the view which Aristotle gives of human life. He excludes religion from his consideration of the subject, though his disciple, Eudemus,[6] in restating his conclusions, tries to introduce it. The same question, What is the *summum bonum* for man? has been answered in somewhat similar terms, in modern times, by Spinoza.[7]

The concluding paragraphs of the *Nicomachean Ethics* form the prelude and introduction to the *Politics* of Aristotle. Neither virtue nor happiness,[8] he says, can be attained by the individual separately. Moral development and the realisation of our powers (ἐνέργεια) require as external conditions a settled community, social habits, the restraint and protection of laws, and a wisely-regulated system of public education. Man is by nature a political creature; he cannot isolate himself without becoming either less or more than man (ἢ θηρίον ἢ θεός). Thus the state is a prime necessity to man, and, indeed, the state is prior in idea to the individual, that is to say, the normal conception of man is of man in a state of civilisation, and this implies beforehand the conception of a state. On these grounds Aristotle went on from his *Ethics* to the composition of his *Politics*. Some little time,[9] however, may have elapsed between the two works. This is suggested by the mature and free handling given to ethical questions when they occur in the *Politics*. Aristotle, with his usual tendency to seek a solid basis of experiences for his theories, may, in this interval, have been engaged in making that remarkable collection called the *Constitutions* (Πολιτεῖαι), which, according to Diogenes Laertius (v. 27), contained a description and history of the constitutions, manners, and usages of 158 states, and of which numerous fragments[10] remain. However this may be, the *Politics*, as we possess them, are full of learning and information. After a preliminary dissertation on the family as a unit in the state, they give a critical history of previous philosophical theories of politics, and an examination of some of the chief existing constitutional systems, before proceeding to the statement of Aristotle's own view. The treatise is unfinished; in Bekker's edition it breaks off in the middle of Aristotle's theory of education (book viii.) Some have thought that this unfinished book was put last by some editor because it was unfinished, but that it originally stood earlier in the treatise, and that the commonly received order of the books should be transposed as follows:—i. ii. iii. vii. viii. iv. vi. v. It is forcibly argued[11] that a better

[1] See Grant's *Ethics*, vol. i. essay 4

[2] *Eth. Nic.*, i. 7, 15.

[3] Plato's term for the law of the beautiful was μετριότης. See *Philebus*, pp. 23-27, and Grant's *Ethics*, essay 4.

[4] *Eth. Nic.*, iii. 9, 4

[5] See *Politics*, i. 2, 12.

[6] See Fritzschius, *Eudemi Rhodii Ethica* (Ratisbon, 1851), p. 40, note, p. 261, note; and Grant's *Ethics*, essay 1.

[7] *De Intellectus Emendatione*, ii. 13, 14. The highest good (says Spinoza) is to arrive at a state consisting in knowledge of the union which the mind has with the whole of nature, and to be able to enjoy that state in common with other individuals.

[8] *Eth. Nic.*, x. 10, 8-23; *Pol.*, i. 2, 8, 9.

[9] Spengel thinks that "the *Politics* were written long after the *Ethics*."

[10] These, as collected and annotated by C. F. Neumann, are given in Bekker's Oxford edition of Aristotle.

[11] See M. Barthélemy St Hilaire's *Politique d'Aristotle* (Paris, 1837); Spengel, "Ueber die Pol. des Ar." (*Abhand. der Bayerisch. Akad.*, 1849); Nickes, *De Arist. Polit. Lib.* (Bonn, 1851); and Mr Congreve's *Pol. of Ar.* (London, 1855, 1874).

logical order for the subject matter of the entire treatise is thus provided; book i. being preliminary on the family, book ii. being critical of previous theories and existing constitutions, books iii. vii. viii. giving Aristotle's own conception of an ideal state (unfortunately not concluded in the most interesting part of all), books iv. vi. v. forming a return from the ideal point of view to practical statesmanship, and suggesting remedies for the different evils apparent in the actual Governments of Greece. Suffice it, however, to say that the *Politics* of Aristotle have come down to us in a fragmentary condition, not carrying out all that their author had intended, and probably never having received his last hand. The contents of this work are interesting, *first*, from an antiquarian point of view, as throwing a flood of light on Grecian history; *secondly*, from the knowledge of human nature and the wise remarks applicable to all times with which they abound. On the other hand, Aristotle's considerations are too much confined to Greek states, that is, to states on an extremely small scale, to allow of his political theories being very useful in modern times. Owing to this his *Politics* have been comparatively little studied. It is said[1] that in the Italian republics, from their resemblance to the Greek states, more attention than elsewhere was paid to this treatise. Aristotle had no political ties; he lived at Athens as a *metic*, or foreigner, without the rights or duties of a citizen, and thus he was in a position to write, with the utmost impartiality, of political questions. But his statesmanship does not appear to have extended to what we should call the "balance of power," by which national existence might be preserved and guaranteed. He limited his view to the well-being of each little state within itself, though he probably would not have objected to, and perhaps even contemplated, the hegemony of Macedonia, provided that under this each Greek city were left to carry on its own civic life.

His ideal state contrasts favourably, from a scientific point of view, with that of Plato. For while giving, as we have seen above, great and predominant weight to the idea of the state, he refuses to allow the individual and the family to be absorbed by the state. He thus resists all approaches to that communism[2] which was carried to so great extravagance in the *Republic* of Plato. The form of government which, ideally speaking, he prefers, is a wise monarchy or aristocracy,—some government, in short, in which neither wealth nor numbers shall be permitted to determine everything. In some points it must be confessed that he exhibits a narrow and conservative spirit, and a belief in the divine right of things as they are, which puts him at a disadvantage in comparison either with Plato or with modern views. Thus, despite counter opinions in his own day, he maintains the institution of slavery as based on nature, and even lays it down[3] that it is justifiable to make war upon and reduce to slavery those races who were evidently intended by nature to be subject. In accordance with his physiological system, he treats woman[4] as stunted man, fixed by nature in a position of inferiority; and, therefore, he resists Plato's proposals for the emancipation and improved education of women. And by a third misapplication of his favourite conception of "nature," he denounces interest[5] as unnatural, money being a mere instrument of exchange, whereas interest unnaturally increases it. These specimens of backwardness of thought all occur in the first book of the *Politics*, and may serve to show how much "Truth is the daughter of Time," and into what weaknesses the strongest individual minds may fall on questions not yet sufficiently ventilated and sifted by time. From his unfinished theory of education[6] in the eighth book of the *Politics*, Aristotle was led on to the composition of his work *On Poetry*. This also is a fragment, and while promising[7] to treat of tragedy, comedy, and epic poetry, it treats only of tragedy, adding a few brief remarks on epic poetry, and omitting comedy altogether. Aristotle, when he wrote it, had not yet written the third book of his *Rhetoric*,[8] and he had not yet got the division of the two subjects clear in his mind; for he introduces into his fragment *On Poetry* observations on style, and even on grammar, which would have been more appropriate elsewhere.

His account of tragedy is a profound piece of æsthetic philosophy. By implication he defends tragedy against Plato, who had wished to banish the drama from his ideal republic, as tending to make men unmanly. In his celebrated definition of tragedy,[9] Aristotle says that, "by pity and fear, it effects the purification of such feelings." On the exact meaning of these terms a lively discussion[10] has taken place in Germany. The question is, whether "purification" (κάθαρσις) has a moral significance, such as was associated with the term in the Greek "mysteries," or whether it is a purely medical metaphor, and means simply "purging." In the *Politics* (viii. 7, 3) Aristotle has used the same term (κάθαρσις) in reference to the effect of certain kinds of music, and had promised to give a fuller explanation of it in his treatise *On Poetry*; but this promise is unfulfilled, and we have rather to go back to the *Politics*[11] as affording most light on the subject. The result of the discussion seems to be that κάθαρσις is a medical term, and that Aristotle's meaning is that tragedy, by causing the feelings of pity and fear to "operate" pleasurably, relieves[12] the moral nature of a certain burden. We must regret, however, that the fuller disquisition on this subject, which he had promised, has not been given. Much stress has been laid, especially by the French, on "the unities" of the drama, as supposed to be prescribed by Aristotle *On Poetry*. But in reality he attaches no importance to the external "unities" of time and place. In enumerating the differences between tragedy and epic poetry, he says,[13] that "the one generally tries to limit its action to a period of twenty-four hours, or not much to exceed that, while the other is unlimited in point of time." But he does not lay this down as a law for tragedy. The peculiarity of the Greek drama, in which a chorus remained constantly present and the curtain never fell, almost necessitated "the unities," but Aristotle only concerns himself with internal unity, which he says that tragedy must have in common with every other work of art,[14] and which consists in making every part bear an organic relation to the whole, so that no part could be altered or omitted without the whole suffering. This principle, much more valuable than that of "the unities," is habitually

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[1] See Mr Congreve, *Pol. of Ar.*, introduction, p. xxiii.

[2] *Pol.*, ii. 1, 3; 5, 28.

[3] *Pol.*, i. 8, 12.

[4] *Pol.*, i. 13, 7-11. *Cf.* A celebrated passage on the characteristics of females, *Hist. Animal.*, ix. 1.

[5] *Pol.*, i. 10, 4.

[6] See an interesting summary of Aristotle's views on this subject, *National Education in Greece, in the 4th Century* B.C., by A. S. Wilkins, (London, 1873), pp. 135-167

[7] *Poet.*, vi. 1.

[8] See note 4, p. 517.

[9] *Poet.*, vi. 2.

[10] See *Aristoteles über Kunst, besonders über Tragödie*, von Dr J. H Reinkens (Vienna, 1870), pp. 78-167, in which the controversy is summarised.

[11] Besides the passage above quoted, there is another place in the *Pol.* where the terms ἰατρεία and ἄκος are used to express the relief of the passions procured by indulging them, *Pol.*, ii. 7, 11. 12.

[12] *Pol.*, viii. 7, 5, πᾶσι γίγνεσθαί τινα κάθαρσιν καὶ κουφίζεσθαι μεθ᾽ ἡδονῆς.

[13] *Poet.*, v. 8

[14] *Poet.*, viii. 4.

violated by all but the few first-rate works of fiction of the present day.

The *Rhetoric*, the *Nicomachean Ethics*, the *Politics*, and the fragment *On Poetry*, make up the sum of Aristotle's extant contributions to "practical" and "productive" philosophy. We have now to follow him into the "speculative" part of his system, consisting of a rich series of physical and physiological treatises. In this department the results arrived at 2200 years ago by Aristotle come into sharp contrast with the achievements of modern science up to the present day. Those who enter upon the comparison are apt to run into one of two extremes,[1]—either to pass undiscriminating eulogies on Aristotle, and to credit him with impossible anticipations of future discovery, or to treat him with undue disparagement, as utterly false in method and puerile in his views of nature. It is only owing to Aristotle's real greatness that such a comparison could for a moment be made,—for what, comparatively speaking, could be expected of a philosophy 2000 years old in respect of the sciences of observation and experiment, whose very essence consists in gradual advance from one new vantage point to another? To do personal justice to Aristotle, we must conceive, as a matter of fancy, what it would have been if he could have had one of the great modern discoveries imparted to him,—the Copernican system, or the law of gravitation, the circulation of the blood, or the analyses of air and water, or the conservation of energy; if he could have had any modern instrument of observation, such as the telescope or microscope, or even the thermometer or barometer, placed in his hands. How swiftly would he have used such an advantage! what new and ramifying deductions and inductions he would have made! how radically he would have had modified many of his views! But all this was, of course, impossible. Physical knowledge was in its infancy; Aristotle could only start where his predecessors left off; he laid the foundation of many sciences, and wherever simple observation was adequate,—as, for instance, in politics and in some parts of natural history,—his achievements were complete and surprising. But for the greater realms of science he had no starting point and no appliances; he could only slightly modify the almost childlike views of the Greeks, and rest content with such unverified hypotheses[2] as seemed to him best to cohere together, and to explain the nature of things. Thus, it is not to be wondered at that he considered the earth to be stationary and the centre of the world, with the seven planets (including as such the sun and moon) moving round it in oblique courses to the left, while the outer heaven or sphere of the stars—composed not of perishable matter, but of divine ether—he thought to move from left to right, with perfect and regular motion returning on itself, deriving its motion from the encompassing Godhead,—that essence which moves things, but is not moved itself. Such was, according to the belief of Aristotle, the framework of the universe; and the order[3] of his physical treatises corresponds with the filling up of this framework. Of his method it may be said, in one word, that no one was ever more keen than he to make "fact" (τὸ ὅτι) the basis of every theory. It is not to be supposed for a moment that he attempted to explain nature by means of the syllogism. But, on the other hand, the art of experimenting, and the exact quantitative record of observations had not been developed. So Aristotle was often quite destitute of the appropriate "facts" for a particular inquiry, and sometimes deceived in the "facts" upon which he founded. And his training as a dialectician was in some respects a disadvantage to him, as it led him to depend too much on the evidence of language in forming his theories of nature.

The logical order of the physical treatises, and, probably to a great extent, the actual order of their composition, is as follows:—1*st*, The *Physical Discourse*, in eight books, forms an introduction to the entire subject. It is, as Hegel called it, "a Metaphysic of Physic." It treats of the Principles of Existence, Matter and Form, Nature, Motion, Time, Space, the Unmoved First Mover, and the Ever-moved, *i.e.*, the sphere of the outer heaven. 2*d*, The treatise *On the Heavens*, in four books, naturally succeeds; and Aristotle, thus beginning with the periphery and divinest part of the universe, descends gradually to the region of the material and perishable. In so doing it becomes necessary to him to consider the causes of those changes,—that passing into and out of existence,—which had no place in the higher region. Therefore, 3*d*, the treatise *On Generation and Destruction*, in two books, gives us Aristotle's theory of the Hot and the Cold, and the Wet and the Dry,—pairs of opposites, the first pair active, and the second pair passive, which by their combinations and mutual workings produce the four elements (Hot and Dry = Fire, Hot and Wet = Air, Cold and Dry = Earth, Cold and Wet = Water), and form the ground for all natural changes. 4*th*, The *Meteorologics*, in three books, treat of the region of the planets, comets, and meteors,—a region ever full of change and alteration. The fourth book of this treatise does not logically belong to it, for in it Aristotle develops his theory of two exhalations—the steamy or wet, and the smoky or dry—which, being imprisoned within the earth, produce, the former the metals, and the latter the rocks, and such other minerals as are incapable of being melted. This theory, which seems to be a dim foreshadowing of the doctrine of crystallisation, takes us out of the mid-air below the surface of the earth. It is, therefore, out of place; but almost everything in Aristotle must be looked upon as unfinished. 5*th*, The treatise *On the Parts of Animals*, in four books, leads the way to the investigation of organic life. It contains Aristotle's physiological distinction between homogeneous and unhomogeneous substances (ὁμοιομερῆ and ἀνομοιομερῆ), *i.e.*, tissues and organs. This distinction, which is recognised still as perfectly valid, gives a scale of ascension from the inorganic to the organic world. First, Heat and Cold, &c., form the simple elements; out of the elements are formed the homogeneous substances or tissues; out of these are formed the organs, out of the organs the organised being. As a principle of method, Aristotle lays it down[4] that all which is common to the various species of living beings should be discussed before entering upon their specific differences. Therefore, 6*th*, the treatise *On Soul* follows next in order, which, as Spengel observes (see note 3), is not to be regarded as a work on psychology in the modern sense, but as a physiological treatise on the soul or vital principle common to all living beings. And next follow, 7*th*, the so-called *Parva Naturalia*, which form appendices to the three books *On Soul*, and treat physiologically of sense and sensation, youth and age, sleep and waking, and other phenomena attaching to life in general. 8*th*, The short essay *On Locomotion of Animals* shows how various organs in the

[1] This subject may be studied in Mr Lewes's *Aristotle, a Chapter from the History of Science*, referred to in note 5, p. 511. Mr Lewes quotes some of the principal eulogies upon Aristotle's scientific merits. He himself affords an instance of the opposite extreme, being in many points too hard upon Aristotle.

[2] There are some interesting remarks on the position of a Greek philosopher of the 4th century B.C. in relation to physical science, in Professor Jowett's *Dialogues of Plato, translated* (Oxford, 1871), vol. ii. p. 503, *sqq.* in the introduction to the "Timæus."

[3] See Dr Leonhard Spengel's paper on this subject, *Abhandlungen der Philos.-philol. Klasse der Bayerischen Akademie*, 5th vol. 2d div. p. 142 (Munich, 1849).

[4] *De Part. Anim.*, i. 1, 4-7.

various creatures are adapted by nature for this purpose. 9*th*, The elaborate treatise, in five books, *On Generation of Animals*, works out this subject with astonishing fulness. And, 10*th*, the great work entitled *Researches about Animals*, in ten books, in which Aristotle exhibits an acquaintance, more or less intimate, with about 500 species,[1] crowns the series of his physical writings, and certainly constitutes one of his greatest achievements.

There were two other treatises which Aristotle had proposed[2] to himself to write, as belonging to this πραγματεία, or department, namely, one *On the Physiology of Plants*, and one *On Disease and Health, so far as belongs to Physical Philosophy*. But neither of these intentions, so far as we know, was executed by him.

Last of Aristotle's extant and undoubted works, we have to deal with the *Metaphysics*. We cannot accept the opinion expressed by Valentine Rose[3] that this work was written before the *Physical Discourse* and the other kindred books which have just been enumerated. Doubtless many of the metaphysical conceptions were pretty complete in Aristotle's head before he wrote on physics, but that is another question. The very name "Metaphysics" (see before, note 8, p. 514) embodies a strong tradition that the work to which it has been applied came "after the physical works." Secondly, There is another tradition[4] that this treatise was sent to Eudemus for revision, and that while Eudemus was suggesting some improvements in the arrangement, Aristotle died. Thirdly, there are four places[5] in the physical writings which put off the discussion of certain questions as belonging to "first philosophy," just as in the *Ethics*[6] other questions are put off as belonging to physics. Fourthly, The *Metaphysics* are quoted in no genuine work of Aristotle's, but only in the book *On the Motion of Animals*,[7] now generally attributed to a later Peripatetic. Fifthly, The doctrine of causes seems to be handled in a more mature way in the *Metaphysics* than in the physical writings. Sixthly, In no less than twelve places[8] of the *Metaphysics* the physical treatises appear to be referred to. There is good ground, then, both external and internal, for believing that the *Metaphysics* were among the latest of Aristotle's works, and they were certainly not finished by him.

As the work stands in Bekker's edition, it consists of thirteen books, exclusive of the brief fragment which succeeds book i., and is marked as A ΕΛΑΤΤΟΝ, or I. Minor. This fragment was attributed by ancient[9] tradition to Pasides, and is probably un-Aristotelian. It merely contains some very general remarks on the search for principles. Book iv. is a sort of glossary of the various meanings in which certain philosophical (but not exclusively metaphysical) words are used. It may have been jotted down by Aristotle himself, and have been found among his papers; but it is only through injudicious editing that it can hove been inserted in this work. Book x. is quite peculiar; the first half of it (chapters 1–7) is a brief restatement (by Aristotle himself, as Bonitz thinks) of the conclusions of books ii. iii. v.; the second half is an un-Aristotelian epitome of part of the *Physical Discourse*. Even making these deductions, the remainder of the work is not homogeneous, but is resolvable into two separate treatises: the first being intended to set forth Aristotle's system of metaphysic, and consisting of books i. ii. iii. v. vi. vii. viii., which give the history of former systems and the groundwork of his own. The second treatise is contained in book xi., which, after a short sketch of the nature of substance in general, ends in a dissertation upon the nature of God. Books ix. (on Unity) and xii. xiii. (on the Pythagorean and Platonic systems of numbers and ideas), appear to have been intended for the first treatise, but they remain as mere materials for a *magnum opus* which was never achieved. We see, then, out of what *disjecta membra* the *Metaphysics* of Aristotle, as they stand in our editions, are composed. How far the making up of them into their present form is due to Eudemus and the earlier Peripatetics, how far to the editorial hand of Andronicus, we cannot tell.

Among the many-sided merits of Aristotle must be mentioned the example set by him of making the history of opinion on each subject the prelude to a scientific consideration of the subject itelf. In the first book of his *Metaphysics* he sketches the leading doctrines of his predecessors on the first principles of existence. He thus becomes the father of the history of philosophy, a study which has been taken up anew and much developed during the present century. His brief and masterly sketch is, however, open to the charge of not doing sufficient justice to the different points of view of former philosophers. And his polemic against Plato's doctrine of Ideas, which is several times repeated[10] in his extant writings, has the appearance of captiousness, and of misrepresenting the[11] doctrine which it impugns. Aristotle himself never discarded idealism. He declared that universals, and the truths apprehensible by the highest reason, were "by nature more known"[12] than individual concrete phenomena, and the facts apprehended by sense. But yet he had the strongest bias towards physical research and empirical observation. A modern physical philosopher might have been content to follow out his own special inquiries without seeking a general scheme for the universe. But Aristotle had to form a theory of the whole, leaving scope, afterwards, for the separate physical sciences. The idealism of Plato did not do this: it left no place for matter, motion, or change; when followed out it reduced all but the Ideas to the category of the non-existent. Aristotle, to rescue all nature from theoretical annihilation, introduced a term between the existent and the non-existent, namely, the "potential" (δύναμις). On the one hand, the potential does not exist, for as yet it has no qualities; on the other hand, it does exist, for some change brings the "actual"

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[1] See *Die Thierarten des Aristoteles, von der Klassen der Säugethiere, Vögel, Reptilien, und Insecten*, von Carl J. Sundevall, Uebersetzung aus dem Schwedischen (Stockholm, 1863). Prof. Sundevall estimates the total number of mammals indicated and described by Aristotle to have been about 70; of birds, 150; of reptiles, 20; and of fishes, 116; making altogether 356 species of vertebrate animals. Of the invertebrate classes, about 60 species of insects and arachnids seem to have been known to Aristotle; some 24 crustaceans and annelids, and about 40 molluscs and radiates. See *The Natural History Review for* 1864, page 494.

[2] *De Sensu*, iv. 14; *De Gen. Animal.*, i. 2, 1; *De Long. Vit.*, i. 4, vi. 8. In *Hist. Anim.*, v. 1, 4, ὥσπερ εἴρηται ἐν τῇ θεωρίᾳ τῇ περὶ τῶν φυτῶν, εἴρηται is probably a misreading for εἰρήσεται.

[3] *De Ar. Lib. Ord. et Auct.*, pp. 135–232.

[4] See Brandis, *Schol. in Arist.*, 519, b. 33.

[5] Quoted by Bonitz, *Ar. Metaphysica* (Bonn, 1849), p. 4

[6] *Eth. Nic.*, viii. 1, 7, &c.

[7] This little treatise bears all the marks of being a monograph in which the conclusions out of various parts of Aristotle's physical, psychological, and metaphysical writings are amplified and brought together. Rose gives arguments to show that the physiology of this book, and of the treatise *On Breath*, belongs to a medical school (Praxagoras, Erasistratus, &c.) later than the time of Aristotle. He admits the *De Motu Animal.* to have been compiled by some very able Peripatetic, *De Ar. Lib. Ord. et Auct.*, pp. 162–174.

[8] See Bonitz, p. 5

[9] See Brandis, *Schol. in Arist.*, p. 589, a. 41.

[10] See a critical examination of all the places in Zeller's *Platonische Studien* (Tubingen, 1839), pp. 199–300.

[11] Plato by no means consistently maintained the doctrine of Ideas, as commonly attributed to him. In the *Parmenides* he himself draws out the objections which may be urged against the system. And, wonderful to relate, Aristotle uses some of these very objections in attacking Plato!

[12] *Topics*, vi. 4, 1–10, and see note 13, p. 514.

(ἐνέργεια) into existence, and this could not be without implying the previous existence of the potential. The universe, according to Aristotle, is a continuous chain; at the one end is the purely potential—matter without form or qualities; at the other end is pure unconditioned actuality, the ever existent, or God.

Reflection upon the relations of the potential and the actual shows the world to have been eternal, for the actual must always have preceded the potential;[1] the seed is the potentiality of the plant, and the plant must always have preceded the seed,[2] the fowl the egg, &c. Thus, all the system of cause and effect, which makes up what is called "nature," has been and will be, according to Aristotle, of eternal duration, and is only slightly modified and altered by two uncalculable elements[3] of causation,—chance and the will of man.

"Nature," or the system prevailing from the earth upwards through the planetary sphere, is full of reason; it does nothing in vain.[4] The formal cause, the form, or perfection, of each thing, is generally to be identified with the final cause, or end, at which nature aims. Matter, rising from the merely potential, through the four elements into various substances, is the material cause; and the efficient, or motive cause is supplied by the active powers of heat and cold. Nature, however, is impersonal, and to speak of it as pervaded by reason, has all the appearance of pantheism. But yet in the system of Aristotle there was a God who was not part of nature. Aristotle's utterances on this subject are obscure; he speaks of the unmoved Mover of all things at one time[5] as if He supplied motion to the periphery of heaven, at another as if He moved things by desire, under the form of the Good. But, at all events, He is personal: He enjoys for ever that bliss which we can only at brief moments attain to; His life is the thinking upon thought. In all this there is something incomplete, and the different points of view are not reconciled. Aristotle argues that[6] God could not, as thought, have any object of thought inferior to himself, else the divine thought, by thinking upon an inferior object, would suffer change and degradation. God, therefore, can only think upon himself. This argument would seem to foreclose the possibility of either Providence or prayer. There is something Eastern in this idea of a God absorbed in self-meditation; and, on the other hand, we observe that Aristotle, while considering no trouble too great to obtain excellence in any little point of art, or science, or morals, or politics,—still, in comparison with the great universe, makes human affairs of relatively little importance. But yet, within the sphere of nature, man is, according to him, the highest product—indeed, the one end for which all the arrangements of nature are but means.[7] Nor does man himself fall wholly within the sphere of nature. Every natural soul is the ultimate expression (ἐντελέχεια) of a corresponding physical body. But in the human soul there is something which has no physical substratum, which came in from without.[8] And, if not physical, this something must belong to the ethereal essence of which the outer heavens and the self-conscious, happy stars are composed. Thus man, by his reason, has a direct connection with the sphere of the eternal and the blessed. The question then arises whether the individual man can look forward to immortality. On this, regardless of Plato's elaborate pictures of a Hell, a Purgatory, and a Heaven, Aristotle says nothing. In one celebrated passage[9] he makes reason twofold, the active and the passive, of which the active reason, and it alone, is indestructible; but if this be incapable of receiving impressions, it would seem that all our memory,—in short, all that constitutes human individuality,—is doomed to extinction. But Aristotle never says so in express terms, and therefore has given scope for much controversy in modern times as to his opinion.[10]

Returning to his psychology, we find that[11] he considers knowledge to imply a certain similarity, if not identity, between the subject and the object. Therefore, the higher reason in apprehending universals, apprehends something homogeneous with itself,—something, in short, ethereal, This would bring the Aristotelian universals very near to the Platonic ideas, but that he maintains[12] that the universals are always immanent in the individuals, never transcendental, or existing by themselves. But this doctrine widely separates Aristotle from the modern experimental school, though, on the other hand, there is no trace of his having believed in "innate ideas" upon any subject. Aristotle, like Locke, considered each human mind to be originally a blank tablet, but he would not agree with Locke that this tablet is written upon by external objects, he would rather say that, by the joint action of the active and the passive reason, the tablet writes upon itself, and that there is much in our knowledge which comes from the nature of the intellect itself. Two doctrines lie at the foundation of his system: 1st, the principle of contradiction,—that a thing must be either A or not A; 2d, the dualistic opposition, throughout the universe, of reason and matter. In modern times we have been long accustomed to think of this world as having had a beginning, and recent theories of "development" are attempts at a speculative history of nature gradually arriving at its present condition. Such theories have nothing to correspond to them in the system of Aristotle, for in his view the present fabric of the world has had an eternal existence, and nature is fixed, being only slightly varied by the element of chance. He admits, indeed, a process of development in human society, but in order to adapt this process to a fixed and eternal frame of things he announces[13] the curious opinion, that the human race has repeatedly brought to perfection all art, science, and philosophy, and has on each occasion been swept away by some widespread catastrophe or convulsion of nature, leaving only a few individuals to repropagate the race, and to begin again the development of civilisation out of the merest rudiments.

In endeavouring to bring forward, in a brief space, some of the salient characteristics of Aristotle, we have been led to mention chiefly those points on which he differs most

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[1] *Metaphys.*, viii. 8, 1-11.

[2] A similar doctrine to this was stated by Sir W. Thomson in his address to the British Association, 1871. He said, "I am ready to adopt as an article of scientific faith, true through all space and through all time, that *life proceeds from life, and from nothing but life.*" His suggestion as to our own globe was "that life originated on this earth through moss-grown fragments from the ruins of another world."

[3] *Eth. Nic.*, iii. 3, 7, &c.

[4] See the whole of book ii. of the *Physical Discourse*

[5] See the dissertation on the nature of God, *Metaph.*, xi. c. 6-10.

[6] *Metaph.*, xi. 9, 4.

[7] See *Polit.*, i. 8, 11, where it is said that "plants are evidently for the sake of animals, and animals for the sake of man; thus nature, which does nothing in vain, has made all things for the sake of man."

[8] *De Gen. Animal.*, ii. 3, 9, 10.

[9] *De Anima*, iii. 5, 2.

[10] Averroes made for himself a bad name by pushing the words of Aristotle to their logical conclusion. On the other hand, St Thomas Aquinas argued in favour of Aristotle's belief in immortality. Spengel, apparently, takes the latter view (see note 3, p. 520); he quotes with approval an anonymous ancient—*Ὅτι Πλάτων, φησί, καὶ Ἀριστοτέλης ἀθάνατον ὁμοίως λέγουσι τὴν ψυχήν, κἂν τινες εἰς τὸν Ἀριστοτέλους νοῦν οὐκ ἐμβαθύνοντες θνητὴν νομίζουσιν αὐτὸν λέγειν.* See some criticisms on Grote's view, *Ed. Rev.*, No. 278, pp. 553-556.

[11] See *Die Erkenntnisstheorie des Aristotles*, von Dr F. Kampe (Leipsic, 1870), p. 316, *sqq.*

[12] *Post. Analyt.*, i. 11, 1, &c.

[13] *Metaphys.*, xi. 8, 19.

widely from the modern point of view, and which, therefore, are his points of weakness. Much that the world has accepted from him, many a solid mass of wisdom and good sense, to be found in his writings, we have been obliged to pass over in silence. On most subjects Aristotle is no longer an authority, but yet, for many reasons his works are well worth study. *First*, on account of the important part they have borne in the history of the world. No one who aspires to cultivation can dispense with a historical knowledge of the thought of Europe, and Aristotle is one of the great fountain-heads of that thought. *Secondly*, if cultivation consists, as has been said, in an acquaintance with all the best productions of the human mind, Aristotle's works, despite their want of style, certainly come among the number. Hegel advocated the study of these works as "the noblest problem of classical philology." The University of Oxford, during the present century, has made a renewed study of Aristotle one of its chief instruments of education,—and with great success, as was especially testified to by the late Dr Arnold[1] of Rugby. Aristotle's great knowledge of human nature, exhaustive classification, and clear methods of disentangling a question and dealing with what is essential in it, render many of his works an excellent *curriculum* for training young men, and fitting them for all the superior business of life. There is a certain dynamical impulse to be derived from Aristotle, independent of all his results and conclusions. The Aristotelian element in thought and knowledge may, perhaps, be summed up as "analytic insight;" and this insight arises out of concentration of the mind upon the subject in hand, marshalling together all the facts and opinions attainable upon it, and dwelling on these, and scrutinising and comparing them till a light flashes on the whole subject. Such is the procedure which may be learnt, by imitation, from Aristotle.

The history of the study of the Aristotelian philosophy, since the time of Andronicus, falls under various heads, dealt with elsewhere. It is contained,—*first*, under such names as those of the Greek commentators, Boethus, Nicolas Damascenus, Alexander of Ægæ, Aspasius, Adrastus, Galenus, Alexander of Aphrodisias, Porphyry, Iamblichus, Dexippus, Themistius, Proclus, Ammonius, Damascius, David the Armenian, Asclepius, Olympiodorus, Simplicius, and Johannes Philoponus; *secondly*, under the history of the caliphs of Baghdad, and their encouragement of the translation into Arabic of Greek philosophical works; *thirdly*, under the names of Avicenna (of Baghdad), and Averroes, and Moses Maimonides (of Cordova), and the history of the controversies to which they gave rise; *fourthly*, under the name of Thomas Aquinas, and the history of Scholasticism generally; *fifthly*, under the history of the Renaissance, and of the manifold editions of Aristotle to which the first age of printing gave birth; *sixthly*, under the names of Ramus and Bacon, and the history of the reaction against scholastic Aristotelianism; *seventhly*, under the names of Lessing, Hegel, and other great Germans who, within the last hundred years, have revived a genuinely philosophical and critical study of Aristotle.

For the bibliography of Aristotle's works we must refer to the first volume of Buhle's (Bipontine) edition (1791–1800), which contains an enumeration of all the earlier editions, translations, and commentaries. All previous editions of the text of the entire works give way to the recension of Immanuel Bekker (1831–1840), which being supplemented by a volume of *Scholia* upon Aristotle, edited by Brandis (1836), and a complete index to all the works, compiled by Bonitz (1870), constitutes the great edition of the Prussian Royal Academy. Within the last forty years much admirable work has been done in Germany in the way of clearing up special questions relating to Aristotle, and introducing correct judgments about his philosophy generally. Perhaps the scholar who, by a mixture of rich learning and penetrating good sense, has deserved best of Aristotle is Dr Leonhard Spengel, to whose papers, contributed to the Royal Bavarian Academy of Munich, we have often previously referred. The historians of philosophy, beginning with Hegel's "Lectures," and going on to Brandis, Zeller, Schwegler, and Ueberweg, reflect the progressive opinions about Aristotle of critical and philosophical circles. Many excellent editions of the separate treatises, and many monographs on special points, have performed a subsidiary function. And a good German translation, executed by Stahr, Bender, Karsel, &c., of the works of Aristotle, now nearly complete, has been published at Stuttgart, by Krais and Hoffmann.

No other nation can compare with Germany in recent services towards a knowledge of Aristotle. France has contributed translations of the *Physics*, *De Anima*, *Parva Naturalia*, *Organon*, *Politics*, and *Ethics*, by Barthélemy St Hilaire, an essay on the *Metaphysics*, by Ravaisson, and a few less important works. The translations are readable, but cannot be relied on for accuracy in any difficult point. In England the contributions to Aristotelian literature have borne no sort of proportion to the extent to which minds have been educationally imbued with certain of Aristotle's works. The unproductiveness of Oxford in this respect is certainly a matter of reproach to that university. Sir W. Hamilton exhibited great learning in all that concerned Aristotle rather than a true insight into Aristotle himself. Grote's work was conceived in a German spirit, but it was begun far too late in life to have any chance of success. The problem how to translate Aristotle into English has not yet been solved. We have had a translation of the entire works by the not very sane, and very unscholarlike, Thomas Taylor (10 vols., London, 1806–12), which exists only as a curiosity for book collectors. And we have had the not uncreditable versions of Bohn's Classical Library, but these latter were done to order, and cannot be expected to perform what is in itself so difficult. Mr Poste, perhaps the most thorough of present English Aristotelians, in his *Aristotle on Fallacies*, gives us rather a condensed paraphrase than a translation, and is often as difficult as the original Greek. The problem is, how to convey, in readable English, a philosophical style, full of technical terms for which we have no exact representatives. Circumlocution, or paraphrase, becomes necessary; the question is, how to use this with the greatest tact, so as, while conveying Aristotle's exact meaning, to retain something of his manner. Perhaps this problem may, in course of time, be solved, if in the meanwhile the study of Greek is not altogether abandoned in England.

The following are works relating to Aristotle which are worthy of consultation, but have not been mentioned in the previous text or notes:—Stahr, *Aristotelia* (2 vols., Halle, 1830–32); *Aristoteles bei den Römern* (Leipsic, 1834). Biese, *Die Philosophie des Aristoteles* (2 vols., Berlin, 1835–42). Waitz, *Organon* (2 vols., Leipsic, 1844–46). Schwegler, *Metaphysica* (4 vols., Tubingen, 1847–48). Torstrick, *De Anima* (Berlin, 1862). Meyer, J. B., *Dissertatio de Principiis Aristotelis in distributione animalium adhibitis* (Berlin, 1854); *Aristoteles Thierkunde: ein Beitrag zur Geschichte der Zoologie, Physiologie, und alten Philosophie* (1855). Spengel, *Ueber die Rhetorik des Aristoteles* (Munich, 1851).

[1] See *The Life and Correspondence of Thomas Arnold, D.D.*, &c., by A. P. Stanley, &c., vol. ii., letter 274.

ARISTOXENUS, of Tarentum, a celebrated Greek philosopher and writer on music, was the son of Spintharus or Mnesias. He was at first a pupil of the Pythagorean school, and received instruction from Xenophilus; afterwards removing to Athens, he studied under Aristotle. He became one of the most distinguished pupils of the Peripatetic school, and is said to have been much disappointed when, after the death of Aristotle, Theophrastus was preferred to him as scholarch. His writings, which, according to Suidas, were 453 in number, have been almost entirely lost. The titles of some of them have been preserved, and show that his activity had been directed to a great variety of topics. With the exception of a few fragments quoted by other authors, there is extant of all his writings only one treatise on Harmony, in three books, which is probably not a complete work, but made up of portions of one or more separate writings. His doctrine of harmony is directly opposed to that of the Pythagoreans, according to whom musical concord depended upon certain numerical ratios, and who were obliged to reject some combinations as dissonant, only because there was no ratio corresponding to them. This theory Aristoxenus considered to be an attempt to force *a priori* determinations upon nature, and he sought to develop a theory of harmony from an empirical basis. According to him, the ear is the true judge of concord, and its impressions can be generalised into rules. His followers were called μουσικοί, or musicians by ear, in opposition to the Pythagoreans, who were κανονικοί, or musicians by rule. Another doctrine attributed to Aristoxenus brings out forcibly the strong empirical tendency of his mind. He is said to have held that the soul stood in the same relation to the parts of the body as harmony stands to the parts of a musical instrument; it was the result of organisation. What proofs he advanced in favour of this view, and how the opinion was connected with his general system of thought, we have not now the means of determining.

The best edition of Aristoxenus is by Marquard, with German translation and full commentary, *Aristoxenus' harmonische Fragmente*, 1868. The fragments are also given in Müller, *Frag. Hist. Græc.*, ii. 269, *sqq.* See also Mahne's work, *Diatribe de Aristoxeno*, 1793; and that of Brill, *Aristoxenus' rhuthmische und metrische Messungen*, 1871.

ARITHMETIC

ARITHMETIC is the science that treats of numbers, and of the methods of computing by means of them. In introducing the subject, and endeavouring to trace the progress of the science, there appear to be three points that call for particular notice, viz., the conception of number, the representation of numbers either by words or graphically by characters, and the principles and modes of computation.

1. The primary conceptions of numbers are necessarily of a very crude kind. The child attains the notion slowly by experience, and the ability that even adults have to apprehend the significance of numbers with precision is restricted to an extremely narrow area. This is still more the case among uncivilised races, some of which do not appear to be able to count beyond 3, or 4, or 5, or are at least believed to have no words in their vocabularies that express larger numbers. It is to be remembered that the knowledge that is acquired regarding numbers through experience and culture is not of numbers absolutely or in the abstract, but rests almost entirely on a perception of the relations which numbers bear to each other.

The power to form a direct and immediate conception of numbers is very limited; but the relative magnitudes of numbers, large as well as small, can be expressed with the utmost accuracy, and so as to be clearly understood. The system of notation in common use, whereby we express not merely numbers, but parts of numbers, supplies us with means of comparing arithmetically together either the greatest or the minutest magnitudes, to which there is absolutely no limit. The proportion, for instance, that the circumference of a circle bears to the diameter, though it cannot be stated with arithmetical exactness, has been calculated to upwards of 200 decimal places,—a nicety for which the vast dimensions that science discloses in the physical universe furnish no means of comparison whatever. For let it be supposed that a circle were described, with a point on the earth's surface as centre, so as to extend beyond the most distant star that can be discerned by the most powerful existing telescope, that the radius of the circle were known and that the circumference were computed from it, it does not appear that an error in the thirtieth decimal place would be of such magnitude that the keenest vision, aided by the most powerful microscope, could detect it.

In all systems of number, with the exception, perhaps, of the very rudest, numerical conceptions are aided by the introduction, usually at a very early stage, of methods of grouping. In nearly every case the methods adopted connect themselves with the number of the fingers, either of one or, more usually, of the two hands. Having reached 5 or 10, the reckoner proceeds by adding to these the prior numbers; and when a second 5 or 10 is reached, a new word or sign is employed, the significance or derivation of which is generally well marked in the name or form it bears. Similarly when (say) five fives or ten tens are reached, a fresh start is made. These processes of grouping are of great importance, conveying clearer conceptions than could otherwise be obtained of the relative magnitudes of numbers. An additional evidence of the value of the principle is to be found in certain numerical combinations which are not additive, as such combinations mostly are, but subtractive. Thus, if a conception be formed of 10, and again of 20, 19 and even 18 will connect themselves more readily with the latter than with the former, and so we have such forms as *duodeviginti* and *undeviginti;* and there is little doubt that similar considerations, in combination with a regard for brevity of expression, have led to the use of the subtractive forms IX., XL., &c.

2. There are two ways in which numbers are represented,—either in words or by particular characters or symbols. It is with the latter that arithmetic has more especially to do, the numerous important and interesting questions that relate to word-numerals falling rather within the domain of language. It is only in so far as they arise out of the systems of grouping already referred to, suggesting in their formation such processes as addition or multiplication, that these call for any notice here. Dr Tylor (*Primitive Culture*, chap. vii.) gives a variety of remarkable collocations of this sort, as well as of descriptive numerals, that are in use among different races and tribes.

There is also a common use of characters to represent numbers which does not properly belong to this subject. The letters A, B, C, &c., or α, β, γ, or the like, the order of whose succession is fixed, are often employed to indicate numerical order, either singly or in combination with numerals proper. This is not, however, an arithmetical use of the characters; they are merely *ordinals*, and cannot furnish a basis for calculation.

The origin of the various characters which have been employed to indicate numbers proper, and by means of which computations can be effected, is in most cases alphabetical. In the Hebrew and Greek notations, for instance, the letters were taken in the main in their alphabetical order, being divided into three groups, of which the first represented units, the second tens, and the third hundreds; and very similar systems have been in use among other nations. As the Hebrew alphabet contained no more than twenty-two letters, the numbers from 500 to 900 were represented by five final forms, and sometimes by additive combinations with ת, 400. The following is the usual Hebrew notation, numbers exceeding ten being made up by placing the larger numeral characters first:—

א	ב	ג	ד	ה	ו	ז	ח	ט
1	2	3	4	5	6	7	8	9
י	כ	ל	מ	נ	ס	ע	פ	צ
10	20	30	40	50	60	70	80	90
ק	ר	ש	ת	ך	ם	ן	ף	ץ
100	200	300	400	500	600	700	800	900

The ordinary Greek notation has not merely a general resemblance of structure to the Hebrew, but corresponds to it closely, character for character, up to 80. The Greek alphabet consisting of twenty-four letters, three additional characters were introduced. The first, for 6, occupying the place of ו, is ϛ (named σταῦ), which was afterwards used as a contraction for στ; the others, for 90 and 900, were named κόππα and σαμπῖ respectively, and written ϙ or ϟ and ϡ. The notation is thus as follows:—

α	β	γ	δ	ε	ϛ	ζ	η	θ
1	2	3	4	5	6	7	8	9
ι	κ	λ	μ	ν	ξ	ο	π	ϙ or ϟ
10	20	30	40	50	60	70	80	90
ρ	σ	τ	υ	φ	χ	ψ	ω	ϡ
100	200	300	400	500	600	700	800	900

To distinguish the numeral letters an accent was written after the last,—thus, 38 was λή, while thousands were indicated by writing the accent below,—thus ͵δ was 4000. The letter M (for μυρίοι) increased the numeral 10,000 times. Fractions were separated by a space from the integers they were affixed to, and the denominator was written like an index or power in our notation,—thus, $\mu\gamma\ \theta^{\iota\alpha}$ was $43\frac{9}{11}$.

In addition to this another entirely different notation is found in Greek inscriptions. It more nearly resembles the Roman system, the numeral characters (except the first) being the initials of the numeral names, and being repeated till the number to be signified was expressed. I represents, 1, Π (πέντε) 5, Δ (δέκα) 10, H (ἑκατόν, the aspirate being written as an H) 100, X (χίλιοι) 1000, M (μυρίοι) 10,000. Characters enclosed within three lines (forming a Π) are thereby multiplied by 5. To give an example, in this notation |H̅| HH |Δ̅| ΔΠIII represents 768.

The Roman system, with which we are still familiar nearly in its completeness, employs the letters of the alphabet, but is not based upon alphabetical order. Many attempts have been made to account for the symbols, and the complete solution of the problem of their origination is perhaps unattainable. Sir John Leslie, following some writers of the 16th and 17th centuries (see in particular the *Cursus Mathematicus* of Dechâles, vol. i. 1674, 2d. ed. 1690), advocated the opinion that, one line or stroke being taken to represent the unit, when ten of these were set down, a stroke would be drawn across them in a slanting direction to cancel them, and the unit stroke and cancelling stroke would thus give the form X for 10; that a repetition of this proceeding would give a third stroke when 100 was reached, and the three might take the form ⊏ or C; and that, similarly, the combination of four strokes would give M for 1000. This explanation is perhaps too ingenious. It has the merit of accounting for the X (the *crux* of the method), which may have been introduced in some such way. But one does not readily see how the ⊏ could be formed from the X, or the M from the ⊏; and it appears far more likely that the signs for 100 and 1000 are merely the initial letters of *Centum* and *Mille*,—all the more that the very ancient notation noticed above as found in Greek inscriptions has evidently an origin of this kind. In any case V, L, and D appear to be respectively the halves of X, the angular C (⊏), and the rounded M (ꟿ). The ancient forms of D and M, viz., IↃ and CIↃ, have ceased to be familiar. By an extension of this style of characters, IↃↃ denoted 5000; CCIↃↃ, 100,000; CCCIↃↃↃ, 1,000,000, &c. To represent two, three, &c., millions, the CCCIↃↃↃ was repeated the required number of times.

The Roman notation employs fewer characters than the Greek, and makes greater use of combinations. One is repeated up to four; to the new character for five, ones are repeated up to nine; ones are added to the ten character; at fifteen the five enters, and so at twenty-five, &c.; for the tens up to forty the ten is repeated, and so on,—the symbols I, V, X, L, C, D expressing all numbers by regular combinations up to M, a thousand. The subtractive collocations, IV, IX, XL, XC, now the ordinary, were originally alternative forms, as were also the rarer combinations IIX for 8, XIIX for 18, XXC for 80, &c. To the extent of these subtractive forms, the values of the characters depended on their position, a smaller number being added to a greater when it followed, and subtracted from it when it preceded it. This element of position is, however, an irregular and exceptional one; and, instead of being of such advantage as the local value of the Arabic notation, is rather a hindrance in calculation.

Far superior to all the ancient systems, and indeed to every other system that exists, is the arithmetical notation that is in common use. The Arabic numerals, as they are called, are ten in number, nine of them representing the first nine numbers, and the tenth, the cipher or zero, indicating the absence or negation of numerical value. The significance of these figures or digits depends on their relative position, and the great merit of the system is due to this element of local value. Standing singly, the figures denote simply one, two, three, &c.; but in combinations of them every removal towards the left increases the value of the figure ten times. In 5673, for instance, the 3 denotes three, the 7 seven tens (70), the 6 six times ten tens (600), the 5 five times ten hundreds (5000). Should any of the series of tens be wanting, as in nine thousand and forty-eight, where hundreds do not occur, the place is supplied by a cipher, which throws back the digit that expresses thousands into its proper place, thus 9048. It is by this use of the cipher in supplying blanks, and so regulating the places of the significant digits, that the principle of local value is carried out. See further the sections on notation and numeration below, p. 527.

The ordinary numerals are called Arabic, and it appears to have been through the Arabians that they were introduced into Europe; but they are now generally acknowledged to be of Indian origin. As may be imagined, they have passed through a great variety of forms, one of the earliest types of them being the *Devanagari*, a species of Sanskrit numerals. In the early Indian treatise of Bhascara and Brahmegupta, translated by Mr Colebrooke (see article ALGEBRA, p. 517 of vol. i.), as well as in the still earlier writings of Arya-Bhatta, there are both indications and illustrations of the use of the nine digits and the cipher;

and the system is thus traced back to the 7th, and in all probability to the 5th century of the Christian era. Even then it was evidently no novelty, but is alluded to as holding an established position; and the Hindu writers nowhere lay claim to the invention of it, but constantly assign to it a supernatural origin. The method was known to the Arabians in the 9th century; and in the course of the 10th it seems to have come into general use among them, especially in their astronomical writings and tables. It was probably in the following century that the Arabs introduced the notation into Spain, but in regard to this we have no explicit information, and different accounts are given of the earliest instances of the use of the system in Europe. On the one hand, it is alleged that the figures first occur in a translation of Ptolemy, of the date 1136, while others maintain that they were introduced (about 1252) by means of the celebrated astronomical tables published by and named from Alphonso the Wise. That their use was known in Italy at the commencement of the 13th century, appears to be satisfactorily established, for there is no good reason to doubt the genuineness of the MS. writings of Leonardo of Pisa, copies of which have been found bearing the dates 1202 and 1220. Numerous other instances are given of the early use of the nine figures and the cipher, especially by astronomers, and in calendars. The great superiority of this to earlier modes of numerical expression became gradually apparent, and in course of time it came into almost universal use among civilised nations.

For a time there was, not unnaturally, considerable inexactness or confusion in the employment of the notation. In early writings such combinations are found, for example, as X2 for 12, 301 for 31, &c. In the latter case the law of local value is lost sight of, and the characters 30 are used as equivalent to thirty, irrespective of their position.

3. Calculation or computation by means of numerical characters is what is ordinarily regarded as the distinctive province of arithmetic, and the worth of a system of notation is to be estimated by the facilities it affords for the operations of reckoning. The methods in common use will be detailed, and the principles on which they depend briefly expounded, in subsequent sections of this article.

Computation of a comparatively rude kind was often carried on in ancient times, and is practised still in some countries, by what are called palpable methods,—as, for instance, by means of counters, or by balls strung on rods or running in grooves. Of this the abacus of the Romans (used too, but not so generally, among the Greeks), the swan-pan, still in constant use among the Chinese, &c., are examples. (See ABACUS, vol. i. p. 4.)

The methods that preceded the adoption of the Arabic numerals were all comparatively unwieldy, and very simple processes involved great labour. The notation of the Romans, in particular, could adapt itself so ill to arithmetical operations, that nearly all their calculations had to be made by the abacus. One of the best and most manageable of the ancient systems is the Greek, though that too is very clumsy, as may be seen from an elementary example.

Let it be required to muliply 862 by 523, *i.e.*, ωξβʹ by φκγʹ. The product of ω and φ is 400,000, *i.e.*, $\mu_{\times}$; of ξ and φ, 30,000, or $\gamma_{\times}$; of β and φ, 1000, or ͵α. Similarly the multiplication of ω by κ gives 16,000, or $\alpha_{\times}$͵ϛ; of ξ by κ, ͵ασ; of β by κ, μ; of ω by γ, ͵βυ; of ξ by γ, ρπ; and of β by γ, ϛ. These may be arranged in some such order as in the margin, and summed. The result is $\mu_{\times}\epsilon_{\times}$ωκϛʹ, or 450,856.

$$\begin{array}{rr}
 & \omega\,\xi\,\beta \\
 & \underline{\phi\,\kappa\,\gamma} \\
\mu_{\times}\gamma_{\times}{}_{,}\alpha & \\
\alpha_{\times}{}_{,}\varsigma & \\
 & \alpha\,\sigma\,\mu \\
 & {}_{,}\beta\,\upsilon \\
 & \underline{\rho\,\pi\,\varsigma} \\
\mu_{\times}\epsilon_{\times} & \omega\,\kappa\,\varsigma
\end{array}$$

The notation employed here extends to hundreds of millions. A scheme proposed by Archimedes, the most distinguished mathematician of antiquity, in his work entitled Ψαμμίτης, *Arenarius*, goes far beyond this. Taking the limit of the ordinary system, viz., a myriad of myriads, or 100,000,000, as the basis of a new scale, he treats of numbers formed by the continued product of that amount repeated eight times, extending to sixty-four places in our notation. These he divided into what we should call periods, of eight figures each, to which he gave the name of *octades*. He thus appears to have to some extent anticipated the modern method of grouping, though, from the want of knowledge of the principle of local value, the practical advance he made was unimportant. Apollonius of Perga, who flourished a little after the time of Archimedes, took the myriad as the basis of his system, and repeated the sign Mυ for each product of a myriad; thus λδMυ.Mυ.Mυ indicates what we would write as 34,000,000,000,000. But his most important contribution to arithmetical science was his grouping the tens in multiplication, so as to connect large numbers, as far as possible, with those we represent by the nine digits. He thus endeavoured, and with some measure of success, to remedy the defect of the general system arising from the want of apparent connection of such characters as λ and τ, for example, or π and ω, with what he called their bases, γ and η. It is chiefly in the commentaries of Eutocius on the works of Archimedes and Apollonius that the examples of the ancient Greek arithmetic which we possess are preserved.

The operations of the Greek arithmetic involving fractions were necessarily very complicated. A simpler system was introduced (by Ptolemy, according to his commentator Theon, but it appears to have existed before his time) in what are known as *sexagesimals*, which are precisely analogous to the duodecimals by which we sometimes calculate areas. The division of the circle into 360 degrees arose, no doubt, from 360 approximating the number of days in the year, and containing a large number of divisors. The radius of the circle, or side of the inscribed hexagon, subtended at the centre 60 of these degrees, and from this the degree was again divided into 60 parts called minutes, the minute into 60 seconds, &c., just as the foot is divided into 12 inches, the inch into 12 seconds, &c., in duodecimals. The sexagesimal system, though applied in the first instance to circular, was also employed in linear, measurements. As an example, the square of λζ δ νε, *i.e.*, of 37° 4′ 55′, will be found to be ͵ατοε δ ιδ ι κε, *i.e.*, 1375° 4′ 14″ 10‴ 25⁗ The numerals beyond 60 or ξ being dispensed with in this system, the next letter, *o*, was used to denote zero; and it has been conjectured that this may have been the origin of the form of our cipher.

The most important step in the progress of modern arithmetic was the introduction of decimal fractions, and the extension of the Arabic notation to the expression of them. The first writer who advocated and exemplified the use of decimals was Simon Stevin de Bruges, better known as Stevinus, in a paper (*La Disme*) published about 1585; but he employed an awkward notation, and it was only after a considerable period that they assumed the form—entirely consistent with the notation of integers—with which we are familiar. From a form which Lord Napier employs in his *Rabdologia* (1617), the introduction of the decimal point (as a comma) has been ascribed to him, but apparently without sufficient evidence.

The following writers on arithmetic may be named, in addition to those already mentioned:—Diophantus, who flourished in or about the 4th century; Maximus Planudes, who died about 1350; Lucas Pacioli (de Burgo, or di Borgo), whose *Summa de Arithmetica* (1494) was the first work on algebra printed, and one of the earliest on arithmetic; Bishop Tonstall, whose *De Arte Supputandi* (1522) was the first work on the subject printed in English;

Robert Recorde (died 1558), whose *Grounde of Artes* and *Whetstone of Witte* were arithmetical works of great value; Nicolo Tartaglia (died 1559); Michael Stiefel or Stifelius (1486–1567), said to have been the inventor of the signs + and −; Peter Ramus (1515–1572); Albert Girard (died 1634); William Oughtred (died 1660); Edward Cocker, whose *Arithmetic* (1st ed. 1677), a posthumous work, and probably a forgery, is of slight merit, though it passed through many editions; Kästner (*Geschichte der Mathematik*, 4 vols. 1796–1800); Montucla (*Histoire des Mathématiques*, vol. i. 1799), De Morgan (*Arithmetical Books*, 1847). By far the best history of arithmetic is that of Dr George Peacock, late Dean of Ely, published in the *Encyclopædia Metropolitana*

Of recent works on arithmetic there is great abundance, and many of them are of great excellence. They usually contain statements of modes of operation, under the name of "Rules," with a number of examples under each for practice; and not a few of them give in addition explanations of the *rationale* of the methods.

In the following sections the ordinary processes of arithmetical calculation and their commonest practical uses are briefly explained. The various methods of operation are given with greater or less detail, as has appeared necessary for the exposition of the principles on which the operations depend; and light is in many instances thrown on both processes and principles by illustrative examples. For further examples the reader is referred to the manuals above alluded to. The earlier sections, forming the greater part of the article, are occupied with numbers in the abstract, and the remainder with arithmetic in its practical applications.

I. Abstract Arithmetic.

Notation.

1. *Notation* is the name usually given to the expressing numbers by means of characters or figures.

The number ten is the basis or *radix* of the Arabic system of notation, and every number may be expressed in that notation by combinations of the ten *digits*, or numeral figures, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, the last (the cipher or *zero*) having no value except in combination. When several of these are placed together, every removal towards the left increases the value of a figure ten times. The figure placed furthest to the right has the same significance as when it stands alone, *i.e.*, it represents units, the figure next to it denotes tens, the next hundreds, the next thousands; 8735 is therefore read as eight thousand seven hundred and thirty-five. With more than four figures we should have—still proceeding to the left—tens of thousands; then hundreds of thousands, and then thousands of thousands; but instead of this we use the term millions. A million of millions is a billion,[1] and a million of billions a trillion. A digit followed by three figures thus expresses thousands; by six figures, millions; by twelve, billions; and so on. Beyond trillions we have—taking the figures in groups of six—quadrillions, quintillions, sextillions, septillions, octillions, nonillions, &c. But occasion is very seldom found to employ these terms, and indeed it is difficult to form any distinct or definite idea of even a billion.

The system of notation in ordinary use is remarkable at once for its simplicity and its completeness. The selection of ten as the basis or radix of the system (whence numbers expressed in this way are said to be in the *denary* scale of notation) is in all probability to be traced to primitive calculations by means of the ten fingers. Ten is well chosen, being neither too large nor too small, but twelve might, in some respects, have been found more convenient. All numbers can be expressed with twelve or any other number as basis, just as with ten.[2]

2. *Numeration* is the art of reading figures employed to express numbers. The following table shows the places of the figures, as already described, up to billions:— Numeration.

(1.) Units
(2.) Tens.
(3.) Hundreds.
(4.) Thousands.
(5.) Tens of thousands
(6.) Hundreds of thousands.
(7.) Millions.
(8.) Tens of millions.
(9.) Hundreds of millions.
(10.) Thousands of millions.
(11.) Tens of thousands of millions.
(12.) Hundreds of thousands of millions.
(13.) Billions.

The figures 8,607,034,740,952, for example, are read thus:—Eight billions, six hundred and seven thousand and thirty-four millions, seven hundred and forty thousand, nine hundred and fifty-two. Ciphers are passed over in reading, their function being to determine the proper position of the significant figures. When the number of figures exceeds four, it is usual to print them off as above in groups of three, by means of commas. At the *odd* commas, reckoning from the right hand, we always read thousands; at the *even* commas, millions, billions, &c.

3. *Notation* has, in addition to the general meaning already explained, a special signification as the converse of numeration, *i.e.*, it is the art of representing by figures numbers that are given expressed in words.

4. *Addition* is the method of finding the *sum* of two or more given numbers, that is, the number to which they amount when taken together. Addition

Suppose a column, added in the ordinary way, amounts to 34. The 4 is set down under the column, and the 3, representing 30, is added with (or, as usually expressed, "carried to") the next column.

5. *Subtraction* is the method of finding the *difference* between two given numbers, that is, the number by which the greater number exceeds the less, or the *remainder* after the less is taken from the greater. Subtraction

In subtracting, say, 38 from 92, since 8 cannot be taken from 2, we "borrow" from the place of tens, *i.e.*, the 2 is increased by 10, and 8 taken from 12 leaves 4. The 10 added (or "borrowed") has to be taken away again, and this is done by taking 1 from 9 in the place of tens. But 3 has also to be taken from this 9; so first of all the 1 and 3 are added together, *i.e*, 1 is "carried" to the 3, and 4 taken from 9 leaves 5, giving 54 as the complete remainder. The "borrowing" process depends on the consideration that when the same amount is added to both numbers their difference is unaltered—it being remembered that *ten* in the upper line corresponds to *one* a place towards the left in the lower line.

6. *Multiplication* is a method of finding the result produced by adding a given number taken a given number of times. The number to be repeated is called the *multiplicand;* the number expressing the times it is taken, the *multiplier;* and the result obtained, the *product*. The Multiplication.

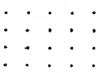
[1] In France, and by a few English writers a *thousand* millions is called a billion, a *thousand* billions a trillion, &c. The ordinary English usage is at least as convenient, and agrees (which the other does not) with the etymological formation of the words—the billion, trillion, quadrillion, &c., being respectively the second, third, fourth, &c., powers of a million.

[2] With twelve as basis (*i.e.*, in the *duodenary* scale), the number represented by the figures 8735 would be the sum of $8 \times 12 \times 12 \times 12$, $7 \times 12 \times 12$, 3×12, and 5, *i.e.*, 14,873 in the ordinary or denary scale. To convert 8735 of the denary into the duodenary scale, we find the twelves in it, that is, divide it by 12, the quotient by 12, &c. This gives (using the character *e* for eleven), 507*e*.

multiplicand and multiplier are also said to be *factors* of the product.

The multiplicand might be written down the required number of times, and the sum found by addition. But this tedious process is unnecessary when the numbers to be added are all the same We do not then require to pass from figure to figure, as when they are different. In adding six nines, for instance, we do not need to proceed step by step (as with $6+5+9+8+6+7=41$), but know the result, 54, at once from a table of products which is committed to memory.

When two numbers are to be multiplied together, either may be taken as the multiplier. For it is evident that the four rows of dots, five in a row, in the margin, are the same as the five rows, four in a row—according as we take the rows horizontally or vertically; that is, 4 times 5 and 5 times 4 amount to the same number.



The process of multiplication by a single digit—by 8, for instance—is nothing but an abridgement of the operation of writing the multiplicand eight times and adding. When there are more digits than one in the multiplier, we arrange the successive products in the well-known fashion, because the multiplication has to be by 10 times the second digit (counting from the right), 100 times the third, and so on. Thus, in multiplying 92058 by 734, the 2 of the multiplicand is really 2000; the 3 of the multiplier, 30; and the product of these, 6, *i.e.*, 60,000, falls by the ordinary process into its proper place.

The process of working may sometimes be considerably shortened by multiplying a product already obtained. Thus, to multiply by 568, we may multiply first by 8, and then take 7 times the result, obtaining the product by 56 at once. So with 549378, we may begin with 9, and multiply the 9 product by 6 for 54, and the 54 product by 7 for 378, observing to arrange the lines correctly, by placing under the right-hand figure of every multiplier the right-hand figure of the corresponding product.

Division. 7. *Division* is the method of finding how often one given number contains another.

Of these two numbers, the former is called the *dividend*, and the latter the *divisor*. The number expressing the times that the first contains the second is called the *quotient*. When the number of times is not exact, the excess of the dividend over the divisor taken the greatest number of times that the dividend contains it exactly is called the *remainder*.

As multiplication is a short method of addition, division (which is the converse of multiplication) is an abridged subtraction. Were we to subtract the divisor from the dividend, subtract it again from the remainder, and continue the process till a remainder less than the divisor were obtained, the number of subtractions would give the required quotient. But this operation is greatly shortened by means of multiplication. Thus, if it is required to find how often 9 is contained in 49, remembering that 5×9 is 45, and that this is the nearest product not greater than 49, we have at once the quotient 5 and remainder 4.

In dividing, *e.g.*, 167685 by 287, by the ordinary process of *long division*, we find (after, it may be, a trial or two) that 1676 is more than 5 times but less than 6 times 287. The first quotient figure is therefore 5, representing 500; and proceeding in the customary way, we take from the dividend 500 times the divisor, then 80 times, and then 4 times, with 77 over. The dividend, therefore, contains the divisor 584 times, with a remainder of 77.

When the divisor does not exceed 12, the operation is conducted mentally, and the quotient set down at once. This is called *short division*. If the divisor is made up of factors not greater than 12, short division may be employed, the factors being taken in succession. When there are two such divisors, the remainder of the whole division is obtained from the partial remainders, by multiplying the second of these by the first divisor, and adding the first to the product. Thus, in the annexed example, division by 48 gives a remainder of 32, for it will be seen that 725 is 5 more than 8 times 90, and 4352 is 2 more than 6 times 725. Therefore, 4352 is 2 more than the sum of 48 times 90 and 6 times 5, *i.e.*, it exceeds 48 times 90 by $6\times5+2=32$, or contains 48 90 times and 32 over.

```
6)4352
8)725—2
   90—5
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Measures and Multiples of Numbers.—8. A *measure* of any number is a number that divides it without a remainder. A *multiple* of any number is a number that it divides without a remainder. A *common measure*, or *common multiple* of several numbers, is a number which is a measure or a multiple of each of them. Thus, 3 is a common measure of 12, 18, and 24; 60 is a common multiple of 6, 10, and 15. A measure of a number is sometimes called a *submultiple* of it. Measures and multiples.

A *prime number* is a number which no other, except unity, divides without a remainder; as 2, 3, 5, 7, 11, 13, 17, &c. Numbers which are divisible by other numbers without remainder, that is, which can be resolved into factors, are called *composite numbers*; as 4, 6, 8, 9, 10, &c. Any factors into which a composite number can be divided are called its *component parts*. Numbers are said to be *prime to each other* when they have no common measure, as 15 and 28. The *prime factors* of a number are the prime numbers of which it is the continued product. Thus, 2, 3, 7 are the prime factors of 42; 2, 2, 3, 5, of 60

9. To find the *greatest common measure* of two given numbers, the greater number is divided by the less; the former divisor is then divided by the remainder, and each successive divisor by the remainder obtained in dividing by it, till there is no remainder. The last divisor is the greatest common measure. Greatest common measure.

This depends on the two following principles:—(1.) If a number measures any other, it measures every multiple of that other; for obviously, since 7 measures 56, it also measures 12 times or 17 times 56; and, (2.) Every number that is a common measure of two others measures also their sum or their difference; for the sum or difference of, say, 13 times 8 and 22 times 8, must, it is evident, be some multiple of 8.

Thus, to find the greatest common measure of 475 and 589, dividing 589 by 475, we have the remainder 114; dividing 475 by 114, we have the remainder 19; and 114 divided by 19 leaves no remainder. Therefore, 19 is the greatest common measure. For any number that measures 589 and 475 will measure their difference, 114, and will, therefore, measure 456, which is a multiple of 114. Also, any common measure of 475 and 456 will measure their difference, 19. Therefore, no number greater than 19 can measure both 589 and 475. Again, 19 will measure both, for it measures 114, and therefore measures 456, a multiple of 114. Hence it measures 475, which is $456+19$, and also 589, which is $475+114$. Therefore, 19 measures both numbers, and since no greater number does so, it is their greatest common measure.

In seeking for measures or factors, it will be of advantage to attend to the following properties of numbers. (For the sake of brevity, we use "divisible" here for "divisible without remainder.")

(1.) A number is divisible by 2, if the last digit is divisible by 2; by 4, if the last *two* digits are divisible by 4; and by 8, if the last *three* digits are divisible by 8. For, to take the last case, the figures preceding the last three are a multiple of 1000, which is a multiple of 8. If, then, the last three figures are divisible by 8, so is the whole number.

(2.) Similarly, and for precisely similar reasons, a number is divisible by 5, if its last digit is so; *i.e.*, if the number ends with 5 or 0; by 25, if it ends with 25 or 75; and by 125, if it ends with 125, 625, 375, or 875.

(3.) A number is divisible by 9 when the sum of its digits is so divisible. This is a case of the important property that the division of a number by 9 produces the same remainder as the division of the sum of its digits by 9. Taking any number, *e.g.*, 583, we see that it is made up of 58 tens and 3; that is, of 58 nines and 58 and 3. Again, 58 is 5 tens and 8; that is, 5 nines and 5 and 8. Thus, 583 is made up of 58 nines, 5 nines, and $5+8+3$; that is, of nines + the sum of its digits. Therefore 583 and $5+8+3$ must give the same remainder when divided by 9.

A proof of multiplication, by "casting out the nines," depends on this property. If a number, made up, say, of nines and 7 over, be multiplied by another made up of nines and 5 over, their product must be nines and 35, that is, nines and 8 over; and unless this relation holds good, there must be an error in the multiplication.

(4.) Similarly, a number is divisible by 3, if the sum of its digits is so; for, if every number be made up of nines and the sum of its digits, it must be made of threes and the same sum.

(5.) A number is divisible by 11, if the sums of its alternate digits are equal, or if they differ by a multiple of 11. Take any number whose alternate digits are equal, or differ by a multiple of 11, as 8294. This is equal to the sum of 8000, 200, 90, and 4; that is, of 80 times 99, 80, twice 99, 2, 90, and 4. Leaving out the multiples of 99 (as being multiples of 11), we have $80+90+2+4$. But as $2+4$ and a multiple of 11 give $8+9$, therefore, if $80+90+2+4$ be divisible by 11, so must $80+90+8+9$ be, and *vice versa*. But $88+99$ is divisible by 11; so, therefore, is $80+90+2+4$, and so also 8294.

If, in finding the greatest common measure by the method described, a divisor occurs containing a factor that evidently does not measure one of the numbers given, that factor may at once be omitted, since it can be no part of the common measure. Thus, in finding the greatest common measure of 59241 and 223014, we get 13950 as a divisor. Now, 50 divides this, *i.e.*, $5 \times 5 \times 2$, and neither 5 nor 2 measures the first of the given numbers. We can therefore reduce 13950 to 279 at once, whence we immediately find 93 to be the greatest common measure.

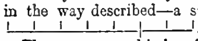
Least common multiple

10. To find the *least common multiple* of two given numbers, divide either of the numbers by the greatest common measure of the two, and multiply the other number by the quotient. Thus, the greatest common measure of 30 and 48 is 6. Therefore the least common multiple is 48×5 or 30×8, *i.e.*, 240. For the product $5 \times 6 \times 8$ is evidently a common multiple of 30 (*i.e.*, 5×6) and 48 (*i.e.*, 6×8), and since 8 and 5 are prime to each other, this product must be the least that contains both 5×6 and 6×8.

To find the least common multiple of any given numbers, arrange them in a line, and strike out any of them that measure any of the others; take any number that measures all or part of the remainder, and divide all that it measures by that number, setting down the quotients and the undivided numbers in a second line; proceed with this second line as with the first, and continue this process till a line is obtained of numbers prime to each other. The continued product of the divisors and the numbers in the last line is the least common multiple required. This depends on the principle just demonstrated, that a common factor of two or more numbers needs to be taken but once for the common multiple.

In finding the least common multiple of 42, 45, 50, 54, 60, 63, 70, 75, and 90, for instance, we may divide in succession by 5, 7, 5, and 6. It is evident that 45 may be omitted, since it will measure every multiple of 90. The division by 5 is virtually the substitution for 50, 60, 70, 75, and 90, of the product $5 \times 10 \times 12 \times 14 \times 15 \times 18$, which is manifestly a common multiple of them. Then 14 and 18 are omitted, being contained in 42 and 54. Next we substitute for 42 and 63 the product $7 \times 6 \times 9$; omit 6 and 9 as being contained in 54; then take $5 \times 2 \times 3$, instead of 10 and 15; omit 2 and 3, as measures of 12; and, lastly, substitute $6 \times 9 \times 2$ for 54 and 12. The product of 5, 7, 5, 6, 9, 2, gives 18900 as the least common multiple.

If the divisors are all prime numbers, the result must be the *least* common multiple; and it is better to avoid using composite numbers as divisors, except when they measure *all* the numbers in the line. Had 10, for instance, been taken in the example as the first divisor, 75 would have remained in the second line, and the result obtained would have been five times too great. It is often found convenient to write the prime factors of the least common multiple, which is in the example $2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5 \times 7$.

Fractions.—11. If unity be divided into any number of equal parts, one or more of these parts is called a *fraction*. If, for example, we divide unity into 7 equal parts, and take 5 of these, we shall obtain the fraction we speak of as five-sevenths. (This, and what follows, may be familiarly illustrated by taking any object and dividing it in the way described—a straight line, for instance, thus, .) Fractions.

There are two kinds of fractions—*Vulgar Fractions*, often spoken of simply as *Fractions*, and *Decimal Fractions* or *Decimals*.

A vulgar fraction is represented by two numbers, called the *terms* of the fraction, which are written, the one above and the other below a horizontal line; thus, the fraction already mentioned is written $\frac{5}{7}$. The number under the line indicates the number of equal parts into which unity is divided, and is called the *denominator*,[1] as showing the "denomination" (see § 32) of the fraction. The number above the line, indicating the number of those equal parts that the fraction consists of, is called the *numerator*.

The most usual definition of a fraction is that which is given above. But it may be also defined or regarded as one number divided by another, the numerator being the dividend, and the denominator the divisor. Thus, the fraction $\frac{5}{7}$, which we have interpreted to mean 5 of the 7 parts into which unity is supposed to be divided, may also be regarded as the seventh part of 5 units. For, if each of 5 units be divided into 7 equal parts, there will be in all 35 of these parts, each of them equal to the seventh part of unity, and the seventh part of these 35 parts is 5 of them. That is, the seventh part of 5 units is the same as 5 seventh parts of unity, or $\frac{5}{7}$ according to the former definition. It follows from this that, when there is a remainder after division, the quotient is completed by the addition of a fraction, of which the remainder is the

[1] Though the word employed to express the denominator (*e.g.*, the "sevenths" in "five-sevenths") agrees in form with the ordinal numeral, this use of it is not ordinal. *The seventh day* means the seventh in order of time; but *the seventh part of a day* is one, *any* one of seven equal parts into which the day is regarded as divided. Some such distinct name as "fractional numerals" should be given to the words when used in the latter sense. The expressions "first part" and "second part" are never used in the fractional sense. For the latter "half" is used; there is no fractional corresponding to the former. $\frac{1}{32}$, however, is called the thirty-second part; and so $\frac{9}{32}$, $\frac{4}{21}$, &c., are read *nine thirty-seconds*, *four twenty-firsts*, &c.

numerator, and the divisor the denominator. For, let it be required to divide 76 by 9. Since 72 divided by 9 gives the quotient 8, and 4 divided by 9 gives $\frac{4}{9}$, 76 divided by 9 must be $8\frac{4}{9}$.

A *proper fraction* is one whose numerator is less than its denominator; as $\frac{9}{10}$, $\frac{12}{20}$. An *improper fraction* is one whose numerator is not less than its denominator; as $\frac{5}{5}$, $\frac{9}{5}$. A proper fraction is evidently less, and an improper fraction not less, than unity. A *mixed number* is an integer or whole number with a fraction annexed to it; as $8\frac{1}{2}$, $5\frac{7}{12}$. The integer and fraction here are to be considered as added together. A *simple fraction* is a single fraction that has both its terms whole numbers; as $\frac{4}{5}$, $\frac{8}{5}$. A *compound fraction* is a fraction of another fraction, or of a whole or mixed number; as $\frac{2}{3}$ of $\frac{5}{6}$, $\frac{3}{8}$ of $10\frac{2}{3}$. A *complex fraction* is one that has a fraction or mixed number for one of its terms or for both; as $\frac{\frac{3}{4}}{4\frac{1}{3}}$, $\frac{3}{4\frac{2}{7}}$, $\frac{6\frac{2}{3}}{5}$. A fraction is said to be *in its lowest terms* when the numerator and denominator have no common divisor.

12. If both terms of a fraction be multiplied, or both divided, by the same number, the value of the fraction will remain unchanged. For, if unity be divided into 7 equal parts, and again into 28 equal parts, it is evident that each of the former parts will be identical with 4 of the latter. 5 of the former will thus be equal to 20 of the latter; that is, $\frac{5}{7}=\frac{20}{28}$.

13. We multiply or divide a fraction by any number, if we multiply or divide the numerator by it. For it is evident that four times $\frac{2}{9}$ is $\frac{8}{9}$, since unity is divided into 9 parts in both cases, and the number of parts taken in the one case is four times the number taken in the other. Conversely, dividing $\frac{8}{9}$ by 4, we have $\frac{2}{9}$.

To multiply or divide either term of a fraction is the same as to divide or multiply the other. If, for instance, we divide the denominator by 3, we divide unity into one-third of the number of parts, and each of these parts must thus be three times greater than before. The fraction is therefore multiplied by 3. Or otherwise, dividing the denominator of $\frac{2}{9}$ by 3, we obtain $\frac{2}{3}$; and multiplying the numerator by 3, we get $\frac{6}{9}$, which (§ 12) is the same as $\frac{2}{3}$. Therefore, to divide a fraction, we may multiply the denominator,—a method which must be employed when the divisor is not a measure of the numerator.

14. To reduce a fraction to its *lowest terms*, divide both terms by their greatest common measure. The reason of this is evident from the definitions. The value of the fraction remains unchanged (§ 12). The results of operations in fractions should, with rare exceptions, be expressed in their lowest terms.

15. To reduce a *mixed number* to an *improper fraction*, the integer is multiplied by the denominator of the fraction, and the numerator added to the product. This gives the numerator of the required improper fraction, and the denominator of the given fraction is its denominator. Take, *e.g.*, $4\frac{5}{8}$. If unity be divided into 8 equal parts, 4 units will make 32 of these parts, and the fraction $\frac{5}{8}$ contains 5 of them; therefore $4\frac{5}{8}=\frac{37}{8}$. Conversely, to reduce an *improper fraction* to a *whole* or *mixed number*, divide the numerator by the denominator; the quotient is the integer required, and the remainder, if there is one, is the numerator of a fraction of which the given denominator is the denominator. Thus, $\frac{38}{7}=5\frac{3}{7}$; for, if unity be divided into 7 equal parts, 35 of these parts will be the same as 5 units; therefore 38 parts will be 5 units and 3 parts, *i.e.*, $\frac{38}{7}=5\frac{3}{7}$.

16. To reduce a *compound fraction* to a *simple one*, multiply the numerators together for the numerator of the simple fraction, and the denominators together for its denominator. Thus, $\frac{3}{4}$ of $\frac{5}{7}$ is equal to $\frac{15}{28}$. For, if we divide unity into 7 equal parts, and each of these again into 4, we shall have for the fraction $\frac{5}{7}$ 20 of these parts, *i.e.*, $\frac{20}{28}$ of unity. The fourth part of this is 5 of these parts, and therefore $\frac{3}{4}$ is 15 of them, *i.e.*, $\frac{3}{4}$ of $\frac{5}{7}$ is $\frac{15}{28}$.

Mixed numbers must be put in the form of improper fractions before the multiplication. The reduction of the result to its lowest terms may be effected by removing before multiplication any factors that are common to the numerators and denominators.

In such compound expressions as where one number is spoken of as one-fourth greater or less than another, the fourth is always to be taken of that number with which the comparison is made. Thus, 30 is *one-fifth* more than 25 (*i.e.*, $\frac{1}{5}$ of 25), but 25 is *one-sixth* less than 30 (*i.e.*, $\frac{1}{6}$ of 30).

17. In order to compare the values of fractions, or to add or subtract them, it is necessary to reduce them to others of equal value that *have the same denominator*. From the definition of a fraction we see at once that $\frac{5}{7}$ is greater than $\frac{4}{7}$, but we do not readily see whether $\frac{5}{12}$ is greater or less than $\frac{3}{8}$. If, however, we take the equivalents of these fractions, $\frac{10}{24}$ and $\frac{9}{24}$, unity being now divided into the same number of parts in both cases, we have like quantities to compare, and see that the former fraction is the greater. In practice it is usually the *least* common denominator that the fractions are compared by. To find this, we first find the least common multiple of the denominators (§ 10), then divide this by the denominator of each fraction separately, and multiply both terms of that fraction by the quotient.

Take, *e.g.*, the fractions $\frac{13}{15}$, $\frac{17}{20}$, $\frac{31}{36}$, and $\frac{38}{45}$. The least common multiple of the denominators is 180, and dividing this by 15, 20, 36, and 45, we get 12, 9, 5, and 4. Multiplying both terms of the fractions in succession by these numbers, we have $\frac{156}{180}$, $\frac{153}{180}$, $\frac{155}{180}$, and $\frac{152}{180}$. The value of the fractions has not been altered, and all have now the same denominator, 180, which we must obtain in each case, because we re-multiply the factors into which we resolved it. In practice, indeed, we merely divide 180 by 15, multiply 13 by the 12, and set down 180 under 156 at once.

18. To *add* fractions, reduce them to others having a common denominator, then add the numerators of these, and write the common denominator under the sum. Thus, $\frac{5}{12}+\frac{1}{8}+\frac{7}{20}=\frac{50}{120}+\frac{15}{120}+\frac{42}{120}=\frac{107}{120}$. In each of the reduced fractions unity is divided into 120 equal parts, and the fractions are respectively equivalent to 50, 15, and 42 of these parts; therefore the sum of the fractions must be $50+15+42=107$ of them, *i.e.*, $\frac{107}{120}$.

Compound fractions must be reduced to simple ones before addition. Mixed numbers *may* be brought to improper fractions, and so added; but it is generally preferable to add the whole numbers and the fractions separately, and then add the two results. The operation may often be shortened by first adding any of the given fractions whose denominator is considerably less than that of all the fractions; thus, to add $\frac{25}{36}$, $\frac{13}{24}$, $\frac{33}{56}$, $\frac{36}{47}$, the sum of the first three may be found first, amounting to $1\frac{52}{63}$. The addition of $\frac{36}{47}$ to this gives $2\frac{1761}{2961}$.

19. To *subtract* fractions, reduce them to others having a common denominator, take the difference of the numerators so found, and write the common denominator under it. The principle is precisely the same as in addition.

Compound fractions must be simplified as in addition. With mixed numbers the subtraction will generally be best effected by treating the fractions separately, borrowing and carrying, if necessary, on the principle explained in § 5. In subtracting $47\frac{25}{28}$ from $85\frac{23}{36}$, for instance, borrowing $\frac{252}{252}$ and carrying 1 gives $85\frac{413}{252}-48\frac{225}{252}=37\frac{188}{252}$, or $37\frac{47}{63}$.

20. To *multiply* fractions, multiply the numerators together for the numerator of the product, and the denominators together for the denominator. Thus, in multiplying $\frac{5}{8}$ by $\frac{7}{9}$, if we multiply $\frac{5}{8}$ by 7, we have $\frac{35}{8}$ (§ 13); but our multiplier, $\frac{7}{9}$, is the ninth part of 7; we must therefore divide $\frac{35}{8}$ by 9, which gives $\frac{35}{72}$ (§ 13).

When there are several fractions to be multiplied continuously together, we proceed in the same way. Mixed numbers are reduced to improper fractions, and common factors may be struck out, precisely as in § 16. When an integer has to be multiplied by a fraction, we may convert the integer into a fraction by putting 1 as the denominator; or we may multiply the integer by the numerator of the fraction and divide by the denominator, since to multiply by $\frac{7}{9}$ is, as has just been shown, to multiply by 7 and divide by 9. So, to multiply an integer by a mixed number, the common method is to multiply by the integer and the fraction of the latter separately, and add the results. In multiplying mixed numbers like $46\frac{1}{4}$ and $14\frac{1}{3}$ together, instead of using improper fractions, we may take the four products 46×14, $\frac{1}{4} \times 14$, $46 \times \frac{1}{3}$, and $\frac{1}{4} \times \frac{1}{3}$, and add them. The amount is $644 + 3\frac{1}{2} + 15\frac{1}{3} + \frac{1}{12} = 662\frac{11}{12}$.

21. To *divide* fractions, invert the terms of the divisor (*i.e.*, interchange the positions of the numerator and denominator), and multiply the dividend by the inverted fraction; thus, $\frac{5}{8} \div \frac{7}{9} = \frac{5}{8} \times \frac{9}{7} = \frac{45}{56}$. If we divide $\frac{5}{8}$ by 7, we have $\frac{5}{56}$ (§ 13). But since our divisor, $\frac{7}{9}$, is the ninth part of 7, in dividing by 7 we divide by a number nine times too large. The true quotient must therefore be nine times $\frac{5}{56}$, *i.e.*, $\frac{45}{56}$.

The common method of dividing an integer by a mixed number is a modification of this division. When, in dividing by $37\frac{4}{5}$, for instance, we multiply both divisor and dividend by 5, and then divide, we really multiply the dividend by $\frac{5}{189}$. Or the method may be explained on the principle (identical with that of § 12) that the multiplication of the divisor and dividend by the same number does not affect the quotient. As an instance of the division of a mixed number by an integer, let $3982\frac{22}{35}$ be divided by 54. The quotient is 73, with remainder $40\frac{22}{35}$; and to obtain the complete quotient, this remainder must be divided by 54 (see § 11), giving $\frac{1422}{35} \times \frac{1}{54} = \frac{79}{105}$; *i.e.*, $73\frac{79}{105}$ is the result of the division.

A *complex fraction* is reduced to a *simple one* by dividing the numerator by the denominator; thus,

$$\frac{6\frac{5}{12}}{10\frac{1}{9}} = \frac{77}{12} \times \frac{9}{91} = \frac{33}{52}.$$

When one term only is fractional, it will be found convenient to multiply both terms of the complex fraction by the denominator that occurs in the fractional term; thus,

$$\frac{13\frac{3}{4}}{22} = \frac{13\frac{3}{4} \times 4}{22 \times 4} = \frac{55}{22 \times 4} = \frac{5}{8}.$$

Decimals.

Decimals.—22. In the ordinary denary notation, a figure in combination with others has only the tenth part of the value it would have if removed a place towards the left (§ 1); thus, in 374, the 3 signifies 3 times 100; the 7, 7 times 10; the 4, simply 4. By an extension of this notation we obtain a species of fractions that are often of very great use, especially for purposes of comparison. If we mark the place of units by a point put after it, and write other figures after the point, we can denote by the first of these figures one-tenth of the value it would have in the units' place; by the second, one-hundredth part, and so on. In 374·691, then, the 6 is 6 times $\frac{1}{10}$, *i.e.*, $\frac{6}{10}$; the 9, 9 times $\frac{1}{100}$, or $\frac{9}{100}$; and the 1, $\frac{1}{1000}$. Whence, by giving these fractions a common denominator and adding them, we have $374{\cdot}691 = 374\frac{691}{1000}$. These *decimal fractions* or *decimals*, therefore, are fractions of which the numerator only is written, the denominator being the continued product of as many tens as there are decimal figures.

In addition, subtraction, multiplication, and division of decimals, the operations are, and from the structure of decimals must be, the same as the like operations with integers. The position of the decimal point in the results is the only thing that needs particular explanation.

Results, it may be mentioned here, are often expressed by decimals that are not exact, but approximate only, it being held sufficient to give the correct value to some assigned number of decimal places. An amount correct to four decimal places differs from the true amount by less than the ten-thousandth part of unity. See above, p. 524

To reduce a decimal to a vulgar fraction, write the decimal as the numerator of the fraction, and set under it for the denominator 1 followed by as many ciphers as there are decimal places. This follows at once from the definition of a decimal.

To reduce a vulgar fraction to a decimal, annex ciphers to both terms of the fraction—the same number in both cases; divide both terms by the significant figures of the denominator, and then write the numerator as a decimal, pointing off as many decimal places (prefixing ciphers, if necessary) as there are ciphers in the denominator. (See also § 25, *infra.*) Thus, $\frac{3}{400} = \frac{300}{40000} = \frac{75}{10000} = {\cdot}0075$. Here the vulgar fractions retain their values unchanged (§ 12), and from the last the decimal is set down according to the definition.

It very often happens that in dividing as above we find there must always be a remainder. In this case, however, a remainder we had before may soon recur, giving the same figure or group of figures over and over again in the quotient; thus $\frac{17}{36}$ is found to be ·47222.....; $\frac{53}{925}$ is ·05729729...... The recurring figures are distinguished by points placed over them, the above results being written ${\cdot}47\dot{2}$ and ${\cdot}05\dot{7}2\dot{9}$. We shall return to the consideration of these recurring decimals at § 26.

23. To *add* or *subtract* decimals, write the numbers under each other, placing units under units, &c., add or subtract as with integers, and place the decimal point under the points in the given numbers. This follows directly from the definition of decimals.

24. To *multiply* decimals, multiply as with integers, and point off as many decimal places as there are in both factors taken together. Thus, in $37{\cdot}64 \times {\cdot}082 = 3{\cdot}08648$, the 4 and 2 in the factors are $\frac{4}{100}$ and $\frac{2}{1000}$, their product is therefore $\frac{8}{100000}$, *i.e.*, ·00008; and so with the others.

If an approximate product be sufficient, the multiplication may be shortened thus. Let it be required to find the product, say, of 4·273 and 6·859 correct to three places of decimals. Write the figures of the multiplier in reverse order, with the unit figure under the third decimal place of the multiplicand. Begin each multiplication with the figure above the multiplier, adding what has to be carried from the right hand figure, and observing to carry the *nearest* ten (*i.e.*, for 36, for instance, not 3, but 4); place the first figures of each multiplication under each other; then add and point off three decimal places. It will be seen that every figure of the product falls into its proper place, *e.g.*, the 8 and 7, the 5 and 2, &c., each give thousandth parts.

$$\begin{array}{r} 4273 \\ \underline{9586} \\ 25638 \\ 3418 \\ 214 \\ \underline{38} \\ 29{\cdot}308 \end{array}$$

25. To *divide* decimals, divide as with integers, and point off as many decimal places in the quotient as the dividend has more than the divisor. This follows from the dividend being the product of the divisor and quotient. *Exs.* $228{\cdot}956 \div 3{\cdot}64 = 62{\cdot}9$; $2{\cdot}28956 \div 36{\cdot}4 = {\cdot}0629$; $22895{\cdot}6 \div {\cdot}364 = 62900$. In the second example, the

dividend having five decimal places and the divisor one, the quotient must have four; a cipher is therefore prefixed to the three figures. In cases like the third example, where the dividend has fewer decimal places than the divisor, the number has to be made up in the former by ciphers, and as far as the end of the ciphers making up that number the quotient must be an integer. The quotient may be pointed at any stage after as many decimal places of the dividend have been made use of as there are in the divisor, the first figure after this being always the first decimal. This is especially to be attended to when the division does not terminate, or when a few figures only are required; thus, 63·94 divided by ·237 to two decimal places gives 269·79; 10 divided by ·264 gives 37·87.

The method of converting a vulgar fraction into a decimal, given in § 22, is in effect the division of the numerator by the denominator, the result being expressed as a decimal. Thus, $\frac{83}{160} = 83 \div 160 = \cdot 51875$.

When the quotient is required to a given number of places only (as three in the example), the operation may be shortened by dropping the last figure of the divisor at each successive multiplication. But this must not be commenced till the figures required in the quotient are fewer than the figures in the divisor, and the carriage from the dropped figure is to be added in each instance.

```
·63584)272·182(428·067
       254336
       ------
        178460
        127168
        ------
         51292
         50867
         -----
           425
           381
           ---
            44
            44
            --
```

26. We have seen that the division by means of which vulgar fractions are converted into decimals (§§ 22, 25) will, in certain cases, always leave a remainder. If the fraction be in its lowest terms, there *must* always be a remainder whenever the denominator contains any other prime number as a factor besides 2 and 5. For in adding ciphers we multiply by tens, and we introduce no other factor. It often happens that we can speedily discover what the decimal must be, so as to be able to set down any number of figures without further actual division. Unless the division terminate, the same figures will recur sooner or later; and the same figures must recur before we use as many ciphers as there are units in the divisor. Supposing the divisor is 17, we can only have the numbers from 1 to 16 as remainders; the quotient must therefore repeat itself after all these remainders occur, if not earlier. All do occur in dividing by 17; thus,

$$\frac{2}{17} = \cdot\dot{1}17647058823529\dot{4}.$$

The fraction $\frac{5}{12}$ must always be greater than the decimal ·41666...., however far the latter be extended; but we can make the difference as small as we choose. Thus ·416666 does not differ from $\frac{5}{12}$ by the millionth part of a unit. The form of the decimal $\cdot 41\dot{6}$ is used to show that the 6 is to be considered as repeated continually; and this being understood, we can say that the decimal is *equal to* $\frac{5}{12}$.

Decimals of this kind are called *Recurring Decimals*. They are sometimes distinguished as *Repeating* or *Circulating Decimals*, according as one figure or more than one recur; and as *Pure* or *Mixed*, according as the recurring figures stand alone or are preceded by non-recurring decimals. Thus, $\cdot\dot{1}4\dot{8}$ is a pure circulating decimal; $\cdot 18\dot{3}$ is a mixed repeating one.

27. To reduce a recurring decimal to a vulgar fraction, subtract the decimal figures that do not recur from the whole decimal; set down the remainder as the numerator of the fraction, and as many nines as there are recurring figures, followed by as many ciphers as there are non-recurring figures, as the denominator.

The reason of proceeding in this way will appear if, taking any mixed recurring decimal, we multiply it by as many tens as there are decimal places, and again by as many tens as there are non-recurring decimals, and subtract the second product from the first. Take, *e.g.*, $\cdot 79\dot{0}5\dot{4}$:

$$100000 \text{ times } \cdot 79\dot{0}5\dot{4} = 79054\cdot 054054054\ldots.$$
$$\text{and} \quad 100 \text{ times } \cdot 79\dot{0}5\dot{4} = 79\cdot 054054054\ldots.$$
$$\text{therefore} \quad 99900 \text{ times } \cdot 79\dot{0}5\dot{4} = 78975$$
$$\text{whence } \cdot 79\dot{0}5\dot{4} = \tfrac{78975}{99900}, \text{ i.e., } \tfrac{117}{148}.$$

In the case of pure recurring decimals, we have no subtraction, and the denominator consists entirely of nines. Thus $\cdot\dot{3} = \frac{3}{9} = \frac{1}{3}$; $\cdot\dot{2}\dot{7} = \frac{27}{99} = \frac{3}{11}$.

28. In practical arithmetic recurring decimals are little used, except in approximations. They can be added or subtracted readily to any number of places by extending all a place or two beyond what is required. When we have to multiply or divide by recurring decimals, we must convert them into vulgar fractions. They may themselves be multiplied or divided by integers or ordinary decimals, though in this case, too, it is often better to use vulgar fractions, especially when exact results are desired.

Powers and roots.

Powers and Roots of Numbers.—29. When a given number is multiplied by itself, the product multiplied again by the number, and so on, the result obtained is called the second, third, fourth, &c., *power* of the number, according as it is the product of the number repeated two, three, four, &c., times. Thus, $7 \times 7 \times 7 = 343$ is the third power of 7; $5 \times 5 \times 5 \times 5 = 625$, the fourth power of 5. The term "square" is nearly always used instead of "second power" (*e.g.*, 81 is the square of 9), and "cube" frequently instead of "third power." The power to which a number is raised is indicated by a small figure written over the number to the right; thus, 8^5 is the fifth power of 8.

The *square root* of a given number is the number which, when multiplied by itself, produces the given number. And so, in general, whatever *power* one number is of another, the same *root* is the second of the first. Thus, 7 is the third root, or cube root, of 343; 5 is the fourth root of 625; 2 is the fifth root of 32. The sign $\surd$ (which is really an *r*, from *radix*, a root) prefixed to a number indicates a root of it. The simple sign stands for the square root; a figure is placed over it to denote other roots. Thus, $\surd 100$ is the square root of 100; $\sqrt[4]{256}$, the fourth root of 256.

Extraction of square root.

30. To extract the *square root* of a given number, divide it into periods of two figures, by putting a point over every second figure, commencing with that in the units' place; set down as the first figure of the root, the largest number whose square does not exceed the first or left-hand period; place the square of this number under the first period, and subtract it from it; to the remainder annex the next period; place before this as a trial divisor twice the root figure; consider how often the former (omitting the right-hand figure) contains the latter, and set down the number that expresses this as the next figure of the root; place also this root-figure to the right of the trial divisor; multiply by it the divisor thus completed; subtract the product from the number formed of the former remainder and the period taken down; add another period to the remainder now found; then double the whole root for a new trial divisor, and proceed as before.

```
      58̇21̇69̇(763
      49
      --
  146)921
      876
      ---
  1523)4569
       4569
       ----
```

The 58 of the example being 580000, the 49 must be 490000, and the root 700. So the 146 is 1460: the 921, 92100; the 6 is 60; and so on. This explains the principle of pointing in periods of two figures.

In place of doubling the whole root for every trial divisor, it will be sufficient to add to the preceding complete divisor its last figure; thus, $146 + 6 = 152$. The 7 has been already doubled in 14, and this doubles the 6.

The reason of proceeding as above will appear from the composition of an ordinary product. Thus, 23×23 is the sum of the four products 20×20, 3×20, 20×3, and 3×3, *i.e.*, 20^2, twice 20×3, and 3×3. Taking away, then, the square of 20, *i.e.*, 400, the remainder must be the sum of $2 \times 20 \times 3$, and 3×3, *i.e.*, 3 times the sum of 2×20 and 3, which we obtain by the method adopted.

```
   23
   23
   --
   69
  46
  ---
  529(23
  4
43)129
   129
   ---
```

If there is a remainder, ciphers may be taken down in pairs, and as many decimal places obtained as we please. In this case there must always be a remainder, since no unit multiplied by itself produces ciphers. After getting half the decimal places required, we may proceed by contracted division (§ 25).

To extract the square root of a vulgar fraction, we find the roots of the numerator and denominator separately. For, since $\frac{3}{4} \times \frac{3}{4} = \frac{9}{16}$, the square root of $\frac{9}{16}$ must be $\frac{3}{4}$. If either term of the fraction is not a complete square, it should be reduced to a decimal. Thus, $\sqrt{\frac{1}{2}} = \sqrt{\cdot 5} = \sqrt{\dot{0}\cdot\dot{5}0} = \cdot 7071067812$ nearly.

Extraction of cube root.

31. To extract the *cube root* of a given number, point off the number from the units' place into periods of three figures; write under the first period the greatest cube contained in it, subtract, and annex the next period to the remainder; then, regarding the root found as tens, multiply the square of it by 3 for a trial divisor, and divide by this for the next figure of the root; to the trial divisor add three times the product of the two root numbers (the first being tens), and also the square of the last root figure; multiply the sum by the last root figure; subtract the product from the number obtained by taking down last period; annex the next period to the remainder, and proceed as before.

```
                                78402752(428
                                64
40² × 3         =   4800 | 14402
40  × 2 × 3     =    240 |
          2²    =      4 |
                  ------ | -----
                    5044 | 10088
                                 ---------
420² × 3        = 529200 | 4314752
420  × 8 × 3    =  10080 |
         8²     =     64 |
                  ------ |
                  539344 | 4314752
                           -------
```

For demonstration of the reason of this process, see ALGEBRA, vol. i. p. 528. It depends on the form of the product obtained in raising a number to its third power. Thus, $24 \times 24 \times 24$ is 24 times $20^2 + 2 \times 20 \times 4 + 4^2$, which will be found to be $20^3 + 3 \times 20^2 \times 4 + 3 \times 20 \times 4^2 + 4^3$. And this is 20^3 added to 4 times $3 \times 20^2 + 3 \times 20 \times 4 + 4^2$, which agrees with the process described above.

II. Practical Arithmetic.

32. Having explained in the foregoing sections the various operations of arithmetic, we now proceed to consider them in their combinations and practical applications. What has been said up to this point refers to numbers merely as numbers, or numbers in the abstract. Now they are to be regarded as applied to particular things, or representing particular magnitudes. Numbers so regarded are called *concrete;* and we now treat of *concrete* as distinguished from *abstract* arithmetic. Concrete numbers frequently represent not so much number as quantity. To form a distinct and accurate idea of 5 lb of tea bought for 15s., it is not necessary to think of the tea as divided into five portions, or as paid for with fifteen pieces of money.

It would be found extremely (indeed intolerably) inconvenient to have to make all payments, great and small, by means of one particular species of coin, or to serve out all quantities of goods, using only one kind of weight or measurement. Various monies, weights, and measures are therefore in customary use, this or that being employed in each particular case according to circumstances. When these measures are of the same kind, differing only in the unit of one of them being so many times the unit of another, they are said to be of different *denominations;* as, pounds, shillings, pence; or again, yards, feet, inches.

In addition and subtraction, the quantities added and subtracted must be either abstract numbers or concrete quantities of the same kind. In multiplication, the multiplicand may be concrete, but the multiplier is regarded in the process as abstract. If 20 men, for example, receive £5 each, the £5 is not multiplied by 20 *men*, but taken 20 *times*, the number of times merely corresponding to the number of men. In division, when the dividend is concrete, the divisor may be abstract, giving a concrete quotient of the same kind as the dividend, or concrete giving an abstract quotient. Thus, £100 may be divided into 20 parts, giving £5 as quotient, or it may be divided into parts of £5 each, giving as quotient the abstract number 20, *i.e.*, containing £5 20 times. A fraction is strictly abstract, though we often write £$\frac{5}{9}$ and the like for $\frac{5}{9}$ of £1.

33. The following are the tables of monies, weights, and measures in common use:—[1] Tables.

I. *Money.*

4 farthings	=	1 penny, *d.*
12 pence	=	1 shilling, *s.*
20 shillings	=	1 pound, £ or *l.*

II. *Avoirdupois Weight.*

16 drams, *drs.*	=	1 ounce, *oz.*
16 ounces	=	1 pound, *lb.*
28 pounds	=	1 quarter, *qr.*
4 quarters	=	1 hundred-weight, *cwt.*
20 hundredweights	=	1 ton.

III. *Troy Weight.*

24 grains, *grs.*	=	1 penny-weight, *dwt.*
20 pennyweights	=	1 ounce, *oz.*
12 ounces	=	1 pound, *lb.*

IV. *Length.*

12 inches, *in.*	=	1 foot, *ft.*
3 feet	=	1 yard, *yd.*
5½ yards	=	1 pole or perch, *po.*
40 poles	=	1 furlong, *fur.*
8 furlongs	=	1 mile, *mi.*

V. *Surface.*

144 square inches	=	1 square foot.
9 sq. feet	=	1 sq. yard.
30¼ sq. yards	=	1 sq. pole.
40 sq. poles	=	1 rood, *ro.*
4 roods	=	1 acre, *ac.*

VI. *Solidity.*

1728 cubic inches	=	1 cubic foot.
27 cubic feet	=	1 cubic yard.

VII. *Capacity.*

4 gills	=	1 pint, *pt.*
2 pints	=	1 quart, *qt.*
4 quarts	=	1 gallon, *gal.*
2 gallons	=	1 peck, *pk.*
4 pecks	=	1 bushel, *bus.*
8 bushels	=	1 quarter, *qr.*

VIII. *Time.*

60 seconds, *s.*	=	1 minute, *m.*
60 minutes	=	1 hour, *hr.*
24 hours	=	1 day.
365 days	=	1 year, *yr.*

On these tables we make the following remarks:—

I. The guinea is 21 shillings, and the crown 5 shillings. Sales are often made in guineas, though the coin is not now used. Farthings are always written as fractions of a penny. $10\frac{3}{4}d.\ \frac{7}{8}q.$ means tenpence three farthings and seven-eighths of a farthing.

III. *Apothecaries' weight* agrees with this, except that the ounce (℥) is divided into 8 drams (ʒ), and the dram into 3 scruples (℈) of 20 grains.

[1] By an Act of Parliament, passed in 1824, the imperial standard weights and measures are connected in the following way with the *mean solar day*, the length of which is fixed invariably:—The *yard of* 36 inches is determined from the length of a pendulum, vibrating once in a second, which, in the latitude of London, is 39·13929 inches; the *pound troy* of 5760 grains, from a cubic inch of distilled water, weighing 252·458 grains; and the *gallon* as being the space occupied by 10 lb avoirdupois (*i.e.*, 70,000 grains troy) of distilled water, equivalent to 277·274 cubic inches,—all these verifications being made with thermometer at 62° Fahr. and barometer at 30 inches.

IV. In measuring cloth, the yard is divided into 4 quarters, the quarter into 4 nails of $2\frac{1}{4}$ inches.

V. To measure land, the surveyor's chain of 100 links is used. The chain is 22 yards long, and 10 square chains make an acre.

VII. The gallon and lower denominations are liquid measures; the quart and those above it are for dry goods.

VIII. The year, strictly speaking, is 365·24224 days. Every fourth year (leap year) has 366 days.

34. *Reduction* is the method of expressing quantities in a denomination lower or higher than that in which they are given.

To reduce a higher denomination to a lower, multiply in succession by the numbers which show the times that the unit of each denomination (beginning with that given) contains the unit of the one next below it till the denomination is reached to which the quantity is to be reduced. If quantities in intermediate denominations are given, add each as its denomination is reached.

To reduce a lower denomination to a higher, divide in succession by the numbers which show the times that the unit of each denomination (beginning with that given) is contained in the unit of the next above it, observing that the remainder after such division is of the denomination of the dividend.

Sometimes the two processes are combined; thus, in reducing guineas to crowns, we multiply by 21, obtaining shillings, and then divide by 5.

35. *Compound Addition* and *Compound Subtraction* are the addition and subtraction of quantities expressed in more than one denomination.

Compound addition. In Compound Addition, arrange the quantities according to their denominations, each under its proper heading; add the lowest, and reduce the sum by division to the next higher, setting down the remainder, and carrying the quotient; add the others, including carriage, in the same way. Suppose that several sums of money are added, and the farthings amount to 29, that is to $7\frac{1}{4}$d., the $\frac{1}{4}$d. is set down and the 7d. carried to the pence column, and so in other cases.

Compound subtraction. In Compound Subtraction, arrange the quantities as in Compound Addition, placing the greater amount over the other, and subtract, beginning with the lowest denomination. If in any case the lower number exceeds that above it, increase the latter by as many as make one of the next higher denomination, and afterwards add one to that denomination in the lower line. In subtracting, *e.g.*, 1 qr. 25 lb from 3 qr. 17 lb, since 25 cannot be taken from 17, a quarter, *i.e.*, 28 lb, is added to the 17, making 45; from this 25 is subtracted, leaving 20 lb, and the quarter "borrowed" is taken away again by being added to the 1 qr. The remainder is thus 1 qr. 20 lb.

Fractions of the lowest denomination are to be added or subtracted according to §§ 18, 19; thus, £72, 8s. $3\frac{9}{14}$d. − £45, 17s. $6\frac{17}{21}$d. = £26, 10s. $8\frac{5}{6}$d.

Compound multiplication. 36. *Compound Multiplication* is multiplication in which the multiplicand is expressed in more than one denomination.

When the multiplier does not exceed 12, multiply the different denominations by it, beginning with the lowest, and setting down and carrying as in Compound Addition. When the multiplier consists of several figures, multiply by each separately in the same way, taking them from right to left, and setting the result of each successive multiplication always one place further towards the left in each denomination, and add the results as thus arranged. In the accompanying example the above arrangement puts the product by 90 in the place of tens; and the sums to be reduced to higher denominations are 30 farthings, 104 pence, 148 shillings. If the multiplier be a composite number, we may multiply by the factors in succession. When the multiplier consists of two or more figures, the multiplication is often performed by the whole quantity at once.

£63	12	$7\frac{3}{4}$	
		94	
254	10	$7\frac{0}{4}$	= 4 times.
572	13	$9\frac{3}{4}$	= 90 times.
£5981	8	$8\frac{1}{2}$	= 94 times.

37. *Compound Division* is division in which either the dividend or both dividend and divisor are expressed in more than one denomination. Compound division.

(1.) To find the amount that a given amount contains a given number of times, divide the highest denomination by the given number, reduce the remainder to the next lower denomination, adding the corresponding term of the dividend; divide again, and proceed in the same way with the other denominations. The denominations of the quotient correspond to those of the dividend.

Let it be required, for instance, to divide £370, 16s. $1\frac{3}{4}$d. into 58 equal shares. As 58 shares of £6 each amount to £348, £6 is part of the quotient, and there remains £22, 16s. $1\frac{3}{4}$d. Reducing £22, 16s. to shillings (456), we find that this gives 58 shares of 7s. each, with 50s. over. Similarly we obtain 10d. and 1 farthing, with 29 farthings over, which, since $\frac{29}{58}=\frac{1}{2}$, is just half a farthing for each of the 58 shares. The quotient then is £6, 7s. $10\frac{1}{4}$d. $\frac{1}{2}$q.

(2.) To find the number of times that one given amount contains another, reduce both to the same single denomination, and then divide the one by the other.

To find, for example, how often 12s. $9\frac{3}{4}$d. is contained in £171, 13s. 9d., since 12s. $9\frac{3}{4}$d. = 615 farthings, and £171, 13s. 9d. = 164820 farthings, the number of times the second amount contains the first must be 164820 ÷ 615, *i.e.*, 268. It is to be observed that the quotient here is an abstract number.

38. In multiplying or dividing by fractions or mixed numbers, we follow the methods explained in §§ 20, 21. As an illustration, we give here the multiplication of £24, 5s. $9\frac{1}{2}$d. $\frac{6}{7}$q. by $62\frac{5}{12}$, where we may note that in the division by 12 we have to divide $2\frac{2}{7}$ farthings, giving $\frac{16}{7}$q. × $\frac{1}{12}=\frac{4}{21}$q., and that in adding the fraction we have $\frac{15}{7}+\frac{4}{21}=2\frac{3}{21}+\frac{4}{21}=2\frac{1}{3}$q.

	£24	5	$9\frac{1}{2}$	$\frac{6}{7}$
			$62\frac{5}{12}$	
12)	121	9	$0\frac{1}{2}$	$\frac{2}{7}$
	10	2	$5\frac{0}{4}$	$\frac{4}{21}$
	48	11	$7\frac{1}{4}$	$\frac{5}{7}$
	145	14	$10\frac{1}{4}$	$\frac{1}{7}$
	£1516	2	$7\frac{1}{4}$	$\frac{1}{3}$

39. *Reduction of Fractions and Decimals.*—To find the proper value of a fraction or a decimal of any denomination, multiply the fraction or the decimal by the numbers in succession that reduce the denomination to lower denominations. Reduction of fractions.

Thus, to find the value of $\frac{59}{96}$ of a pound, it is manifest that this is $\frac{59}{96}$ of 20 shillings, *i.e.*, $\frac{59}{96}\times 20$s. = $12\frac{7}{24}$s., or 12s. $3\frac{1}{2}$d.; and so in other cases.

To find the value of a fraction of a quantity consisting of different denominations, we may either first reduce the quantity to one denomination, or we may multiply the compound quantity by the numerator, and divide by the denominator of the fraction; thus, $\frac{2}{9}$ of £5, 7s. $11\frac{1}{4}$d. being the same as the ninth part of twice the amount, we may multiply by 2 and divide by 9, obtaining £1, 3s. $11\frac{3}{4}$d. $\frac{1}{3}$q. as the result.

40. To reduce any amount to the fraction or the decimal of another denomination or amount, reduce both amounts to the same denomination, and write them as the terms of a fraction, the quantity of which the fraction is required being made the denominator. If the decimal is required, convert the vulgar fraction into a decimal.

Thus, to reduce 13s. $1\frac{1}{2}$d. to the fraction and also to the decimal of a pound, since a pound contains 480 halfpence, a halfpenny is $\frac{1}{480}$ of a pound, and therefore 13s. $1\frac{1}{2}$d., *i.e.*, 315 halfpence, is £$\frac{315}{480}$ = £$\frac{21}{32}$ = £·65625.

It is often sufficient to throw the expressions into the reduced form, without actually performing the reduction, and divide the numerator of the complex fraction so obtained by the denominator. Thus, to find the fraction of £$46\frac{31}{50}$ that $\frac{3}{4}$ of $46\frac{2}{5}$ guineas is, both terms may be expressed as shillings,—$\frac{3}{4} \times \frac{232}{5} \times \frac{21}{1}$, and $\frac{2331}{50} \times \frac{20}{1}$; whence, dividing the former by the latter, the required fraction is found to be $\frac{29}{37}$.

In reducing a compound quantity to a decimal of a higher denomination, it is generally best to proceed by successive divisions, beginning with the lowest denomination, and inserting the others as they occur, as in the accompanying example, where 13 cwt. 8 ℔ 12 oz. is found to be ·65390625 of a ton. It is to be noted that the integers here are inserted from the data, and the decimals obtained by division. The form, though somewhat incongruous, is convenient.

```
   16) 12 oz.
   28)  8·75 ℔.
    4)   ·3125 qrs.
  2,0)1,3·078125 cwt.
         ·65390625 tons.
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Practice. 41. *Practice* is the name given to a method of calculating prices from certain rates being *aliquot parts* (that is, exact measures) of other rates.

The basis of this species of calculation is generally £1, and the given price is broken up into portions, the first of which is an aliquot part of a pound, and each of the others an aliquot part of some one before it. By the method adopted we virtually multiply the different aliquot parts in succession by the number of articles given. The sum of the result is the total price.

Proportion 42. *Proportion.*—When the first of four quantities is the same multiple or the same fraction of the second that the third is of the fourth, the first is said to have the same *ratio* to the second that the third has to the fourth, and the four quantities are said to be *proportionals*, or *in proportion.* Thus, since 30 is $\frac{5}{6}$ of 36, and 50 is $\frac{5}{6}$ of 60, the numbers 30, 36, 50, and 60 form a proportion.

The proportion is written $30 : 36 = 50 : 60$, or, more commonly, $30 : 36 :: 50 : 60$. This is read 30 is to 36 as 50 is to 60. It may also be written $\frac{30}{36} = \frac{50}{60}$.

The ratio of two numbers is thus equivalent to the fraction that the one is of the other; and a fraction may therefore be defined as the ratio of the numerator to the denominator.

Ratio is a mere abstract relation between two numbers, or between two concrete quantities of the same kind. The ratio of 4s. to 6s., or of 48d. to 72d., is not shillings or pence, but the abstract fraction $\frac{2}{3}$.

If two quantities of one kind be proportional to two of another kind, when any three are given, the fourth can be found. If, for instance, we know the value of any quantity of goods, we can determine the value of any other given quantity, or the quantity that has any assigned value, —it being always understood that the rate is the same in both cases; that is, that were the quantity doubled, trebled, halved, &c., so also would the value be, or, in other words, that the quantity is proportional to the value. Questions of this sort occur with very great frequency in practical arithmetic. The three quantities given are usually arranged as the first three terms of a proportion, whence the fourth term is found.

The rule by which we proceed in such cases of *Simple Proportion*, as it is called, has often the name given to it of the *Rule of Three.* It is as follows:—Of the three quantities given, set that down for the third term which is of the same kind as what is required. Consider whether the amount to be found will be greater or less than this third term; if greater, make the greater of the two remaining quantities the second term, and the other the first term; but if less, put the less term second, and the greater first. Having thus arranged or "stated" the three terms of the proportion, multiply the second and third together, and divide the product by the first.

The first and second terms must be reduced to the same denomination, and it will often be convenient to reduce the third term to the lowest denomination contained in it.

Ex. 1. If 54 yards of cloth cost 63s., what will 30 yards cost at the same rate?

Stating by the rule, we have 54 yards : 30 yards :: 63s., whence the fourth term is $\frac{30 \times 63}{54} = 35$s.

This process is to be explained by the consideration that, since the rate of price is the same for both quantities, the one price must be the same fraction of the other that the one quantity is of the other; that is, $\frac{54 \text{ yds}}{30 \text{ yds.}} = \frac{63\text{s}}{\text{the price required}}$, or $\frac{30}{54} = \frac{\text{the number of shillings required}}{63\text{s.}}$ Multiplying each of these equal fractions by 63, we have $\frac{30}{54} \times 63 = 35$, the number of shillings required, as above.

The first and second terms are to be stated according to the rule, because their ratio is equal to that of the third and fourth, and must therefore be a proper or an improper fraction, according as the other is so. After the proportion is stated, and the terms reduced, any common factor may be removed from the first and second terms, or from the first and third; for, as will appear from the working above, this is virtually reducing a fractional expression to lower terms.

Ex. 2. A bankrupt, whose debts amount to £1275, pays 14s. 6d. in the pound. What do his creditors lose?

Since 14s. 6d. is paid, there is 5s. 6d. loss for every pound of debt, and the question is—If £1 give 5s 6d. loss, what will £1275 give? The "stating," therefore, is— £1 : £1275 :: 5s. 6d., and the result, £350, 12s. 6d. Particular care must be taken, when all the terms are money, as here, that the first and second be of the same kind. In this instance these terms are *debt;* and the third term, *loss*, corresponds to the term required.

Ex. 3. If 91 men could perform a piece of work in 78 days, in what time could 21 men do it, working at the same rate?

Here, if the number of men were doubled, trebled, halved, &c., the time required would be one-half, one-third, double, &c., the given time; or as the former is increased the latter is diminished in the same proportion, and *vice versa.* The time in this case is said to be *inversely proportional* to the number of men. We have then as equal ratios $\frac{21 \text{ men}}{91 \text{ men}} = \frac{78 \text{ days}}{\text{days required}}$; that is, the "stating" of the proportion is 21 men : 91 men :: 78 days, according to the rule, and the result 338 days. The process may also be explained thus:—The work will be 91×78 times what 1 man can do in 1 day, or $\frac{91 \times 78}{21}$ times what 21 men can do in 1 day, *i.e.*, it will be $\frac{91 \times 78}{21}$ days' work for 21 men.

43. *Compound Proportion.*—The ratio of two quantities frequently depends on a combination of other ratios. If, for instance, we have to compare the times required for building two walls, one twice the length, twice the height, and twice the thickness of the other, the men employed on the former being half the number employed on the other, and the day half the length, each of these separate conditions implies double the number of days. Each condition gives the ratio 1 : 2, and the result must correspond to the *product* of all the ratios, that is, it is 1 : 32. This is an instance of what is called compound proportion. Compound proportion.

In such cases set down for the third term the quantity which is of the same kind as that required. State each proportion as though it alone had to be considered, writing them under each other. Multiply the product of all the second terms by the third term, and divide the result by the product of the first terms.

Ex. If 36 men, working 10 hours a day, perform three-fifths of a piece of work in 17 days, how long must 25 men work daily to do the rest of it in 16 days?

Men,	25 : 36 :: 10
Fifths of the work,	3 : 2
Days,	16 : 17

$$\frac{36 \times 2 \times 17 \times 10}{25 \times 3 \times 16} = \frac{51}{5} = 10\tfrac{1}{5} \text{ hours a day.}$$

The length of the day will be greater the fewer the men and the fewer the days are, and less the less the work is; we therefore state as above.

44. It not unfrequently happens that ratios have to be compounded, or other reductions made, before we can state the proportion which will give the required result. We give an example or two of this.

Ex. 1. Though the length of my field is one-seventh greater than that of my neighbour's, and its quality is one-ninth better, yet, as the breadth of mine is one-fourth less, his is worth five guineas more than mine. What is my field worth?

The length of his field is to that of mine as 1 to $1\frac{1}{7}$, *i.e.*, as 7 to 8. The other ratios are 9 : 10 and 4 : 3 (see § 16 *ad fin.*). Therefore the values of the fields are as $7 \times 9 \times 4$ to $8 \times 10 \times 3$, *i.e.*, as 21 to 20, and the difference of these values being £5, 5s., we have the proportion 1 : 20 :: £5, 5s., which gives £105 as the worth of my field.

Ex. 2. If 9 men or 15 women, working 10 hours a day, could reap a field in 8 days 6 hours, in how many days of $10\frac{1}{2}$ hours each could 10 men and 12 women reap a field one-fourth larger?

Since 15 women do as much as 9 men do in the same time, 12 women will do $7\frac{1}{5}$ times a man's work, for $15 : 12 :: 9 : 7\frac{1}{5}$. Therefore 10 men and 12 women will do $17\frac{1}{5}$ times a man's work. From this the stating in the margin follows. The result is $56\frac{1}{4}$ hours, *i.e.*, 5 days $3\frac{3}{4}$ hours, the day being $10\frac{1}{2}$ hours long.

$$17\tfrac{1}{5} : 9 :: 86 \text{ hrs.}$$
$$4 : 5$$

Ex. 3. A dealer who has bought 9 oxen and 5 sheep for £186, 2s. 6d., would lose £2 by exchanging 2 oxen for 11 sheep. What is the price of an ox?

The price of 2 oxen being the price of 11 sheep and £2 more, the price of 9 oxen will be (from the ratio 2 : 9) $49\frac{1}{2}$ times the price of a sheep and £9 more. Hence from the data, $54\frac{1}{2}$ times the price of a sheep and £9 more will amount to £186, 2s. 6d.; *i.e.*, $54\frac{1}{2}$ times the price of a sheep is £177, 2s. 6d., and therefore a sheep cost £3, 5s. Also, since the price of 2 oxen is that of 11 sheep and £2 more, 2 oxen cost £35, 15s. + £2, *i.e.*, £37, 15s.; therefore 1 ox cost £18, 17s. 6d.

Proportional parts. 45. *Proportional Parts.*—To divide a number or quantity into parts in proportion to given numbers, state and work out the proportions,—As the sum of the given numbers is to each of them in succession, so is the number to be divided to the several parts required.

If, for example, a bankrupt owes A £580, B £935, C £675, and D £770, and his assets amount to £999, the stating 2960 : 580 : £999 gives £195, 15s. as A's share, and the others are found similarly.

Here, too, there may be a compound proportion, as when different sums are invested for different times. The division in those cases must be in proportion to the amounts invested, and also to the time; each amount is therefore to be multiplied by its time.

Applications of Proportion.—46. In commercial and financial transactions frequent use is made of proportion; and very often, when it is not directly employed, computations are performed according to formulæ or rules which rest on this as a basis. Advantage is very generally taken of the convenience of 100 as a standard of reference or comparison, proportional relations being stated as at such and such rates per cent. This occurs continually in the calculation of interest, discount, stock-exchange operations, &c., as well as in the expression of mercantile losses and gains.

47. *Interest* is the allowance given by the borrower to the lender for the use of money lent. It is usually computed at a rate agreed upon of so many pounds for every hundred lent for a year; this is called the *rate per cent.* The interest of £564, for instance, for 3 years 4 months at $3\frac{3}{4}$ per cent. per annum, is to be found by a compound proportion, the meaning being—If the interest of £100 for 1 year be £$3\frac{3}{4}$, what will the interest of £564 be for $3\frac{1}{3}$ years? The result (£70, 10s.) may be obtained by the general rule based on this and similar proportions—Multiply the amount lent (called the *principal*) by the rate per cent. and by the number of years, and divide the product by 100. When the time is given in days, the fraction of a year is taken that the days amount to. Interest.

$$£100 : 564 :: 3\tfrac{3}{4}$$
$$1 : 3\tfrac{1}{3}$$

Money is laid out at *Compound Interest*, when at the end of a year or other assigned period the interest that has accrued is not paid to the lender, but is put to interest along with the amount originally lent. Here the simple interest has to be computed for each successive year or period, and added to the principal or former amount.

48. *Commission* is the allowance paid to an agent for transacting commercial business, and usually bears a fixed proportion or percentage, as may be agreed on, to the amount of value involved in the transactions. *Brokerage* is the allowance paid to a broker for buying or selling shares in the public funds, or bargaining otherwise with reference to money investments. *Insurance Premiums* are payments in return for which the owner of the property insured is entitled to receive the assured value of it in the event of its being destroyed. In all these the rates are commonly stated at so much per cent., and the computation is similar to that for interest, but simpler, as the element of time does not enter into it. Commission. Brokerage. Insurance.

49. *Discount* is a deduction allowed for a payment being made at a date prior to the time when the full amount is exigible. The *true discount* on a money payment due on the expiration of a certain time is the excess of the amount over its *present value*—the present value being the sum which, laid out at interest, would in the given time amount to the given sum. Suppose, for instance, it is required to find the true discount on £664 due 10 months hence at $4\frac{1}{2}$ per cent. Here the interest of £100, being £$4\frac{1}{2}$ in 12 months, will in 10 months be £$3\frac{3}{4}$, *i.e.*, £100 would amount to £$103\frac{3}{4}$ in 10 months, and the discount of £$103\frac{3}{4}$ due 10 months hence is therefore £$3\frac{3}{4}$. Hence the stating £$103\frac{3}{4}$: £664 :: £$3\frac{3}{4}$, which gives as the discount £24. The present value is seen from this to be £640. A banker or merchant, in discounting a bill, charges interest instead of discount, and would in this instance gain the interest of £24, since the £24, the true *discount* of £664, is evidently the *interest* of £640. Discount.

50. In calculations relating to mercantile *Profit and Loss*, which are also effected by proportion, it must be carefully remembered that the percentage of gain or loss is always reckoned on the *buying price*, unless the contrary is expressly stated. Thus, let it be required to find the cost of goods that are sold for £448, 17s. 6d. at a loss of $6\frac{1}{4}$ per cent. Since goods that cost £100 are sold for £$93\frac{3}{4}$, we have the stating £$93\frac{3}{4}$: £$448\frac{7}{8}$ :: £100, which gives £478, 16s. as the cost price. Profit and loss.

(G. M'A.)

ARIUS (Ἄρειος), a well-known name in ecclesiastical history, identified with the origin and spread of the first great "heresy" in the Christian church. Arius is supposed to have been a native of Cyrenaica in Africa, but nothing is really known of his birth or of his early training. He first comes clearly into view as a presbyter of the Church of Alexandria, in the commencement of the 4th century, engaged in conflict with his bishop, Alexander. At a previous period he is said to have been connected with the Meletian schism, and on this account to have been excommunicated by Peter of Alexandria, who had ordained him deacon. But if so, he had regained a position of importance in the Alexandrian Church, as he is found, under Peter's successor, Achillas, in charge of one of the great city churches, Baucalis or Boucalis, where he continued to discharge his duties with apparent faithfulness and industry for six years after the accession of Alexander, the third bishop in order with which ecclesiastical tradition connects him. Theodoret (*Hist. Eccl.*, i. 2) does not hesitate to say that Arius was chagrined because Alexander, instead of himself, was appointed to succeed Achillas in the see of Alexandria, and that the beginning of his heretical attitude is, in consequence, to be attributed to discontent and envy. But this is so common an explanation of heretical movements with the early church historians, that it is not to be received without reserve. Upon the whole, there is no evidence that Arius was animated by mere personal considerations in the advocacy of his doctrinal opinions. Rather, it seems evident, as Neander says (*Church Hist.*, vol. iv. 25), that he thought he was only unfolding the traditionary church doctrine. Although an African he appears to have been trained in the school of Antioch, under Lucian, and there to have imbibed a strong leaning towards the subordination system as to the relation of the Father and Son, which prevailed in that school. Probably it was this training, and a natural lack of insight and speculative depth, which led him into a line of negative thought, from which the church had hitherto wisely abstained. Yet the idea of his craft and ambition deeply pervades early Christian history. In his well-known treatise against eighty heresies (*Lib. II. Hær.*, lxix. c. 3), Epiphanius describes him as a man "inflamed by his own opinionativeness; of tall stature, with a downcast look; his figure composed like that of a subtle serpent, to deceive the guileless by his crafty exterior." "His dress," he adds, "was simple; his address soft and smooth, calculated to persuade and attract, so that he had drawn away seven hundred virgins from the church to his party."

The views of Arius first attracted attention about 319 A.D. According to the church historian Socrates (lib. i. c. 5), Bishop Alexander, in addressing the presbyters and other clergy on the doctrine of the Trinity, dwelt so strongly on the consubstantial unity of the Father and the Son that Arius charged him with holding Sabellianism. But, according to Sozomen, a contemporary historian of the 5th century, Arius made himself conspicuous by the advocacy of his special opinions, and Alexander only interfered after being charged with remissness in leaving him so long to disturb the faith of the church. Having called Arius and his opponents before him, Alexander heard their respective arguments, and finally, after due examination, gave judgment against Arius. The result was a wide-spread commotion, extending not only through Africa, but other provinces of the Roman empire. Bishops joined issue with bishops; congregations were violently excited; and the greatest mystery of the Christian religion became a subject of irreverent controversy among women and children. Even the heathen joined in the profane uproar. Arius himself cannot be excused from stirring up this popular and unworthy clamour; for he composed verses, under the name of Thalia (Θαλεία), which appear to have been a sort of popular miscellany for diffusing his opinions. He addressed at the same time an elaborate letter to Eusebius of Nicomedia, which remains to this day one of the clearest statements of his dogmatic position. It sets out with a complaint of the persecution which he had suffered at the hands of Alexander, who had driven him and his adherents (he says) out of the city as impious men or atheists (ἀθέους), "merely for dissenting from his public declaration that 'as God is eternal so is His Son'—when the Father, then the Son—the Son is present in God without a birth (ἀγεννήτως), ever begotten (ἀειγενής), an unbegotten-begotten (ἀγεννητογενής);—an eternal God, an eternal Son; the Son is from God himself." . . . . "These blasphemies we cannot bear to hear even," he says, "no, not if the heretics should threaten us with ten thousand deaths. What, on the other hand, do we maintain? that the Son is not unoriginate (ἀγέννητος), nor part of the Unoriginate, nor made of any previously existing substance, but that by the will and purpose of God He was in being before time (πρὸ χρόνων καὶ πρὸ αἰώνων), perfect God, the only begotten (πλήρης Θεὸς, μονογενής); that before this generation or creation He was not (πρὶν γεννηθῇ . . . . οὐκ ἦν)," &c.

There is another letter to the same purpose, but more moderate in statement, addressed to Alexander after his banishment; and the student will find in those letters, and in the Thalia, the most original and trustworthy account of the opinions of Arius. "We believe," he says in the letter to Alexander, "in one God alone without birth, alone everlasting, alone unoriginate . . . . We believe that this God gave birth to the only begotten Son before eternal periods (πρὸ χρόνων αἰωνίων), through whom He made these periods (αἰῶνας) and all things else; that He gave birth to Him, not in semblance, but in truth, giving Him a real existence (ὑποστήσαντα), at His own will so as to be unchangeable, God's perfect creature, but not as other creatures . . . . not, as Valentinus (a Gnostic of the 2d century) maintained, a development (προβολήν); nor, again, as Manichæus, a consubstantial part (μέρος ὁμοούσιον); nor as Sabellius, Son and Father at once (υἱοπάτερα), which is to make two out of one, . . . but created by the will of God, and endowed with His own glorious perfections—yet not so that the Father did thereby deprive himself of attributes which are His without origination (ἀγεννήτως), being the Source (πηγή) of all things; so that while there are three persons (ὑποστάσεις) yet God is alone the Cause of all things and unoriginate. The Son, on the other hand, is originate, begotten by the Father time-apart. The Son is not, therefore, co-eternal or co-unbegotten with the Father, as if these were two unbegotten principles; but God is before all things as (μονάς) single and the principle of all, and therefore before Christ also."

On the one side, therefore, Arius denied of Christ that He was *unoriginate;* or part of the Unoriginate; or consubstantial (ὁμοούσιον) with the Father; or without beginning (ἄναρχος); or a mere development of God. The Son, he said, "did not exist before He was begotten (οὐκ ἦν πρὶν γεννηθῇ)." In other words, "He is of a substance that once was not (ἐξ οὐκ ὄντων),"—hence the name of *Exoucontians* sometimes given to his followers. But, on the other side, Arius affirmed of the Son that He was in being before time (προχρόνων); that he was perfect God (πλήρης Θεός); only begotten (μονογενής); that God made the worlds or ages (αἰῶνας) through Him; that He was the making or offspring of the Father, and yet not as one amongst things made (γέννημα ἀλλ' οὐχ ὡς ἓν τῶν γεγεννημένων).

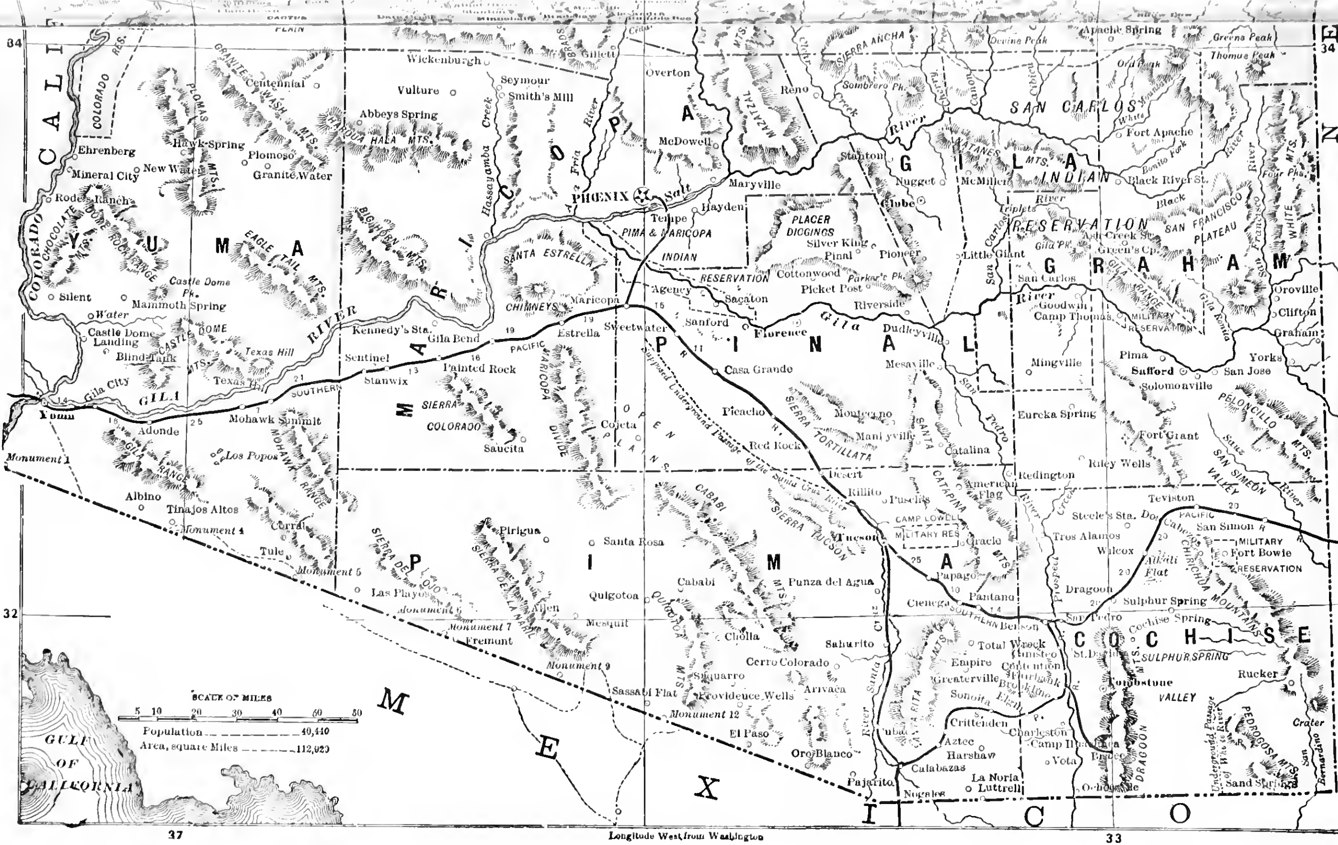
Such were the questions which distracted the church beyond all precedent in the beginning of the 4th century, and led to the first great œcumenical council, which was convened in Nicæa in 325. The account of the proceedings of this council will be given under its own heading. It requires only to be mentioned here, that after various turns in the controversy, it was finally decided against Arius, that the Son was "of the same substance" (ὁμοούσιον) with the Father, "very God of very God." Constantine embraced the decision of the council, and resolved to uphold it. Arius and the two bishops of Marmarica and Ptolemais, who refused to subscribe the creed of Nicæa, were excommunicated and banished to Illyria; and even Eusebius of Nicomedia, who accepted the creed, but not its anathemas, was exiled to Gaul. Alexander returned to his see triumphant, but died soon after, and was succeeded by Athanasius, his deacon, who had been the soul of the orthodox party of Nicæa, and with whose indomitable fortitude and strange vicissitudes the further course of the controversy is bound up. This will be explained in detail under the heading ATHANASIUS, and it only remains for us to sketch at present what is known of the future career of Arius.

Although defeated at the Council of Nicæa, Arius was by no means subdued. He obtained means of access to Constantia, the sister of the emperor, who, on her deathbed, strongly urged her brother to reconsider the question, and to recall the heresiarch from banishment. Restored to court, he, along with the Eusebian party, who, although professing to accept the Nicene doctrine, were in reality indifferent, if not hostile, to it, renewed the theological strife, in which Athanasius was nothing loth to join. Interchanges, now of friendly recognition and now of menace, passed betwixt the emperor and the intrepid bishop of Alexandria, who obstinately refused to reinstate Arius as presbyter. At length, on the banishment of Athanasius to Treves in 336, Arius returned to Alexandria to claim his old position; but even in the absence of the bishop the people rose in uproar against the heretic, and the emperor was forced to recall him to Constantinople. There the bishop was reluctantly compelled to profess his willingness to receive him once more into the bosom of the church, but before the act of admission was completed Arius was taken suddenly ill, while walking with a friend in the evening, and died in a few moments. This was interprêted by the adherents of the Nicene theology as a special interposition of Providence on their behalf, and they openly gave thanks to God in the church. The modern reader will look with less credulity upon an event which was probably quite natural in its occurrence, but he will hardly see any cause in it for lamentation. The character of Arius, if not originally tainted by self-seeking and restless ambition, appears to have gathered something of this taint in the course of his career, and the most impartial student of church history fails to see anything in it to admire beyond the pertinacity of his courage and his faithful devotion to his own opinions.

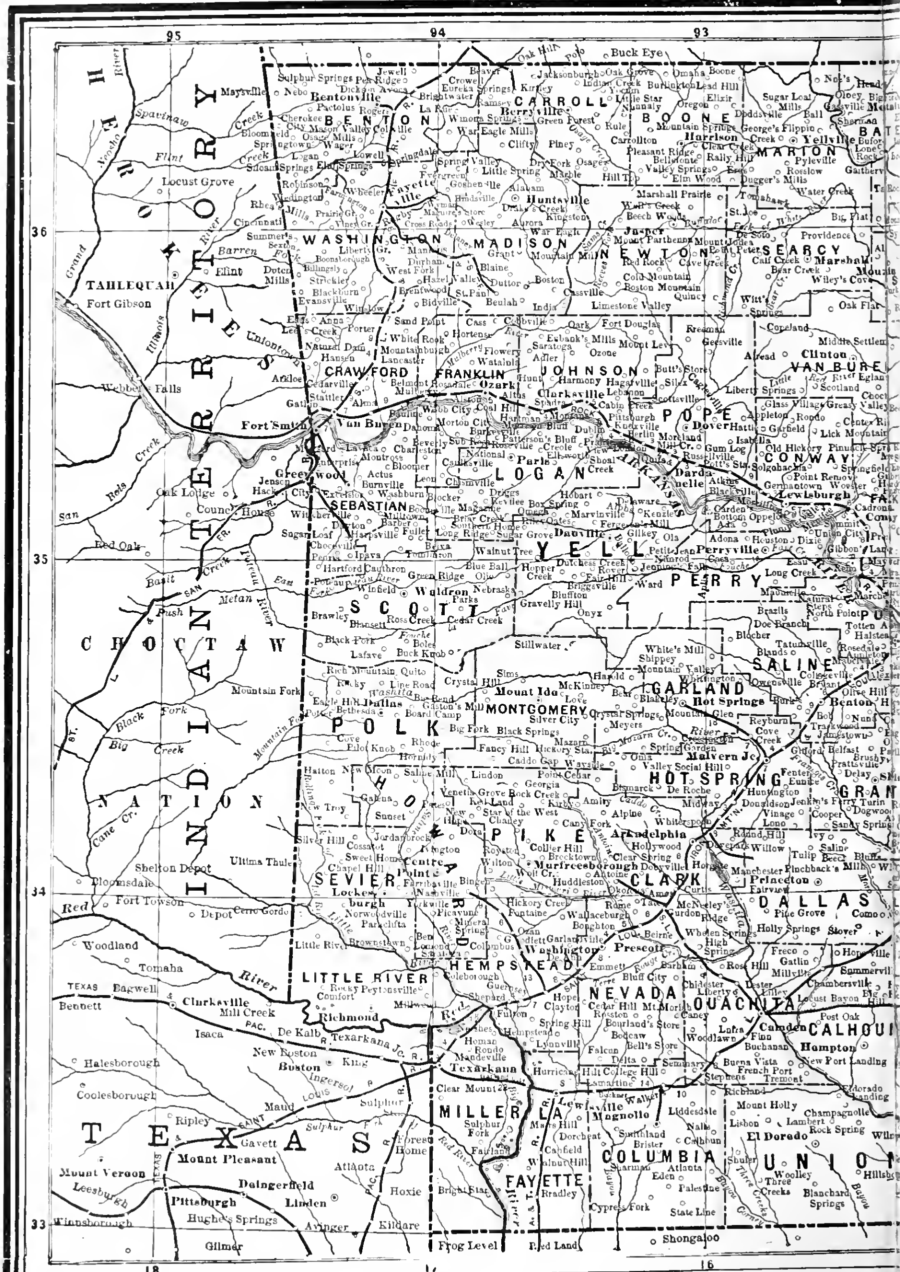
The Followers of Arius.—The death of Arius, as described above, did not extinguish the Arian party. On the contrary, they continued active and zealous *within* the church for upwards of fifty years, or till the second general council at Constantinople, in 381. Afterwards they may be said to have existed, as a distinct Christian sect, outside the Catholic Church, till about the middle of the 7th century. Constantine, while strongly disposed at first to enforce the Nicene decrees, was gradually won to a more conciliatory policy by the influence especially of Eusebius of Cæsarea, and his namesake, Eusebius of Nicomedia. On the other hand, the Nicene doctrine found the most able and ardent defender in Athanasius, the young deacon who had attended Bishop Alexander at the council, and who shortly afterwards succeeded him in the see of Alexandria. An unceasing contention ensued betwixt the Eusebian and Athanasian factions of the church. Constantius, who succeeded his father in 337, strongly favoured the former, or semi-Arian party, and successive synods were called with the view of adjusting differences and compelling uniformity of faith. "The highways were covered," says an ancient historian (Ammianus, xxi. 15, quoted by Gibbon, vol. iii. 67, Milman's ed.) "with troops of bishops galloping from every side to these assemblies." At length the tenet of the *Homoiousion* was substituted for that of the *Homoousion* at the Council of Rimini (Ariminum) in 360. But the war of words raged as fiercely as ever during the reigns of Julian (the Apostate) and his successors till after the accession of Theodosius the Great, under whose auspices the Council of Constantinople was convened and the Nicene doctrine was confirmed and finally accepted as the catholic doctrine of the church. Even then, however, Arianism was warmly espoused by several of the German nationalities then assailing the empire. The entire nation of the Ostrogoths became Arian; the Visigoths followed their example, till, at the request of their king, Reccared, they embraced the catholic faith at the Council of Toledo in 589. The Vandals in Africa, the Suevi in Spain, and the Burgundians in Gaul, were all for a time zealous Arians, and the heresy maintained its influence amongst the Lombards in the north of Italy to a later period than elsewhere. Gradually, however, it perished as a distinctive national type of Christianity before the growth of mediæval Catholicism, and the name of Arian ceased to represent a definite form of Christian doctrine within the church, or a definite party outside of it. Individual Christian teachers of great eminence, such as John Milton and Samuel Clark, and even Ralph Cudworth, have been accused of Arianism, but even where, as in Milton's case, the accusation seems well founded, the peculiar heresy known by that name has never assumed any influence, or regained, for any length of time, its influence in the church. (J. T.)

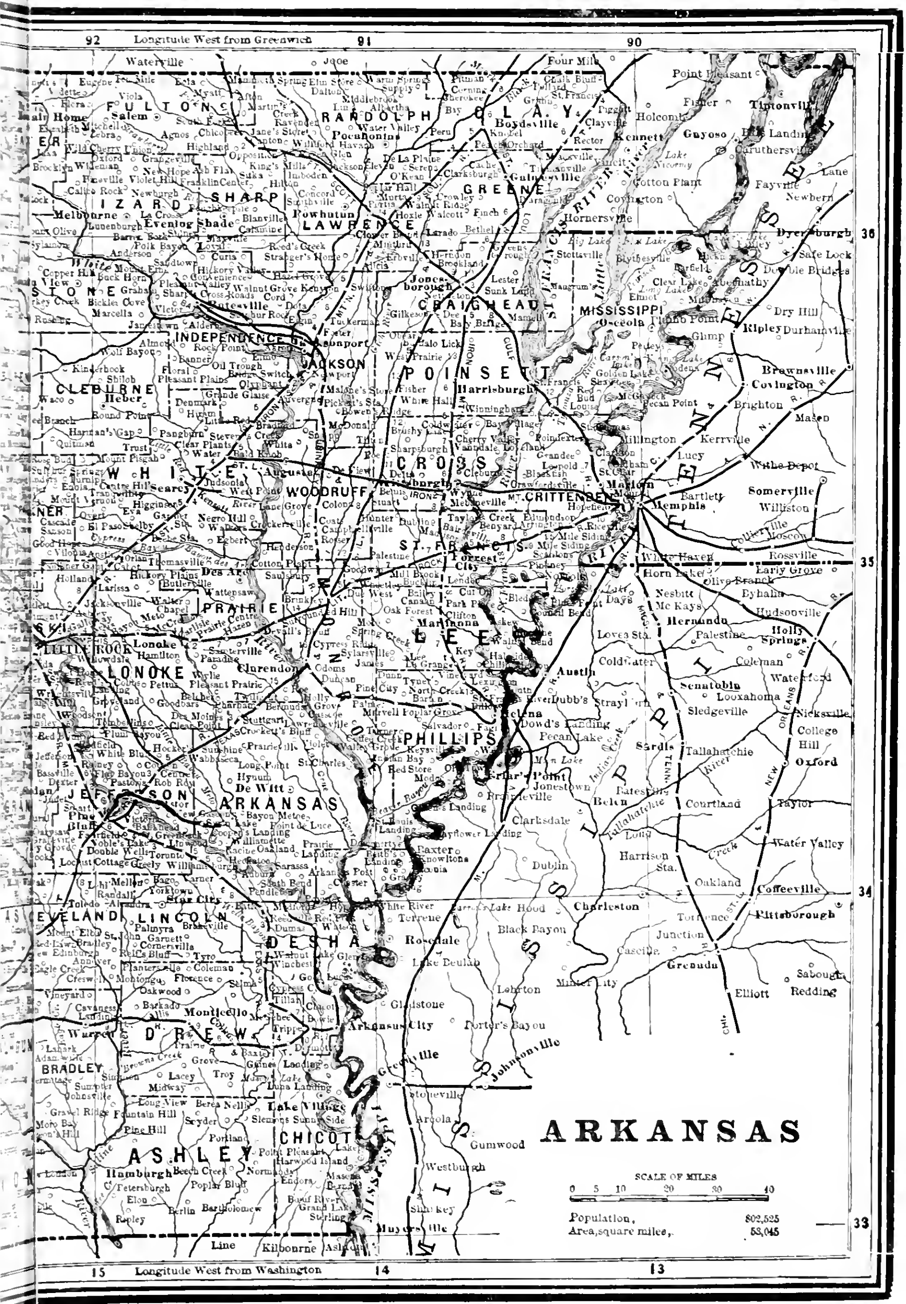
ARIZONA, a territory of the United States, bounded N. by Utah, E. by New Mexico, S. by Mexico, and W. by California and Nevada, with an estimated area of 113,900 square miles. According to the Act creating it a territory in 1863, Arizona comprises all the lands of the United States formerly belonging to New Mexico, extending from W. long. 109° to the California line. Since then, however, the N.W. corner has been ceded to Nevada. The territory lies in the basin of the Colorado River, which enters it in about 37° N. lat., and forms its western boundary southwards from 36°. In the north there is an extensive but barren plateau, with an average elevation of 7000 feet, through which the Colorado cuts its way, and forms one of the most remarkable gorges in the world, the length being about 300 miles, and the perpendicular walls reaching heights of from 3000 to 6000 feet. South of this plateau is the valley of the Colorado Chiquito (Little Colorado, or Flax River), which joins the Colorado in 36° 15′ lat. N. and 113° long. W., while further south the ground rises into another plateau, the main portion of which is known as the Mogollon Mountains. In this district the country is reported to be beautiful and fertile, the mountains covered with noble pine-trees, and the valleys clothed with rich grama grass. Further south, again, is the basin of the Gila, with its numerous tributaries, obliquely crossed by detached prolongations of the Sierra Madre of Mexico. The inhabitants of Arizona are mostly Indians. Of these 4300 Pinas and Maricopas occupy a reservation of 64,000 acres on the Gila River; 4000 Papagoes, a wandering tribe in the south-eastern part of the territory, have no grounds allotted them; 4000 Mohaves have 75,000 acres on the Colorado River; 2000 Yumas live near the mouth of the Colorado, but belong to the Mohave reservation; while 1500 Hualapais and 8000 or 12,000 Yavapais and Apaches, without settled habitations,

Longitude West from Greenwich
114
112
110
36
U T A H
N E V A D A
N E W M E X I C O
C A L I F O R N I A
A R I Z O N A
M O H A V E
Y A V A P A I
A P A C H E
COLORADO RIVER
GRAND CANON
MARBLE CANON
KAIBAB PLATEAU
PARIA VALLEY
SHIWITS PLATEAU
HURRICANE LEDGE
UINKARET PLATEAU
KANAB PLATEAU
SAND DUNE PLATEAU
WANZITS TERAVU
NINE MILE VALLEY
Summit Valley
Vermillion Cliffs
VIRGIN RANGE
MUDDY RANGE
Beaverdam
Black Rock Spring
Diamond Butte
Solitaire Butte
Moccasin Spring
Cottonwood
Mt. Bangs
Mt. Trumbull
Mt. Logan
Mt. Emma
Mt. Dellenbaugh
Cave Spring
Antelope Spring
Wolf Spring
Pipe Spring
Hanging Rock
Shehomo Canon
Jacob's Pools
Lees Ferry
Echo Pk.
Navajo Spring
Bitter Spring
Shenomo Altar
Willow Spring
Whitmore Pools
Waterpocket
WHITE MESA
PAINTED DESERT
Little Colorado River
Moen Copie
Moen Ava Settlements
Hatche's Well
Thousand Wells
Pueblo Tocalote
LANA NEGRO
DIAMOND FIELDS
Laguna
Ojo Puerte
Los Gigantos
Cave Dwellings
NAVAJOE
Coal Region MESA
Burning Coal Beds
MOQUI
LA VACA
Trout Spring
Ruins
INDIAN RESERVATION
Agency
Oraibi
Shipauahuri
Te-wa
Shong-a-pavi
Walpi
Mishonginuvi
Spring Butte
Chimney Pk.
Signal Butte
INDIAN de Chelly
RESERVATION
NAVAJO VALLEY
White Rock Spring
BONITO VALLEY
Agency
Fort Defiance
NAVAJOE VALLEY
Willow Spring
Hot Spring
Salt Spring
Dinoah Spring
Tiri-nah-ha Spring
El Dorado Mill
Yucca Spring
Altoohah Spring
Mountain Spring
Red Lake
Spencer's Ranch
HUALPAI
Mt. Tipton
Mt. Davis
BLACK MTS.
CERBAT MTS.
Chloride City
Mineral Park
Cerbat
Cayote Hole
Alexandria
Hardyville
Mohave City
Mohave Wash
Needles
The Needles
MOHAVE RANGE
Liverpool
Aubrey
Mt. Whipple
Stockton
Peacock Spring
Hackberry
PEACOCK MTS.
Willapi Spring
HUALPAI MTS.
Big Sandy Creek
AQUARIUS
Artillery Pk.
Signal
New Virginia
Greenwood
Williams Fork
Planettown
Cross Mt.
MUDDY CANON
Fort Rock
Mt. Hope
HOPE MTS.
Hualapai
Granite Mt.
Skull Valley
Witche's Pool
Mt. Floyd
Aubrey
Whitmore
Chino
Prescott Jc.
Picacho
Mt. R.
Sullivan
Garland
Juniper
Clearwater
Verde Bridge
Williamson's Valley
Simmons
Reeses
BLACK HILLS
Windmill
Webster
Smith Valley
Prescott
Aqua Fria Valley
Howells
Walker
Hassayampa
Big Bug
Red Rock
Bueno
Antelope Valley
Walnut Grove
Stanton
Date Creek
Mt. Verde
Clenega
Stoddard
Townsend
Meesville
Bradshaw
Alexandria
Santa Maria
Spencer Cr.
Sicamores Cr.
Suppai Indian Settlement
AVAPI SAPA RESERVATION
COCONINO FOREST
Cataract Creek
Red Butte
Blue Mesa
Red Mesa
AUBREY CLIFFS
COLORADO PLATEAU
Mesa Butte
Antelope Peak
SAN FRANCISCO MTS.
Kendrick Pk.
Mt. Sitgreaves
Mt. Williams
San Francisco Mt.
Pineveta
Ash Fork
Fairview
Supai
Pamela
Bill Williams Mt.
Belmont
MESA
Cosnino
Angell
Walnut Creek
Flagstaff
SAN FRANCISCO FOREST
Canon Diablo
Oneal Spring
Clark Valley
Live Oak
MIN. BELT
Snyders Hole
Mt. Hawley
Camp Lincoln
Stoneham Lake
Mormon Lake
Mormon Canon
Long Meadow
Camp Verde
Strawberry
Pine Spring
Cleaver Canon
Fossil Canon
Verde River
Dennison
Winslow
Diablo
ATLANTIC PACIFIC
Cottonwood
Hardy
St. Joseph
Lerous Fork
Sherlons Fork
MOGOLLON MESA
Canado
Jara Spring
Pueblo Grande
Aqua
Viboras
Sanders
Allantown
Puerco R.
Navajo Springs
Billings
Carriso
Lithodendron Cr.
Holbrook
Canon Butte
Woodruff
Deer Spr.
Zuni
Nutrioso Cr.
Snowflake
Taylor
Erastus
St. Johns
Salado Spring
Franklin Spring
Show Low
Pueblo Col. Cr.
Bonito Cr.
Rio Puerco



YUMA
MARICOPA
PINAL
PIMA
GILA
GRAHAM
COCHISE
MEXICO
CALIF
NEW MEX
GULF OF CALIFORNIA
SCALE OF MILES
5 10 20 30 40 60 80
Population 40,440
Area, square Miles 112,920
Longitude West from Washington
34
32
37
33
COLORADO RES.
COLORADO
Ehrenberg
Mineral City
Rodes Ranch
CHOCOLATE MTS.
DOME ROCK RANGE
Silent
Water
Castle Dome Landing
Blind Tank
Gila City
Yuma
Monument 1
GILA RANGE
Adonde
Albino
Tinajos Altos
Monument 4
Los Popos
Tule
Corral
Monument 5
MOHAWK RANGE
Mohawk Summit
Texas Hill
CASTLE DOME MTS.
Castle Dome Pk.
Mammoth Spring
Hawk Spring
PLOMAS MTS.
New Water
GRANITE WASH MTS.
Centennial
Plomoso
Granite Water
EAGLE TAIL MTS.
HARQUA HALA MTS.
Abbeys Spring
Vulture
Wickenburgh
BIG HORN MTS.
GILA RIVER
Kennedy's Sta.
Gila Bend
Sentinel
Stanwix
Painted Rock
SOUTHERN PACIFIC
SIERRA COLORADO
Saucita
MARICOPA DIVIDE
CHIMNEYS
SANTA ESTRELLA
Estrella
Maricopa
Sweetwater
Hassayampa Creek
Seymour
Smith's Mill
Fria River
Gillett
Overton
McDowell
PHŒNIX
Salt
Tempe
Hayden
Maryville
PIMA & MARICOPA INDIAN RESERVATION
Agency
Sacaton
Sanford
Florence
Gila
Casa Grande
Picacho
Red Rock
OPEN PLAINS
Cojeta
Supposed Underground Passage of the Santa Cruz River
SIERRA TORTILLATA
Desert
Killito
Tucson
SIERRA TUCSON
CABABI MTS.
Cababi
Punza del Agua
Santa Rosa
Quigotoa
QUIGOTOA MTS.
Mesquit
Pirigua
SIERRA DEL OJO
SIERRA DE LA NARIZ
Las Playos
Monument 6
Monument 7
Fremont
Allen
Monument 9
Sassabi Flat
Cholla
Cerro Colorado
Saguarro
Providence Wells
Monument 12
El Paso
Arivaca
Oro Blanco
Sahurito
Santa Cruz River
Pajarito
Nogales
Calabazas
Tubac
SANTA RITA MTS.
Aztec
Harshaw
Crittenden
Sonoita
La Noria
Luttrell
Greaterville
Empire
Total Wreck
Benson
Cienega
Pantano
Papago
Gracia
CAMP LOWELL MILITARY RES.
CATAPINA
Puseltis
American Flag
Redington
Catalina
SANTA CATALINA
Mountagno
Maniyville
Dudleyville
Mesaville
San Pedro
Riverside
Picket Post
Cottonwood
Parker's Pk.
Pinal
Silver King
PLACER DIGGINGS
Pioneer
Globe
Nugget
Stanton
McMillen
NATANES MTS.
INDIAN RESERVATION
SIERRA ANCHA
Reno
MAZATZAL MTS.
Sombrero Pk.
Cherry Creek
Canon
Cibicu
Ord Peak
Apache Spring
Greens Peak
Thomas Peak
SAN CARLOS
White
Fort Apache
Bonito Fork
Black River St.
Little Giant
San Carlos
Triplets
Ash Creek St.
Green's Cp.
Gila Pk.
GILA RANGE
MILITARY RESERVATION
Goodwin
Camp Thomas
Mingville
Eureka Spring
Pima
Safford
San Jose
Yorks
Solomonville
Gila Ronita
Graham
Clifton
Oroville
SAN FRANCISCO PLATEAU
San Francisco River
Black
WHITE MTS.
Four Pks.
PELONCILLO MTS.
Fort Grant
Riley Wells
Sauz
SAN SIMEON VALLEY
Teviston
Steele's Sta.
Tres Alamos
Wilcox
Alkali Flat
San Simon
MILITARY
Fort Bowie
RESERVATION
CHIRICHUA MOUNTAINS
Dragoon
Sulphur Spring
San Pedro
Cochise Spring
SULPHUR SPRING VALLEY
Tombstone
St. David
Charleston
Camp Huachuca
Vota
Bisbee
Ochoaville
DRAGOON MTS.
Rucker
PEDROGOSA MTS.
Underground Passage of White River
Sand Springs
Crater
San Bernardino
Prospect Creek


95
94
93
36
35
34
33
18
16
CHEROKEE
TERRITORY
INDIAN TERRITORY
CHOCTAW NATION
TEXAS
TAHLEQUAH
Fort Gibson
Locust Grove
Webbers Falls
Fort Smith
Van Buren
Greenwood
BENTON
Bentonville
CARROLL
Berryville
BOONE
Harrison
MARION
Yellville
WASHINGTON
Fayetteville
MADISON
Huntsville
NEWTON
Jasper
SEARCY
Marshall
CRAWFORD
FRANKLIN
Ozark
JOHNSON
Clarksville
VAN BUREN
Clinton
POPE
Dover
CONWAY
Lewisburg
LOGAN
Paris
SEBASTIAN
YELL
Danville
Dardanelle
PERRY
Perryville
SCOTT
Waldron
POLK
Dallas
MONTGOMERY
Mount Ida
GARLAND
Hot Springs
SALINE
Benton
HOT SPRING
Malvern Jc.
PIKE
Murfreesborough
HOWARD
Centre Point
SEVIER
Lockesburgh
CLARK
Arkadelphia
DALLAS
Princeton
LITTLE RIVER
Richmond
HEMPSTEAD
Washington
NEVADA
Prescott
OUACHITA
Camden
CALHOUN
Hampton
MILLER
Texarkana
LAFAYETTE
Lewisville
COLUMBIA
Magnolia
UNION
El Dorado
Clarksville
Boston
Mount Pleasant
Daingerfield
Linden
Pittsburgh
Mount Vernon
Shongaloo
Frog Level
Red River
Arkansas River
Buck Eye



Longitude West from Greenwich
92
91
90
36
35
34
33
FULTON
RANDOLPH
CLAY
SHARP
IZARD
LAWRENCE
GREENE
STONE
INDEPENDENCE
CRAIGHEAD
MISSISSIPPI
JACKSON
POINSETT
CLEBURNE
WHITE
CROSS
WOODRUFF
CRITTENDEN
ST. FRANCIS
PRAIRIE
LEE
LONOKE
PHILLIPS
JEFFERSON
ARKANSAS
LINCOLN
DESHA
DREW
BRADLEY
ASHLEY
CHICOT
TENNESSEE
MISSISSIPPI
Memphis
Little Rock
Helena
Pine Bluff
Arkansas City
ARKANSAS
SCALE OF MILES
0 5 10 20 30 40
Population, 802,525
Area, square miles, 53,045
Longitude West from Washington
15
14
13

live in a state of continual warfare with their neighbours. Civilisation, however, is gradually asserting her claim to those fertile districts. Arizona is rich in mineral products—nearly all the mountains in the south and centre yielding gold, silver, copper, and lead. Lime, gypsum, and coal are also present, and salt of excellent quality exists in extensive deposits. The vegetable productions are iron-wood, mesquite, cotton-wood, sycamore, ash, oak, willow, walnut, prickly pear, cactus, aloe, artemisia; and, under cultivation, grapes, figs, oranges, lemons, tomatoes, tobacco, Indian corn, and the other cereals. Much of the land produces two crops in the year. The towns are all of inconsiderable size, and the whole white population of the territory, in 1870, did not amount to more than 9658. The capital is Tucson, in Pima county; and the other towns, Arizona City and Prescott. Many interesting remains exist of the early inhabitants of this region. See a paper by W. A. Bell, *J. of Roy. Geog. Soc.*, 1869; *Colorado Exploration;* S. W. Cozzens, *The Marvellous Country.*

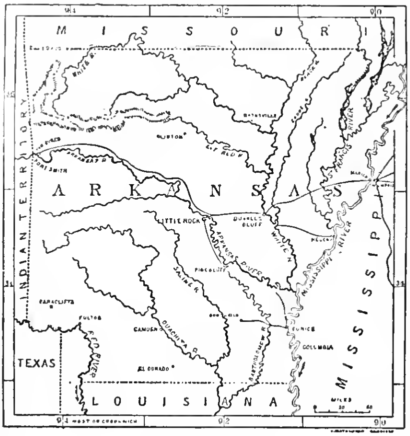
ARK OF NOAH, the vessel constructed by Noah for preservation from the approaching deluge. The Biblical account of it is contained in Genesis vi. 14–22. See NOAH.

ARK OF THE COVENANT, ARK OF THE REVELATION (E.V. ark of the testimony, Exod. xxv. 16, 22, &c.), are the full names of the sacred chest of acacia wood, overlaid with gold, which occupied the holiest place in the tabernacle and temple, and through which the idea of the constant presence of the covenant God with the people of Israel received symbolical expression. The Old Testament religion conceived of God as spiritual, and so could not think to secure His presence by the use of images. But the notion of communication between the spiritual God and His people still took the form of a *tryst* or *meeting* (מוֹעֵד E.V. wrongly, *congregation*, Exod. xxvii. 21, &c.), under conditions of time and place divinely appointed (Exod. xx. 23, 24), and the idea of purely spiritual approach to God without any local and symbolical point of *rapport* between heaven and earth was reserved for the New Testament (John iv. 21, *ff.*) In accordance with this view, certain fixed sanctuaries, consecrated by former revelations, were fit places for man to draw near to God. But the constant presence of God with the nation in its wanderings could not be realised without a portable sanctuary, the central point of which was very fitly the chest in which was contained the "revelation" (Exod. xxv. 16, xl. 20), that is, the tables of stone with the ten commandments (Exod. xxxi. 18; Deut. x. 5), which formed the basis of the covenant. This meaning of the ark is symbolically expressed by the addition of an upper piece called the *kappóreth* (E.V. mercy-seat), which was wholly of gold, and surmounted by two cherubim or symbolical winged figures, which, in the Old Testament, are always associated with the idea of local manifestations of the God who, though inaccessible to man, yet reveals himself to him. The space above the *kappóreth* and between the cherubim was conceived as the point of meeting between God and man (Exod. xxv. 22; Lev. xvi. 2); and the name *kappóreth*, which has been very variously interpreted, is probably derived from the atoning ordinances through which alone the high priest, as the people's representative, ventured to come face to face with this awful spot (Lev. xvi.)

The ark contained nothing but the tables of the law, 1 Kings viii. 9. That the pot of manna and Aaron's rod were also contained in it is an opinion resting on Heb. ix. 4, and Rabbinical tradition, but quite without evidence from the Old Testament (Exod. xvi. 33; Num. xvii. 10). That the presence of God to his people above the *kappóreth* was marked not only by artificial symbols, but by a miraculous cloud, is not certainly taught in Lev. xvi. 2, where the cloud is, according to many interpreters, the incense cloud of verse 13.

As the permanent pledge of God's gracious presence, the ark preceded the people in their march, and led them on to victory (Num. x. 33–36). During the conquest of Canaan it stood in the headquarters of the invaders, first at Gilgal, and then at Shiloh, nor does it appear to have ceased to move from place to place during the insecure period of the Judges (compare 2 Sam. vii. 6 with 1 Chron. xvii. 5), though the pre-eminence of the tribe of Ephraim seems to have kept it for the most part within their territory. At the close of this period we find it established in Shiloh. But the old tradition, that the ark is essentially the sanctuary of the armed host of Israel, with the Levites for its body guard, was not yet extinct. and it was brought into the field and captured by the Philistines in the fatal battle of Ebenezer, which broke the supremacy of Ephraim (1 Sam. iv.) Though soon restored by the Philistines who, smitten by a plague, feared to retain it, the ark could not be replaced in the central sanctuary, which had probably been destroyed in the war, and it remained in obscurity till David brought it to Zion, and again gave to the nation a religious as well as a political centre. Even in David's time the ark was carried into the field by the armies of Israel (2 Sam. xi. 11); but the king, who had himself so long maintained his religious life in banishment from the national sanctuaries, was the first clearly to express the conception, that God's help could reach forth to those who were far from Zion without any material pledge (2 Sam. xv. 25; compare Psalm iii. 4, and the idea of a heavenly temple, Psalm xviii.) So soon as this idea was reached, the importance of the ark (which ceased to be carried beyond the temple) was lost in the gradually increasing weight laid on the fixed sanctuary of Zion. Probably it was altogether lost in the counter-reformation of Manasseh, for soon after, in the beginning of the reign of Josiah, Jeremiah (iii. 16) speaks of it as missing and anxiously sought for, though 2 Chron. xxxv. 3 seems to imply that it was subsequently restored. But Jeremiah teaches that the religious significance of Jerusalem is quite independent of this symbol, and the wild legends of its preservation at the taking of Jerusalem (2 Mac. ii. and elsewhere) only show that the popular mind was unable to share the view that the ark was now an obsolete relic. More poetical is the tradition that the ark was raised to heaven, there to remain till the coming of the Messiah, which embodies the spiritual idea that a heavenly pledge of God's covenant faithfulness had superseded the earthly symbol. Compare with this Rev. xi. 19. (Ample traditional material will be found in the younger Buxtorf's dissertation *De Arca Fœderis*, Basel, 1659. For historical treatment of the subject compare especially Ewald's *Geschichte*, vol. ii., and essays by Graf in Merx's *Archiv*, i. 78, and by Kuenen in the *Theologisch Tijdschrift* for 1872, together with the usual works on Biblical Antiquities.) (W. R. S.)

ARKANSAS, one of the south-western states of the North American Union, situated between lat. 33° and 36° 30′ N., and long. 89° 45′, and 94° 40′ W., with an area of 52,198 square miles. It is bounded N. by Missouri, E. by Tennessee and Mississippi, from which it is separated by the Mississippi River, S. by Louisiana, and W. by the Indian territory. It belongs to the great basin of the Mississippi, being watered by that river and by several of its main tributaries, which are all more or less navigable. Of these the principal are the St Francis, in the north-east; the White River with its affluents, the Cache, Little Red, and Black Rivers in the north; and notably the Arkansas, which, entering the state at Fort Smith, traverses it in a south-easterly direction until it joins the Mississippi at Napoleon. The southern part of the state is watered by the Washita in the east, and by a bend of the Red River in the west. The eastern part of the state, bordering on the Mississippi, is low and swampy, and is annually overflowed. Westward the country gradually attains a greater elevation, passing off into hills and undulating prairies, which lead up to the Ozark Mountains, beyond which, again, an elevated plain stretches towards the Rocky



Sketch Map of Arkansas.

Mountains. The Ozark Mountains do not exceed 2000 feet in height, and the only other great masses of elevation are the Black Hills and the Washita Hills. A geological survey of the whole territory was commenced at the state expense by Dr David D. Owen, in 1857, and two volumes of Reports were published in 1858 and 1860. In the district north of the Arkansas River, the three leading formations are the "mill-stone grit, with its associate shales and conglomerate; the subcarboniferous limestone and its associate chert, shales, and sandstones; and the magnesian limestones, and their associate sandstones, calciferous sand-rocks and chert, belonging to the lower Silurian period." The mineral products are reported to be very considerable, "including zinc, manganese, iron, lead, and copper; marble, whet and hone stones, rock-crystal, paints, nitre-earths, kaolin, granite, freestone, limestone, marls, green-sand, marly limestones, grindstones, and slate." The zinc ores are said to compare very favourably with those of Silesia, while the argentiferous galena produces a high average percentage of silver. Of coal, anthracite, and lignite, there are abundant supplies. A great number of mineral and thermal springs occur in various parts of the state, the most remarkable and most frequented groups lying to the south of the Arkansas in Hot Springs county. The heat of several attains 146° or 148° Fahr. Among what are called natural curiosities may be mentioned the sandstone dam across Lee's Creek in Crawfurd county, the Mammoth Spring in Fulton, which is supposed to have underground connection with Howel's Valley in Missouri, and is said to pour forth its water "at the rate of 8000 (?) barrels per minute," the Bee Rock in White county, and the crystalline productions of Magnet Cove. It need hardly be said that there is great variety of soil in such a state as Arkansas. Along the river "bottoms" the alluvium is dark, rich, and deep, and yields excellent crops. The chief crops cultivated are maize, wheat, cotton, and tobacco, as well as apples and other fruits. There is a natural flora of great richness, a complete list of which is given in Dr Owen's second report. The trees and shrubs most frequently occurring are poplars, oaks, pines, sweet gum, sycamore, black locust, ash, elm, hickory, dogwood, elder, palma-christi, black spice, papaw, mocker-nut, wild vine, &c. The fauna of Arkansas includes the buffalo, eland, red-deer, beaver, otter, hare, racoon, wild turkey, goose, and quail, as well as bears and wolves among the mountains. The climate of the lower districts is decidedly unhealthy, largely on account of the lack of wholesome water; but in the upper regions it is quite salubrious. Hitherto Arkansas has been mainly agricultural, but it is rapidly advancing in the development of its mineral wealth, in the extension of its railway communication, in the embankment and guidance of its rivers, in the reclaiming of its waste but fertile lands, in the progress of manufactures and industries, and in the establishment of educational and benevolent institutions. At the census of 1870 the population amounted to 484,471, comprising 362,115 whites and 122,169 coloured persons. In 1860 the population amounted to 435,450, so that an increase of more than 10 per cent. has taken place between these two periods, principally in the white population. The capital is Little Rock, originally a French settlement, situated on the Arkansas River, and occupying a very central position in the state; population, 18,000. Arkansas was first colonised by the French, in the 17th century, and in 1720 Louis XV. made a grant of land on the Arkansas to the well-known John Law, but this led to no results of importance. In 1763 the territory was handed over to Spain, but returned to France in 1800. In 1803 it was purchased by the United States, along with the rest of what was then called Louisiana, and was established as a separate non-Indian territory in 1819. It was received into the Union as a slave state in 1836; and during the American Civil War, 1861–65, its Convention sided with the Confederate States, joining that organisation May 6, 1861.

Arkansas, a river of North America, which rises in the Rocky Mountains, in lat. 39° N., long. 106° W., 10,000 feet above the level of the sea, flows with a generally eastward direction through Colorado and part of Kansas, then turns to the south-east, and so proceeds through the rest of Kansas, the north-east part of the Indian territory, and the state to which it gives its name, and finally falls into the Mississippi at Napoleon in lat. 33° 40′ N. The length of its course is stated at 2170 miles, and its drainage-area at 178,000 square miles. It receives a large number of tributaries, of which the most important are the Cimarron, Rio Nutria, and Canadian River. It is navigable for steamboats of about 4 feet draught 40 miles above Little Rock, and during flood for some 150 miles further to Fort Gibson.

ARKLOW, a sea-port and market town in the county of Wicklow, Ireland, 50 miles from Dublin, the inhabitants of which are principally engaged in the fisheries and in copper-mines. There are oyster-beds on the coast, but the produce requires to be freed from a peculiar flavour by the purer waters of the Welsh and English coast before it is fit for food. The ruins of the ancient castle of the Ormonds, demolished in 1649 by Cromwell, still exist, but there are no traces of the monastery founded by Fitzwalter. In 1789 the Irish insurgents were defeated by the royal troops near Arklow Bridge. Population (1871), 5178.

ARKWRIGHT, Sir Richard, famous for his inventions in cotton spinning, was born at Preston in Lancashire, in 1732, of parents in humble circumstances. He was the youngest of thirteen children, received but a very indifferent education, and was bred to the trade of a barber. In the year 1760 he had established himself in Bolton-le-Moor, where he exchanged the trade of a barber for that of an itinerant hair-merchant; and having discovered a valuable chemical process for dyeing hair, he was in consequence enabled to amass a little property. It is unfortunate that very little is known of the steps by which he was led to those inventions that have immortalised his name. His residence in a district where a considerable manufacture of linen goods, and of linen and cotton mixed, was carried on, must have given him ample opportunities of becoming acquainted with the various processes that were in use in the cotton manufacture, and of the attempts that had been made and were then making to improve them. His attention was thus naturally drawn to this peculiar department; and, while he saw reason to conclude that it was likely to prove the most advantageous in which he could engage, he had sagacity and good fortune to invent and improve those extraordinary machines by which, unlike most inventors, he amassed vast wealth, at the same time that he added prodigiously to the demand for labour, and to the riches and comfort of the civilised world.

The *spinning-jenny*, invented in 1767 by Hargraves, a carpenter at Blackburn in Lancashire, gave the means of spinning twenty or thirty threads at once with no more labour than had previously been required to spin a single thread. The thread spun by the jenny could not, however, be used, except as weft, being destitute of the firmness or hardness required in the longitudinal threads or warp. But Mr Arkwright supplied this deficiency by the invention of the *spinning-frame*—which spins a vast number of threads of any degree of fineness and hardness. It is not difficult to understand the principle on which this machine is constructed, and the mode of its operation. It consists of two pairs of rollers, turned by means of machinery. The lower roller of each pair is furrowed or fluted longitudinally, and the upper one is covered with leather, to make them take a hold of the cotton. If there were only one pair of rollers, it is clear that a carding of cotton, passed between them, would be drawn forward by the revolution of the rollers; but it would merely undergo a certain degree of compression from their action. No sooner, however, has the carding, or *roving* as it is technically termed, begun to pass through the first pair of rollers, than it is received by the second pair, which are made to revolve with (as the case may be) three, four, or five times the velocity of the first pair. By this ingenious contrivance the roving is drawn out into a thread of the desired degree of tenuity, a twist being given to it by the adaptation of the spindle and fly of the common flax wheel to the machinery. Such is the principle on which Arkwright constructed his famous spinning-frame. It is obvious that it is radically different from the previous methods of spinning either by the common hand-wheel or distaff, or by the jenny, which is only a modification of the common wheel. The idea was entirely original, and was perfected and reduced to practice with consummate skill. Arkwright stated that he accidentally derived the first hint of his great invention from seeing a red-hot iron bar elongated by being made to pass between rollers; and though there is no mechanical analogy between that operation and his process of spinning, it is not difficult to imagine that, by reflecting upon it and placing the subject in different points of view, he might be led by it to his invention. The precise date of the discovery is not known; but it is most probable that the idea had occurred to his mind as early as the period when Hargraves was engaged in the invention of the jenny, or almost immediately after. Not being himself a practical mechanic, Arkwright employed John Kay, a watchmaker at Warrington, to whom we shall afterwards have to refer, to assist him in the preparation of the parts of his machine. An application in 1767 to Mr Atherton of Liverpool for pecuniary assistance was unsuccessful, though he is said to have sent some workmen to assist in the construction of the machine, the first model of which was set up in the parlour of the house belonging to the Free Grammar School at Preston.

His inventions being at length brought into a pretty advanced state, Arkwright, accompanied by Kay, and a Mr Smalley of Preston, removed to Nottingham in 1768, in order to avoid the attacks of the same lawless rabble that had driven Hargraves out of Lancashire. Here his operations were at first greatly fettered by a want of capital. But Mr Strutt of Derby, a gentleman of great mechanical skill, and largely engaged in the stocking manufacture, having seen Arkwright's inventions, and satisfied himself of their extraordinary value, immediately entered, conjointly with his partner, Mr Need, into partnership with him. The command of the necessary funds being thus obtained, Arkwright erected his first mill, which was driven by horses, at Nottingham, and took out a patent for spinning by rollers in 1769. But as horse-power was found too expensive, he built a second factory, on a much larger scale, at Cromford in Derbyshire, in 1771, the machinery of which was turned by a water-wheel, after the manner of the famous silk-mill erected by Sir Thomas Lombe. Having made several additional discoveries and improvements in the processes of carding, roving, and spinning, he took out a fresh patent for the whole in 1775; and thus completed a series of machinery so various and complicated, yet so admirably combined and well adapted to produce the intended effect in its most perfect form, as to excite the admiration of every one capable of appreciating the ingenuity displayed and the difficulties overcome.

When the vast importance of these discoveries became generally known, it is not surprising that every effort should have been made to have the patents set aside, and Arkwright deprived of the profit and honour to be derived from them. But an attentive consideration of the various proceedings relative to this subject will show that there are no good grounds for crediting the statement made in the Court of King's Bench in 1785, and again repeated by Mr Guest in his work on the cotton manufacture, which ascribes the invention of spinning by rollers to Highs, or Hayes, from whom Arkwright is said to have learned it.

Arkwright's *first* patent for spinning by rollers, which is the essential part of his inventions, was obtained, as we have previously stated, in 1769; and its value and importance were no longer doubtful after the establishment of the factory at Cromford in 1771. The success which attended this novel method of spinning naturally excited the strongest desire on the part of the Lancashire manufacturers to participate in the advantages to be derived from it; and the fair presumption is that, instead of attempting clandestinely to pirate the invention, they would, had they conceived there were any good grounds to go upon, have at once contested the validity of the patent. But no such attempt was made till 1781, *twelve* years after the date of the first patent, and *six* years after the date of the second. And even then, Arkwright's opponents came forward only in consequence of his having resolved to vindicate his rights, which had begun to be invaded on all sides, by raising an action against Colonel Mordaunt for an infringement of his patent. Mordaunt was supported by a combination of manufacturers; and, as they felt the question to be of the greatest importance, it is all but impossible to suppose that anything would be omitted on their part which was conceived likely to contribute to their success. The case having been tried in the Court of King's Bench, after Trinity term, July 1781, the decision was unfavourable to Arkwright. But it is of importance to observe, that no attempt was made at the trial to charge him with having purloined the inventions of others, and that the verdict was given on the sole ground of the *description of the machinery in the specification being obscure and indistinct.* Arkwright admitted that this was partly the case; adding, however, that the obscurity had been intended only to prevent foreigners from pirating his inventions. On any other principle, indeed, his conduct would be inexplicable; for, as his inventions were fully known to hundreds of workmen in his own employment, and as he had sold the privilege of using them to many persons in different parts of the country, it is impossible to suppose that he could either have expected or intended to conceal his inventions after the expiration of his patent. In consequence of the result of this trial, Arkwright and his partners prepared a "case," setting forth the value of the inventions, and the circumstances which had led to the indistinctness complained of in the specification, which they at one time intended to lay before Parliament, as the foundation of an application for an Act for their relief. But this intention was subsequently abandoned; and in a new trial (Arkwright *v.* Nightingale), which took place in the Court of Common Pleas on the 17th of February 1785, Lord Loughborough, the presiding judge, having expressed himself favourably with respect to the sufficiency of the specification, a verdict was given for Arkwright. On this, as on the former trial, nothing was stated against the originality of the invention.

In consequence of these conflicting verdicts, the whole matter was brought, by a writ of *scire facias*, before the Court of King's Bench, to have the validity of the patent finally settled. And it was not till this third trial, which took place before Mr Justice Buller and a special jury, on the 25th of June 1785, that Arkwright's claim to the inventions which formed the subject of the patent was disputed. To support this new allegation, Arkwright's opponents brought forward, for the first time, Highs, or Hayes, a reed-maker at Bolton. He stated that he had invented a machine for spinning by rollers previously to 1768; that he had employed the watchmaker Kay to make a model of that machine; and Kay was produced to prove that he had communicated that model to Arkwright, and that that was the real source of all his pretended inventions. Having no idea that any attempt was to be made at so late a period to overturn the patent on this new ground, Arkwright's counsel were not prepared with evidence to repel this statement; but it was stated by Mr Sergeant Adair, on a motion for a new trial on the 10th of November of the same year, that he was furnished with affidavits contradicting, in the most pointed manner, the evidence that had been given by Kay and others with respect to the originality of the invention. The court, however, refused to grant a new trial, on the ground that, whatever might be the fact as to the question of originality, the deficiency in the specification was enough to sustain the verdict. But, independently altogether of the statements made on the motion for a new trial, the improbability of the story told by Highs and Kay seems glaring and obvious. Highs states in his evidence that he had accused Arkwright of getting possession of his invention by means of Kay so early as 1769, or about that period. Where, then, it may be asked, was this Mr Highs ever since that period, and particularly during the first trial in July 1781, and the second in February 1785? Living in Lancashire, associating with manufacturers, and in the habit, as he declares in his evidence, of making machines for them, he could not fail to be speedily informed with respect to the vast importance and value of the invention Arkwright had purloined from him. It is impossible but he must have been acquainted with the efforts that were making by the Lancashire manufacturers to set aside the patents; and is it to be supposed, had he really been the inventor, that he would have remained for *sixteen* years a passive spectator of what was going forward? that he would have allowed Arkwright to accumulate a princely fortune by means of *his* inventions while he remained in a state of poverty? or that he would have withheld his evidence when the manufacturers attempted to wrest from Arkwright what he had so unjustly appropriated? A single hint from Highs or Kay would, had their story been well founded, have sufficed to force Arkwright to give them a share of his profits, or would have furnished the manufacturers with the means they were so anxious to obtain, of procuring the immediate dissolution of the patents. But it has never been alleged that Arkwright took any pains to conciliate these persons; on the contrary, he treated Highs with the most perfect indifference, and not only dismissed Kay from his service, but even threatened to prosecute him on a charge of felony. The supposition that persons with so many and such overpowering temptations to speak out, and with no inducement of any sort to be silent, should have kept so important a secret for so many years is almost incredible; and it is infinitely more consistent with probability to suppose that the story of Highs and Kay had been manufactured for the occasion than that it was really true. None of Arkwright's most intimate friends ever had the slightest doubt with respect to the originality of his invention. Some of them, indeed, could speak to the circumstances from their own personal knowledge; and their testimony was uniform and consistent.

On their introduction, Arkwright's machines were regarded by the lower classes as ever more adverse to their interests than those of Hargraves, and repeated attacks were made on the factories built for them. But however extraordinary it may appear, it was amongst the manufacturers that the greatest animosity existed against Arkwright; and it required all the prudence for which he was so remarkable to enable him to triumph over the powerful combination that was formed against him. At the outset of the business they unanimously refused to purchase his yarn; and when his partners, Messrs Strutt and Need, had commenced a manufacture of calicoes, the manufacturers strenuously opposed a bill to exempt calicoes from a discriminating duty of 3d. a yard laid on them over and above the ordinary duty of 3d. by an old Act of Parliament. Luckily, however, the manufacturers failed of their object; and, in 1774, an Act of Parliament was obtained (14 Geo. III. cap. 72) for the encouragement of the cotton manufacture, in which fabrics made of cotton are declared to have been *lately* introduced, and are allowed to be used as "a lawful and laudable manufacture;" the duty of 6d. the square yard on such cottons as are printed or stained being at the same time reduced to 3d. But this disgraceful spirit of animosity, which must, had it been successful, have proved as injurious to the interests of the manufacturers as to those of Arkwright, did not content itself with actions in the courts of law, or a factious opposition to useful measures in Parliament, but displayed itself in a still more striking and unjustifiable manner. A large factory, erected by Arkwright at Birkacre, near Chorley, in Lancashire, was destroyed by a mob collected from the adjacent country, in the presence of a powerful body of police and military, without any one of the civil authorities requiring them to interfere to prevent so scandalous an outrage.

Fortunately, however, not for himself only, but for his country and the world, every corner of which has been benefited by his inventions, Arkwright triumphed over every opposition. The same ingenuity, skill, and good sense, which had originally enabled him to invent his machine and get it introduced, enabled him to overcome the various combinations and difficulties with which he had subsequently to contend.

Though a man of great personal strength, which he is said to have displayed, when young, in election riots at Preston, Arkwright never enjoyed good health. During the whole of his memorable career of invention and discovery, he was labouring under a very severe asthmatic affection. A complication of disorders at length terminated his truly useful life in 1792, at his works at Cromford, in the sixtieth year of his age. He was high sheriff of Derbyshire in 1786; and, having presented a congratulatory address from the wapentake of Wirksworth to his Majesty George III., on his escape from the attempt on his life by Margaret Nicholson, received the honour of knighthood. No man ever better deserved his good fortune, or has a stronger claim on the respect and gratitude of posterity. His inventions have opened a new and boundless field of employment; and while they have conferred infinitely more real benefit on his native country than she could have derived from the absolute dominion of Mexico and Peru, they have been *universally* productive of wealth and enjoyment.

ARLES (*Arelate*), a city of France, in the department of Bouches du Rhône, 46 miles north-west of Marseilles, in lat. 43° 40′ 18″ N., long. 4° 37′ 46″ E. It stands on the left bank of the Rhone, where that river divides to form its delta. It is generally well built, with regular streets and fine quays. The public buildings consist of the town-hall, dating from Louis XIV., and built after plans by Mansart; the cathedral of St Trophime, founded in the 7th century and remarkable for its portico; a college, museum, school of navigation, and public library. The building of railway waggons, &c., is largely carried on, as well as the manufacture of silk, glass-bottles, and soap, and the sausages of Arles are famed for their excellence. The trade in agricultural produce, oil, wine, fruits, cattle, wool, and salt, is considerable. A canal (called after the city) has been constructed from Arles to the harbour of Bouc on the Mediterranean, and a connection is formed with the canals of Beaucaire and Craponne. The latter affords communication with the Durance. Population in 1872, 24,695.

Arelate was an important town at the time of Cæsar's invasion, and subsequently received a Roman colony, and became under the later emperors one of the most flourishing towns on the further side of the Alps. It was pillaged in 270 A.D., but restored and embellished by Constantine, who made it his principal residence, and founded what is now the suburb of Trinquetaille. After the fall of the Roman empire the city passed into the power of the Visigoths, and rapidly declined. It was plundered in 730 by the Saracens, but in the 10th century became the capital of a kingdom of the same name, formed by Bozon from the two kingdoms of Burgundy. In the 12th century it was a free city, governed by *consuls* and *podestats* after the model of the Italian republics, which it also emulated in commerce and navigation. In 1251 it submitted to Charles of Anjou, and from that time onwards followed the fortunes of Provence. A number of ecclesiastical councils have been held here, as in 314,—when the Donatists were condemned,—354, 452, and 475. Arles still possesses many monuments of Roman architecture and art, the most remarkable being the ruins of an amphitheatre (*arènes*), capable of containing 20,000 spectators, which was turned, by Abd-el-Rahman, into a fortress and flanked with four massive towers, of which two are still standing. There are also a theatre, in which, besides the famous Venus of Arles, discovered in 1651, many other remains have been found; an ancient obelisk of a single block, 47 feet high, erected in 1676 in the *Place Royale*; and the ruins of two temples, an aqueduct, and a triumphal arch. There is, besides, a Roman cemetery of great beauty, which has been laid out as a public pleasure-ground, and bears the name of Aylscamps or Eliscamps, which hardly conceals the original designation, "*Elysii Campi*." (See Clair, *Monuments d'Arles*, 1837; Millin, *Voy. dans les départ. du Midi de la France*; Estrangin, *Etudes archéol. sur Arles*.)

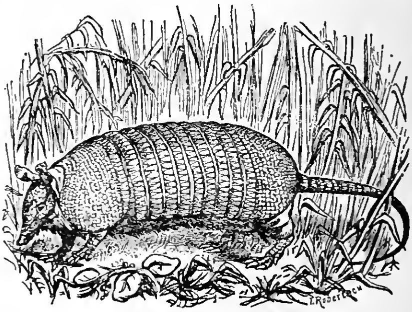
ARLON (*Orolaunum* in the Antonine Itinerary), the capital of the Belgian province of Luxemburg, is situated on a rising ground in the midst of a well-cultivated plain. It is a flourishing place of some 5000 or 6000 inhabitants, who are engaged in the manufacture of iron-wares, tobacco, crockery, and clay-pipes, and carry on a trade in grain. Antiquities found on the spot seem to indicate a Roman settlement. Under its present name the town is mentioned in 870. At one time an independent marquisate, it was united to the countship of Luxemburg in 1214. In the neighbourhood was the nunnery of Clairefontaine or Bardenburg, established about 1216, which is now a foundry.

ARMADA, a Spanish word, meaning generally an armed force or fleet, is applied specially to designate the great expedition sent out against England in 1588 by Philip of Spain. His principal motive for this enterprise was the desire to strike a decisive blow at the Protestant faith, of which England was then the bulwark. For many months the whole energies of the Spanish nation had been directed towards the construction and equipment of the requisite ships. In 1587 everything was nearly ready, but the sailing of the expedition was delayed for a year by Drake, who made a bold dash into the harbour of Cadiz and destroyed nearly a hundred ships, with immense stores of provisions. A further delay was caused by the sudden death of the marquis of Santa Cruz, who had been originally intrusted with the chief command. His loss was a serious blow to the Spanish cause, for he was an experienced sailor. The duke of Medina Sidonia, a man almost entirely ignorant of naval affairs, was then made admiral. All preparations being at length completed, the great fleet sailed from Lisbon on the 29th (19th o. s.) May 1588. It consisted of 129 large vessels, and carried 19,295 soldiers, 8460 sailors, besides slaves as rowers, and 2431 cannon. Their destination was the coast of Flanders, where Alexander Farnese, prince of Parma, was lying with about 35,000 men and a flotilla of boats. This force was to be landed on the Isle of Thanet at the mouth of the Thames, under the protection of the Armada, which would be able to keep the Channel perfectly clear. Another body of troops was then to be landed further north; and it had been hoped at one time that the duke of Guise would effect a diversion by landing a force on the west coast. These plans, however, were considerably deranged by the length of time occupied in preparing the expedition, and by the further delays encountered. For the fleet had scarcely sailed from Lisbon, when it was overtaken by a severe storm, which shattered several of the ships, and compelled them all to put in for repairs at Coruña. It was the 22d (12th) July before they finally sailed from Spain. England meanwhile had not been idle; when the news arrived that the great expedition was really about to set out, the most intense enthusiasm took possession of the people, who gladly furnished ships and stores, and raised volunteer bands for coast defence. The command of the army was given to the earl of Leicester, who took his post, with about 16,000 men, at Tilbury to oppose the landing of Parma. About 45,000 were assembled round the Queen, to protect her person. The royal navy, which consisted of about thirty ships, was at once put in order, and gradually increased, by the addition of merchantmen and privateers, to about 180 vessels. These carried about

18,000 sailors, but they had not half the weight of the Spanish artillery, and they were scantily supplied with ammunition and provisions. The ships, however,—those of the Queen in particular,—were in splendid order, and the sailors were the finest in England. The lord high admiral was Lord Howard of Effingham, who had under him Drake, Hawkins, Frobisher, and others, the most celebrated mariners of the age. He took his station with the main body of the ships, about eighty in number, at Plymouth, and another squadron, under Lord Seymour, cruised off Dunkirk, commanding the straits and blockading the prince of Parma. Meantime news was brought to England that the Armada had encountered severe storms, and that the expedition was given up. So much faith was put in this report that several ships began to discharge their crews. Howard, however, sailed down towards Coruña, and discovered that the report had no foundation. On the 29th (19th) July, the fleet was observed entering the Channel, and the beacon-lights along the coast gave warning to England that the dreaded enemy was at hand. That evening Howard's ships were moored so as to be able to slip out of Plymouth Sound at a moment's notice. On the following day the Armada was seen standing up the Channel in the form of a crescent, seven miles long, and numbering 150 ships. They passed Plymouth towards evening, and during the night the English fleet sailed out of the Sound, and took up a position to windward. On the following day the action began by the duke of Medina Sidonia attempting to close and come to a general engagement. But he found this to be impossible; the English ships, light and admirably handled, sailed so swiftly, and were manœuvred with such dexterity, that it was out of his power to inflict any injury on them. Their fire also was rapid and deadly, while the Spanish guns were worked slowly, and generally sent the shot far over the light English vessels. Dismayed at their want of success, the Spanish fleet stood off up the Channel, closely pursued by the English. Throughout all the next week the same tactics were pursued; the English, hovering on the rear of the Armada, harassed and weakened it without coming to a general engagement. At length, on the 6th August (27th July), Medina Sidonia cast anchor in the roads of Calais, and sent messengers to the prince of Parma, asking him for ammunition and light vessels, and suggesting that he should now attempt his landing on the coast of England. But the prince declared that it was impossible to cross the Channel while the English fleet was on the sea, that he had no light ships, and that the state of the weather prevented him sending such ammunition as he could spare. Lord Howard had now been joined by Seymour's squadron and by many private ships, but he and the other commanders were still in the deepest anxiety. They were almost destitute of provisions and powder, and did not yet know what damage they had inflicted on the Armada, which, after all their endeavours, seemed now to have reached its destination. At last it was resolved to drive the Spanish fleet out into the open sea, and to effect this by means of fire-ships. Eight ships were selected and filled with combustibles, their rigging was smeared with pitch, and on the night of the 7th August (28th July) they were drifted down with the tide and set on fire. The Spaniards, in great alarm, immediately cut their cables and cleared off from the shore. Next morning Drake pursued them, while Howard remained for some time to attack a galleon that had gone ashore during the night. The Spanish fleet was scattered over a large space off Gravelines, and Drake at once began the action, driving them together into a confused mass by his rapid firing and swift manœuvring, and forcing the whole towards the coast of Flanders. Had his ammunition held out he might have completed the ruin by driving them on shore; as it was, the injury inflicted by this one day's fighting was enormous. Nearly 4000 men were killed and many ships were disabled, and the hopes of the Spaniards were broken. Their courage completely deserted them; and next day, when a council of war was held, it was resolved to try the perilous voyage to Spain by the North Sea and Pentland Firth rather than again face Drake and the English fleet. The whole fleet, still numbering 120 vessels, stood off accordingly towards the North Sea. Drake and Howard pursued for some days, till want of provisions compelled them to return. But the weather proved a sufficiently formidable enemy to the unhappy Spaniards. The continuous violent gales which accompanied them along their route, by the north of Scotland and the wild Irish coast, completely shattered their unseaworthy vessels. The shores were strewn with wrecks, and many hundreds of unfortunates who were saved from the sea were slain by the Irish. Constant sickness had decimated the troops, and when at length, in September and October, fifty-four shattered vessels reached Spain, they conveyed only 9000 or 10,000 men, and these were in a pitiable state from sickness and want.

A full account of the Armada is given in the curious Spanish work, *La felicisima Armada, &c.*, published in 1588, a copy of which, with Lord Burleigh's manuscript notes, is in the British Museum. Froude (*History*, vol. xii.) gives valuable extracts from Spanish manuscripts bearing on the expedition.

ARMADILLO, a family of South American mammals (*Dasypidæ*), belonging to the order Edentata, and distinguished by the peculiar nature of their external covering. This consists of a bony case, partly composed of solid buckler-like plates, and partly of movable transverse bands, the latter differing in number with the species, and, to a certain extent, with the age and sex of the individual, and giving to the entire body a considerable degree of flexibility. The under parts are destitute of bony covering, but in every case are more or less thickly covered with hair. The legs of the armadillo are short, and its movements usually slow, although, when pursued, it is said to be able to outrun a man. In danger, however, it chiefly depends for safety on its long, powerful claws, by which it can bury itself, in a few minutes, several feet below the surface of the ground. Most of the species are nocturnal in their habits, with small, weak eyes, but highly developed organs of hearing and smelling. They all possess molar teeth, and, with the exception of a single species, those only. Their food consists principally of fruits, roots, worms, and insects, but a few species are more carnivorous, greedily devouring the semi-putrid carcases of the wild



The Peba (*Tatusia Peba*, Owen).

cattle of the *pampas*, and even, it is said, burrowing into human graves. All the species are eaten by the natives and by the Portuguese and Spanish settlers, who esteem them a delicacy when roasted in the shell. The habitat of the armadilloes, extending from Mexico and Texas southward to Patagonia, is the region which, during the Tertiary period, was inhabited by the Glyptodons—gigantic armadilloes as large as the rhinoceros, whose remains are found abundantly in the bone-caves of Brazil.

ARMAGH, an inland county of Ireland in the province of Ulster, situated between lat. 54° 3′ and 54° 31′ N., and long. 6° 14′ and 6° 45′ W.; comprising an area of 328,086 statute acres, of which 178,064 are under tillage, 100,137 in pasture, 4670 in plantation, and 28,177 in waste, &c., while 17,038 acres are under water. It is bounded on the N. by Lough Neagh, on the E. by the county of Down, on the S. by Louth, and on the W. by Monaghan and Tyrone. The general surface of the county is gently undulating and pleasingly diversified; but in the northern extremity, on the borders of Lough Neagh, is a considerable tract of low, marshy land, and the southern border of the county is occupied by a barren range of hills, the highest of which, named Slieve Gullion, attains an elevation of 1893 feet, being the highest mountain in Ulster excepting Slieve Donard in the county of Down. The summit of Slieve Gullion, commanding one of the finest prospects in the province, is crowned by a large cairn or pile of stones, which forms the roof of a singular cavern of artificial construction. In the western portion of the county are the Few Mountains, a chain of abrupt hills mostly incapable of cultivation.

The soil of the northern portion of the county is a rich, brown loam, on a substratum of clay or gravel, with an abundance of limestone near Armagh and other places. Towards Charlemont there is much reclaimable bog resting on a limestone substratum. The eastern portion of the county is generally of a light friable soil; the southern portion rocky and barren, with but little bog except in the neighbourhood of Newton Hamilton. The climate of Armagh is considered to be one of the most genial in Ireland, and less rain is supposed to fall in this than in any other county.

The county is well watered by numerous streams. The principal are the Callen, the Tynan, and the Tallwater, flowing into the Blackwater, which, after forming the boundary between this county and Tyrone, empties itself into the south-western angle of Lough Neagh. The Tara, the Newtown-Hamilton, the Creggan, and the Fleury flow into the Bay of Dundalk. The Cam or Camlin joins the Bann, which, crossing the north-western corner of the county, falls into Lough Neagh to the east of the Blackwater. The Newry canal, communicating with Carlingford Lough at Warrenspoint, six miles below Newry, proceeds northwards through the county of Armagh for about 21 miles, joining the Bann at Whitecoat. The Ulster Canal commences at Charlemont on the River Blackwater, near its junction with Lough Neagh, proceeding through the western border of the county, and passing thence to the south-west by Monaghan and Clones into Upper Lough Erne, after a couse of 48 miles.

The geological features of the county are various and interesting. The granite of Slieve Gullion, an offset of the granite district of Down, is often used for millstones, being very hard and fine grained. The Newry Mountains and the Fathom Hills are also composed of granite. Around Camlough large beds of mica-slate exist. Slate quarries have been worked partially at Dorcy, Newtown-Hamilton, Creggan Duff, and in the neighbourhood of Crossmaglen. Lead mines have been worked, but without much success, in several parts of the county. There are extensive deposits of lignite in the district near Lough Neagh. The other mineral substances found are potters' clay and a variety of ochres.

The total population in 1821 amounted to 197,427 souls. In 1831 the population was 220,134, and in 1841 it was 232,393, but in 1851 the numbers had declined to 196,085, and by the census of 1871 it was 179,260.

The land is in general but indifferently cultivated, yet owing to the occupation of the peasantry in the linen manufacture they are better lodged, clothed, and fed than in most other parts of Ireland. The cultivation of grain has been for some time slightly on the decrease, and the number of acres under flax diminished from 27,245 in 1866 to 7530 in 1872; but in the green crops there has been considerable increase. The total number of acres under crops amounted in 1872 to 172,550, viz., wheat, 10,599; oats, 68,487; barley, bere, and rye, 379; beans and pease, 254; potatoes, 32,799; turnips, 7998; other green crops, 3287; flax, 7530; meadow and clover, 41,164.

The farms are in general very small, and show less tendency to decrease in number than in most other parts of Ireland. In 1872 there were 6220 holdings of less than five acres each. Notwithstanding this, their owners are generally in circumstances of comparative comfort, owing to their employment in the linen manufacture. There are few who do not keep at least one cow, or a few sheep; none but the poorest cottar is without a pig. The usual diet is oatmeal, potatoes, and milk-porridge, varied sometimes by salt-herrings. The better description of farmers use animal food, chiefly bacon and poultry.

The principal manufacture, and that which has given a peculiar tone to the character of the population, is still that of linen, though it has somewhat declined of late. It is noways necessary to the promotion of this manufacture that the spinners and weavers should be congregated in large towns, or united in crowded and unwholesome factories. On the contrary, most of its branches can be carried on in the cottages of the peasantry. The men devote to the loom those hours which are not required for the cultivation of their little farms; the women spin and reel the yarn during the intervals of their other domestic occupations. Smooth lawns, perennial streams, pure springs, and the open face of heaven, are necessary for perfecting the bleaching process. Hence the extensive bleachers dwell in the country with all their assistants and machinery. Such is the effect of this combination of agricultural occupations with domestic manufactures, that the farmers are more than competent to supply the resident population of the county with vegetable, though not with animal food; and some of the less crowded and less productive parts of Ulster receive from it a considerable supply of oats, barley, and flour. Apples are grown in such quantities as to entitle the county to the epithet applied to it, the orchard of Ireland.

The antiquities consist of cairns and tumuli; the remains of the fortress of Eamania near Armagh, once the residence of the kings of Ulster; the Dane's Cast, an extensive fortification in the south-east of the county, extending into the county of Down; spears, battle-axes, collars, rings, amulets, medals of gold, ornaments of silver, jet, and amber, &c., have also been found in various places. The religious houses were at Armagh, Clonfeacle, Killevy, Kilmore, Stradhailloyse, and Tahenny. Of military antiquities the most remarkable are Tyrone's ditches, near Poyntz-Pass, Castle Roe, the fort of Navan, the castles of Criff-Keirn and Argonell, and that in the pass of Moyrath.

Armagh, together with Louth, Monaghan, and some smaller districts, formed part of a territory called Orgial or Urial, which was long subject to the occasional incursions of the Danes.

The county was made shire ground in 1586, and called Armagh after the city, by Sir John Perrott. When James I. proceeded to plant with English and Scotch colonists the vast tracts escheated to the crown in Ulster, the whole of the arable and pasture land in Armagh, estimated at 77,800 acres, was to have been allotted in sixty-one portions. Nineteen of these, comprising 22,180 acres, were to have been allotted to the church, and forty-two, amounting to 55,620 acres, to English and Scotch colonists, servitors, native Irish, and four corporate towns,—the swordsmen to be dispersed throughout Connaught and Munster. This project was not strictly adhered to in the county of Armagh, nor were the Irish swordsmen or soldiers transplanted into Connaught and Munster from this and some other counties.

Armagh is now divided into eight baronies, viz., Armagh, Fews Lower and Upper, Oneiland East and West, Orior Lower and Upper, and Tiranny. It contains twenty-nine parishes and parts of parishes, the greater number of which are in the archdiocese of Armagh, and a few in the diocese of Dromore. The county is in the Belfast military district, having barracks at Armagh and Newry. The constabulary force has its headquarters at Armagh, the county being divided into five districts. Assizes are held at Armagh, where the county prison, the county infirmary, and the district lunatic asylum are situated. The only savings bank in the county is at Armagh. There are two poor-law unions, Armagh (partly in Tyrone) and Lurgan (partly in Antrim and Down). The valuation of rateable property in 1872 amounted to £410,757. The chief towns are—Armagh, population in 1871, 8946; Lurgan, 10,632; Portadown, 6735; and part of Newry, with 5321 inhabitants, the remainder of this place, with 9616 inhabitants, being in the county of Down. The county returns three members to the imperial parliament, two for the county generally,—constituency in 1873, 7044; and one for Armagh city,—constituency, 621.

In the towns and level parts of the county the Protestant religion, in its two principal forms of the Episcopal and Presbyterian, predominates; but the Roman Catholic faith is prevalent in the mountainous and less cultivated parts. By the census returns of 1871 the Roman Catholics number 85,057, or nearly one-half of the gross population. The number of children at school in 1871 amounted to 19,887, of whom 14,838 attended the various "National Schools." There were in the same year twenty-one persons who knew nothing but the native Erse, and 3903 were able to speak both that language and the English.

ARMAGH, a city and parliamentary borough in the above county, 64 miles north of Dublin, in lat. 54° 20′ 55″ N., and long. 6° 37′ 57″ W. It derives its name of *Ard-macha*, or High Field, from its situation on the sides of a steep hill called Drumsailech, or the Hill of Willows, which rises in the midst of a fertile plain. Of high antiquity, and, like so many other Irish towns, claiming to have been founded by St Patrick, it long possessed the more important distinction of being the metropolis of Ireland; and, as the seat of a flourishing college, was greatly frequented by students from other lands, among whom the English and Scotch were said to have been so numerous as to give the name of Trian-Sassanagh, or Saxon Street, to one of the quarters of the city. Of a synod that was held here as early as 448, we have interesting memorials in the *Book of Armagh*. Exposed to the successive calamities of the Danish incursions, the English conquest, and the English wars, and at last deserted by its bishops, who retired to Drogheda, the venerable city sank into an insignificant collection of cabins, with a dilapidated cathedral covered with shingles. From this state of decay, however, it was raised by the unwearied exertions of Primate Robinson (otherwise Lord Rokeby), which, seconded as they have been by similar devotion on the part of his successors of the Beresford family, have made of Armagh one of the best-built and most respectable towns in the country. As the ecclesiastical metropolis of both the Anglican and Roman organisations, it possesses two cathedrals—of which the Catholic is of the more recent construction—and two archiepiscopal palaces. As the county town it has a court-house, a prison, a lunatic asylum, and a county infirmary. Besides these, there is a fever hospital, erected by John George Beresford; a college, which Primate Robinson was very anxious to raise to the rank of a university; a public library founded by him, and containing upwards of 14,000 volumes; an observatory, which has become famous from the efficiency of its astronomers; and a number of churches and schools. Almost all the buildings are built of the limestone of the district, but the Anglican cathedral is of red sandstone. Population of the parliamentary borough in 1871, 8946.

ARMAGNAC, a district of the south of France, corresponding to a large part of the present department of Gers, with portions of the neighbouring territory, erected in the 10th century into a countship in favour of Bernard the Squint-eyed (le Louche), son of the count of Fezinsac. The family thus founded at various times exercised great influence on the destinies of France, especially in the persons of John I. (d. 1373), Bernard VII. (d. 1418), John IV. (d. 1451), and John V. (d. 1473). Under Bernard VII. the name Armagnacs was given to the party of the house of Orleans, which carried on so ruthless a contest with the house of Burgundy during the imbecile reign of Charles VI. In 1444–5, the Emperor Frederick III. of Germany obtained from Charles VII. a large army of Armagnacs to enforce his claims in Switzerland, and the war which ensued took the name of the Armagnac war (*Armagnakenkrieg*). In Germany the name of the foreigners, who were completely defeated in the battle of St Jakob on the Birs, not far from Bâle, was mockingly corrupted into *Arme Jacken*, Poor Jackets, or *Arme Gecken*, Poor Fools. On the death of Charles of Armagnac, in 1497, the countship was united to the crown by Charles VII., but was again bestowed on Charles, the nephew of that count, by Francis I., who at the same time gave him his sister Margaret in marriage. After the death of her husband, by whom she had no children, she married Henry of Albret, king of Navarre; and thus the countship of Armagnac came back to the French crown along with the other dominions of Henry IV. In 1645, Louis XIV. erected a countship of Armagnac in favour of Henry of Lorraine, count of Harcourt, in whose family it continued till the Revolution. James of Armagnac, grandson of Bernard VII., was made duke of Nemours in 1462, and was succeeded in the dukedom by his second son, John, who died without issue, and his third son, Louis, in whom the house of Armagnac became extinct in 1503.

ARMENIA (*Hayasdani* or *Haikh*, in the native language), formerly an extensive country of Western Asia, which is now divided between Turkey, Russia, and Persia. Its political relations, and consequently its geographical limits, were subject to frequent variation, but in its widest extent it may be described as reaching from the Caucasus in the N. to the Mountains of Kurdistan in the S., and from the Caspian Sea in the E. to Asia Minor in the W., frequently, indeed, somewhat overlapping with the last-mentioned geographical division. From a very early period a distinction was drawn between Greater Armenia (*Armenia Major, Medz Hayotz*), to the east of the Euphrates, and Lesser Armenia (*Armenia Minor, Phokhr Hayotz*), lying to the west. The former is more properly Armenia. It consists for the most part of an elevated table-land, about 7000 feet above the level of the sea, culminating in the peaks of Mount Ararat, and sinking towards the plains of Iran on the east and those of Asia Minor in the west, while it is frequently broken by glens and valleys. It is watered by the Euphrates, the Tigris, the Aras, and the Kur, all of which have their sources within its borders; and, like other mountainous countries, it possesses a large number of lakes. The most important of these are Van or Aghtamar, Sevan or Khabodan, and Urmiah or Keghem. The country is naturally fertile, producing grain, cotton, tobacco, and grapes, but for many centuries it has been sadly neglected. It abounds in romantic scenery and luxuriant pasture. The beauty of the district of Ararat especially has been celebrated by patriotic historians like Moses of Khorene and Lazarus of Pharb. In the time of its greatest prosperity, Armenia Major was divided into fifteen provinces, and contained a large number of flourishing and important towns. The capital for many centuries, under the Haikian dynasty, was Armavir, to the north of the Araxes, but it was changed for Artaxata (Ardashad) towards the close of the first century of our era. Erovant II. (58–78 A.D.) built Erovantashad and Pakaran, and adorned them with the spoils of the earlier cities. From the 2d to the 4th century the royal residence was at Valarsabad, which no longer exists, and, under the Pagratid dynasty, the chief town was first Shiragavan and afterwards Ani, the remains of which still testify to its magnificence. (Texier, *Description de l' Arménie;* Brosset, *Ruines d'Ani,* 1860, 1861.) Other places of importance were Erzeroum, Van or Shamiramaguerd, Nakhjuan, Amid, and Pakovan. Divided and incorporated by the three great empires already mentioned, Armenia has no longer a separate existence, and details regarding the present condition of the country that formerly bore the name come more appropriately elsewhere. The Russian portion extends south to the Aras, and is mainly included in the government of Erivan; the Persian share is absorbed in Azerbijan; and Turkish Armenia is principally contained in the province of Erzeroum. The chief towns in the first are Erivan, Etchmiadzin, Ordubad, and Alexandropol; in the second, Urumiyah; and in the third, Erzeroum and Van.

According to their own legendary history, in which ancient traditions are curiously incorporated with Biblical lore, the Armenians are descendants of Haik, a son of Togarmah, the grandson of Japhet, who fled from the tyranny of Belus of Assyria and settled in the country which now, in their language, bears his name. The conquest of the land by Semiramis, and the revolt of Barvir against Sardanapalus, are the chief events in the early ages. Tigranes or Dikran is regarded as the contemporary and ally of Cyrus, and the history of his reign is recorded in detail. His son, Vahakin, who succeeded him, was celebrated for his strength, and was deified after his death. The dynasty came to an end in the person of Vahi, who was defeated by Alexander the Great, 328 B.C.

The Armenians threw off the Macedonian yoke in 317 B.C., and chose Ardvates as their king; but on his death, about thirty-three years afterwards, they submitted to the Seleucids of Syria. About 190 B.C., Artaxias, who had been appointed governor by Antiochus the Great, took advantage of that monarch's defeat by the Romans and proclaimed Armenia Major independent. It was this prince who afforded an asylum in his court to the exiled Hannibal. The example of revolt was followed in Lesser Armenia by Zadriades, whose descendants maintained their position till the time of Tigranes II., when their territory was annexed to Greater Armenia.

About the middle of the 2d century B.C., the great Parthian king, Mithridates I., who had already extended his empire over Syria, established his brother, Valarsaces (Wagharshag), in Armenia, and thus rendered him the founder of one of the most important branches of the Arsacid family. The new king greatly promoted the prosperity of the country by founding cities, establishing laws, and rewarding persons of talent. The most celebrated of his successors was his great-grandson, Tigranes II., who made himself master of Syria, the Lesser Armenia, and many Parthian provinces, and would, probably, have been the founder of an extensive empire had not the solicitations of his father-in-law, Mithridates of Pontus, brought him into collision with the Romans. In reward for the submission which he ultimately made to Pompey, he was allowed to keep possession of Armenia, with the exception of the provinces of Sophene and Gordyene, which were erected into a separate kingdom for his son, Tigranes. He continued a faithful ally of the Romans till his death, about 55 B.C., when he was succeeded by his son, Artavasdes, who, having adopted a more independent policy, was taken prisoner by Antony and carried to Alexandria, where he was afterwards beheaded by Cleopatra in 30 B.C.

Arsacid dynasty, 149 B.C.–428 A.D.

Roman influence and supremacy

A period follows of nominal Roman supremacy and actual anarchy; 170 independent families all asserting themselves to the best of their ability, and a few of them succeeding in establishing their petty principalities. At length a usurper, Erovant, an Arsacid by the female line made himself in some sort master of all the kingdom about 58 A.D., and maintained his position till he was expelled by Ardashes (Exedarus), a more direct representative of the race, who was repeatedly dethroned and restored by Parthian and Roman interference, but managed to do something for the amelioration of his country.

Subjection to Persia, 232 A.D.

When the Arsacids were driven from the Persian throne by the Sassanid Artaxerxes (Ardeshir), Chosroes the Great of Armenia naturally took up arms in their defence; and he maintained the contest till his assassination by Anag, an Arsacid prince of Persia, when Armenia became subject to the Persian dynasty, 232 A.D. In the massacre of the royal family which ensued, none escaped but Tiridates (Tirdat), a son of Chosroes, who fled to Rome, and afterwards, with the help of the Romans, established himself on the throne, 259 A.D. The first act of his reign was the persecution of the Christians, who had begun to take root in the country during the previous century. St Gregory, surnamed the Illuminator, was cast into prison; but the king being, as he supposed, miraculously cured of a dangerous distemper by the saint, the Christian religion was embraced by himself and most of his people. The introduction of Christianity tended to arouse the animosity of the Persians; and from this period Armenia became the theatre of almost uninterrupted struggles between that nation and the Romans, until Theodosius the Great agreed to cede to Persia the eastern part of the country, which was thence called Persarmenia, while the western part was annexed to the Roman empire. Theodosius nominated Arsaces IV., then nominal king of Armenia, governor of the western division; and the Persian king, to conciliate the people, appointed Chosroes III., a descendant of another branch of the Arsacids, governor of the eastern part. The rule of the Arsacids in Persarmenia ended with Ardashes IV., who was dethroned by Bahram V. of Persia in 428; and from that date Armenia ceased to be a kingdom, and was ruled till 632 by Persian *marzbans* or governors. The Persians had all along endeavoured to subvert Christianity, and for that purpose had recourse to the most cruel persecutions. Frequent insurrections were the consequence, one of the most remarkable being that which was led by Vartan (see Neumann's *History of Vartan, by Elisæus,* 1830). From 632 till 839 Armenia was the scene of almost incessant struggles between the Greeks and Mahometans, while its own native princes added to the confusion by their rivalries and strife.

Pagratid dynasty, 743-1079.

Ashod, a member of the Pagratid family, which claimed to be of ancient Jewish origin, became master of Central and Northern Armenia about 743, and, being recognised by the caliphs as an independent prince, founded a dynasty which continued till 1079, when Cakig II was assassinated, and his kingdom incorporated with the Greek empire.

Ardzrunian dynasty, 908-1080.

Another family, which claimed the parricide sons of Sennacherib as its founders, held possession of the province of Vasburagan and some of the neighbouring territory, and maintained its independence till 1080, when it likewise succumbed to Byzantium.

Merwanid dynasty, 984-1085.

During the same period the district north-west of lake Van was held by the Mussulman race of the Merwanids,—called by the Armenians the princes of Abrahuni,—who gave a nominal submission now to the Byzantine government and now to the sultans.

Rhupenian dynasty, 1080-1393.

Rhupen (Ruben), a relative of the last king of the Pagratid dynasty, retired to the north of Cilicia, and founded in the shelter of the Taurus a small principality, which gradually extended its boundaries to the Mediterranean, and became known as the kingdom of Lesser Armenia. The Rhupenians entered into alliance with the Crusaders, and formed, along with the kings of Cyprus, the last bulwark of Christianity in the East. They welcomed as allies the Mongolian hordes that overran Asia in the 13th century, and shared in the hostility and vengeance of the Mamelukes. The last king of the family, Leon, or Ghevond VI., was taken prisoner in spite of a vigorous defence at Gaban in 1375, and, after six years of captivity in Egypt, wandered through Europe till his death, at Paris, in 1393. (See Langlois, *Essai sur les rois de la dyn. Roupénienne*, St Petersb., 1860; *Documents pour servir à l'hist. des Lusignans de la P. Arm.*, 1859; *Le Trésor des chartes d'Arménie*, 1863.)

About the middle of the 14th century the Kurds had possession of the south of Armenia, the Persians of the north, and the Ottomans of the west. The whole was subjected to the sway of Timour, of whose cruelties a graphic account has been left by the Armenian, Thomas of Medzoph (see Nève's *Etude sur Thomas de Medzoph*). It was mainly governed by Persian officials during the next century, the only national authority being the patriarch. In 1604 Shah Abbas, in his contest with Ahmed I., laid the whole country waste, and forcibly transplanted about 40,000 of the inhabitants into Persia, where they settled principally in Ispahan and New Julfa, as they fondly called the city which they founded Since then the Armenians have had no political position as a nation, though they continue to form an important and valuable portion of the population in Russia, Turkey, and Persia, and their colonies have spread into almost all quarters of the globe. It was calculated, about 1850, that there were approximately four millions of Armenians in the world, of whom 2,500,000 were inhabitants of the Ottoman empire, 1,200,000 of the Russian empire, 25,000 in the empire of Austria, 150,000 in Persia and Azerbijan, 25,000 in continental India and the Archipelago of Asia, and the remaining 100,000 scattered in various countries (Dulaurier). According to a recent statistician of Turkey (Lejean), there are 400,000 Armenians in the European part of the empire, of whom more than 200,000 are in Constantinople itself. Originally a brave and warlike people, they have become distinguished for their peaceful character and their submissiveness to the government of every country in which they live. (See the articles of Dulaurier and Prince Dadian in *Revue des D. Mondes*, 1854 and 1867.)

See Saint-Martin's *Mémoires sur l'Arménie*, Paris, 1818-19 Brosset's *Voy. Archeol. dans la Georgie et dans l'Arménie en* 1847-8, Paris, 1849-51; Boré's "Arménie" in *L'Univers Pittoresque;* Curzon's *Armenia*, London, 1854; Jaubert's *Voy. en Arménie*, &c.; Morier's *Zweite Reise durch Persien u. Armenien;* Serpos's *Compendio storico concernente la naz. Arm.; Collection des hist. anc. et mod. de l'Arm.*, by Langlois; *Recueil d'actes et documens rel. à l'hist. de la nation Arm.*, 3 vols., Moscow; Chamich's *History*, trans. by Avdall, Calcutta, 1827; Phahnazarian's *Esquisse de l'hist. de l'Arm.*, 1856; Dulaurier, *Rech. sur la chron. Arm.;* Goerres, *Die Japhetiten und ihre gemeinsame Heimath in Armen.*, Munich, 1845.

ARMENIAN CHURCH, THE, is one of the oldest Eastern Christian churches not in communion with the orthodox Greek Church or with the Church of Rome.

1. *History.*—This is divided into three periods, from 34 to 302 A.D., from 302 to 491, and from 491 to the present time. (1.) The first period is mainly legendary. The Church of Armenia claims an older than apostolic foundation. Our Lord, they say, corresponded by letter with Akbar, prince of Ur or Orfa; and the apostle Thaddeus, accompanied by Bartholomew and Judas, preached the gospel, and founded a Christian church in Armenia as early as the year 34 A.D. But whatever the value of these primitive traditions, Armenia could hardly be said to have a church at all during this first period, although there are evident traces of Christian worship in the country at a very early time. (2.) The historical founder of the Armenian Church was S. Gregory, called the "Illuminator." He was a prince of the reigning family of the Arsacidæ, who, having been converted to Christianity, was eager for the conversion of his countrymen. In his missionary work he endured many persecutions, but at last managed to win over the king of Armenia and a considerable portion of his subjects. At the king's desire Gregory went to Cæsarea, or Sis, and was there consecrated bishop of Armenia (302 A.D.) His successors afterwards assumed the title of Patriarch, subsequently Catholicos, and under their rule the infant church grew and prospered. It had to struggle against the opposition of heathen fellow-countrymen and Persian conquerors, but it succeeded in establishing itself in the hearts of the people. The Bible was translated in 410 A.D.; the Liturgy, said to be very old, was improved; and the Armenian bishops took part in several of the synods of the church, notably in the third œcumenical council (Ephesus, 431 A.D.) About 450 A.D. the Armenian Church suffered a severe persecution, which prevented any of the bishops being present at the fourth œcumenical council (Chalcedon, 451 A.D.), at which Eutyches and his followers, the extreme opponents of Nestorius, were condemned. The Armenian Church never accepted the decisions of the Council of Chalcedon, and, in 491 A.D., the patriarch, in full synod, solemnly annulled them. This act led to the separation of the Armenian from the orthodox Greek Church. (3.) The period of schismatic existence divides into three—(*a*), from 491 A.D. to the middle of the 15th century; (*b*), from the middle of the 15th to the middle of the 18th centuries; (*c*), from 1746 down to the present time. It is difficult to account for the schism of the Armenian Church; according to common report, the Armenians were Eutychians, and were virtually cut off from the church when the Council of Chalcedon condemned that heresy, but their own account of the matter in their authoritative documents is very different. They allege that they were misled by false reports when they annulled the fourth council; that it was reported to them that the council had decided in favour of the Nestorian heresy, and that this mistake was confirmed by a letter to the patriarch upon the subject from the bishop of Rome, in which certain words were used which might easily be interpreted in the Nestorian sense. The Patriarch Narses, in his letter to the Emperor Manuel Comnenus, in 1166, distinctly repudiates the Eutychian heresy, but it is to be noted that, in defending the doctrinal views

of his church, he employs the somewhat vague terms in use before the Council of Chalcedon, not those stricter definitions which were in use afterwards; he employs σύμμιξις, for instance, in its pre-Chalcedonian meaning, not ἕνωσις. However occasioned, the separation was gradual; Armenian bishops attended the 5th, 6th, and 7th œcumenical councils (2d of Constantinople, 553; 3d of Constantinople, 680; 2d of Nicæa, 788), and the church acknowledges the decrees of those councils as binding. Cut off from the Eastern Church, the Armenian bishops became all the more closely identified with their native country, and kept alive patriotic feeling in times of great national distress. In spite of many national calamities, foreign domination, internal dissensions, and even banishment, the Armenian Church preserved its character, doctrine, and discipline until the middle of the 15th century, when great dissensions arose which resulted in a schism. These quarrels were occasioned by Jesuit missionaries, who endeavoured to make the Armenians adopt the doctrine, liturgy, and ceremonies of the Roman Church. They succeeded in prevailing upon a great number of the adherents of the Armenian Church to separate from the community and join the communion of Rome. The Catholic Armenians, as they are called, first became a separate community towards the end of the 16th century; their existence has proved a source of great weakness to the orthodox church, and through their exertions the old persecutions were revived. This state of matters went on until the middle of the 18th century, when the patriarch sought and obtained the intervention of Peter the Great of Russia. Since then the Armenian Church has found shelter under the protection of Russia. There is a reformation now going on in the Armenian Church, and a Reformed Church has arisen, which seeks to ally itself with the Calvinist Churches of Europe and America.

2. *Doctrines.*—These are almost identical with those of the orthodox Greek Church. The Armenians accept the first three, and the fifth, sixth, and seventh œcumenical councils, denying that of Chalcedon only, but, as has been explained, they, in their authoritative documents, reject the Eutychian heresy, which that council was called to condemn. The chief source of information as to the doctrine is contained in the letter of Narses above referred to. They reject the Western addition of *filioque* to the Nicene Creed, and deny the distinctive doctrines of the Roman Church.

3. The *Liturgy* is said to date from the 1st century, and to have been founded on that of the Church of Jerusalem. St Gregory remodelled it, and introduced the Nicene Creed, using that edition which contains the damnatory clause, and adding a conclusion of his own. Prayers of John Chrysostom and of Basil the Great were introduced in 430 A.D. Prayers are said for the dead, and entreaty is made for the pardon of their sins, but the church does not believe in purgatory, nor admit of indulgences. The holy days are Sundays, the chief feasts observed in the Eastern Church, and ten national saints' days. Christmas is celebrated on the 6th of January, on the day of the Epiphany, and not on the 25th of December.

4. *Sacraments.*—The Church of Armenia has the seven sacraments: baptism, confirmation, the eucharist, penance, ordination, marriage, and extreme unction. *Baptism* is by immersion; the child is immersed three times; it is then anointed with holy oil, is confirmed, and partakes of the eucharist in both elements. *Confirmation* is administered to children immediately after baptism. The *eucharist* is administered in both elements to all members of the church; the bread is always unleavened, and the wine is not mixed with water. Confession must precede the partaking of the eucharist, save in the case of children under seven years of age. *Penance* consists of confession and fasting. *Ordination* is by anointing with the holy oil. The *marriage service* is almost the same as in the Greek Church. In *extreme unction* only priests are anointed with oil. Laity have the prayers said over them, but are not anointed.

5. *The Clergy.*—There is the threefold order—bishops, priests, and deacons; and there are three degrees of episcopal rank—the archbishops (chief among whom is the patriarch or catholicos), the bishop, and the vartabed, or doctor of theology, who has frequently charge of a diocese, with episcopal functions. The clergy are further divided into the black and the white. The black clergy are monks, and are alone eligible for the higher clerical offices; the white clergy include the parish priests and lower clergy. The clergy may marry before ordination, but not after; and a priest's widow is not allowed to remarry. The priesthood is hereditary. During his father's or grandfather's lifetime the heir may follow a secular calling; but he must leave this and enter the priest's office on the death of the priest he is heir to. There are four patriarchs, who have their seats at Constantinople, Jerusalem, Sis, and Etchmiadzin. The clergy of all ranks are supported entirely by the free-will offerings of the people.

Authorities:—*The Life and Times of S. Gregory the Illuminator*, translated by S. C. Malan, 1868. (This is a translation of authoritative papers, and includes a short summary of the state of the Armenian Church. It is founded on authoritative documents.) *The Divine Liturgy of the Armenian Church*, transl. by S. C. Malan, Lond. 1870 (very carefully done). *Histoire, Dogmes, Traditions et Liturgie de l'Eglise Arménienne*, Paris, 1855 (fuller, but not so accurate). *Codex Mysterii Missal Armenorum seu Liturgia Armena*, Rome, 1677 (Lat. and Armen. Later editions of the Liturgy published at Rome belong to the Catholic Armenian Church, and are worthless). (T. M. L.)

ARMENIAN LANGUAGE. The Armenian or Haikan language is an offshoot of the Iranian branch of the Indo-Germanic family of languages. Its earliest stage is probably represented in the cuneiform inscriptions of Van, on which see Hincks, in *Jour. R. Asiatic Soc.*, vol. ix. (1848), and Mordtmann. in *Zeitschrift d. deutschen morgenl. Gesellschaft*, vol. xxvi. (1872). The existing literature of the Armenians dates from the 4th century, and is essentially and exclusively Christian. The translation of the Old Testament by Sahag Bartevatsi, and of the New by Miesrob, are among its oldest monuments. The dialect in which this version is written, and in which it is still publicly read in their churches, is called the old Armenian. The modern Armenian not only departs from the elder form by dialectic changes in the native elements of the language itself, but also by the great intermixture of Persian and Turkish words, which has resulted from the conquest and subjection of the country, and by the character of inversion in the structure of its sentences. Of its two principal dialects,—the Western, spoken in Constantinople and Asia Minor, and the Eastern, spoken by the Armenians scattered over Tartary, Persia, and India,—the latter approaches more nearly to the idiom of the ancient language. According to Philostratus (*Vita Apollonii*, ii. 2), the Armenians had an alphabet of their own in the 2d century A.D., of which, however, no traces remain. The invention of the present alphabet is ascribed to Miesrob at the beginning of the 5th century; it is probably an amplification of the previous one upon the Greek system of arrangement, and consists of thirty-eight letters, the two last of which, ô and f, were added after the 12th century. The order of writing is from left to right. The capital letters are used in inscriptions, and at the beginning of sentences and proper names. As to its phonetic elements, the Armenian language is rough and consonantal, with the accent on the last syllable. It possesses no grammatical gender, except that a masculine is sometimes made feminine by the addition of *uhi*, and that the words for *man* and *woman* may be prefixed to nouns to express their natural gender; there is no dual. The declension is divided into vowel and consonantal declensions, each again being subdivided into strong and weak There are seven cases, including an instrumental. The nine demonstrative pronouns are regulated by the demonstrative letters *s*, *t*, *n*, the first of which expresses proximity, the second lesser, and the last greater distance. The verb has four conjugations, according to the class vowels, *e*, *a*, *u*, *i*, and four tenses,—present, imperfect, aorist, and future, the last two having two forms. In its syntactical structure the old Armenian resembles most nearly the classical Greek. The best and most recent *Grammars* are by H. Petermann (Berlin, 1872), and M. Lauer (Vienna, 1869); *Dictionaries* by Aucher and Brand (2 vols., Venice, 1821), and by A. Calfa (Paris, 1861), which comprises also the modern dialects. A good Grammar of the modern Armenian (Western dialect) is that of E. Riggs (Constantinople, 1856). There is an essay on the dialect of Tiflis, by H. Petermann, in *Abhandlungen der K. Academie der Wissenschaften*, Berlin, 1867. The best recent surveys of Armenian literature are by H. G. O. Dwight (*Jour. Amer. Or. Soc.*, iii.) and M. Patcanian (*Mélanges Asiatiques*, iv.) See also, by the last-mentioned writer, "Recherches sur la formation de la langue Arménienne," in *Journal Asiatique*, August and September 1870.

ARMENIAN LITERATURE. With the exception of a few fragments incorporated in later writers, the pre-Christian literature of Armenia has totally perished. The early Armenians seem to have possessed a body of traditional and historical songs analogous to the *Shah-nameh* of Persia, the memory of which lingered long among the common people, especially in the province of Koghten. Portions of these have been preserved by Moses of Khorene, and investigated by several modern scholars (see *Vebk Hnuin Hayasdani*, i.e., *Chants hist. et pop. de l'Ancienne Arménie*, J. B. Emin, Moscow, 1850; Dulaurier, *Rev. des D. Mondes*, 1852, vol. xiv.; "Etudes sur les chants hist. de l'anc. Arménie," in *Journal Asiatique*, 1852). With the introduction of Christianity a great development of literary activity took place, which chiefly expended itself, however, in translations from the Syriac and Greek. Armenian students were found in Athens and Byzantium, Alexandria and Rome, and some of them attained celebrity in their chosen pursuits. To this tendency we owe the preservation, in Armenian, of many works that have perished in their original languages. Such are the Chronicle of Eusebius, some of the works of Philo, Bardesanes, Faustus of Byzantium, Lerubna of Edessa, &c. (see Wenrich, *De auctorum Græcorum versionibus Arabicis, Armeniacis, &c.*, Leipsic, 1842). The 5th century was one of the most flourishing periods of Armenian literature. It was then that Miesrob accomplished that modification and development of the Armenian alphabet which has frequently procured him the honour of being regarded as its inventor (see Fr. Muller, *Ueber den Ursprung der Armenischen Schrift*, 1865). The Old Testament was translated from the Septuagint by Isaac or Sahak, the patriarch (critical edition, Ven. 1805). These learned men were succeeded by a number of worthy disciples, such as Esnig of Golp (Koghb), Goriun the biographer of Miesrob, and David the Invincible, a keen student of Greek philosophy, who has left us *Philosophical Definitions* and translations from Aristotle (see "La vie et les ouvrages de David le phil. Armén.," by Neumann in *Journal Asiatique*, 1829). Yeghishe or Elisæus wrote a very popular account of the wars of Vartan against the Persians, which has been frequently translated (Neumann, London. 1830). Moses of Khorene is one of the most important as well as best known historians of his native country. In the 6th century all connection with the centres of Greek culture being cut off by the Persian monarchs, Armenian literature became almost extinct. In the 7th century John the Mamigonian continued Zenob's *History of Daron* (Taron); Sebeos composed a history of Heraclius; Ananias of Shirag was the author of astronomical works, and Theodorus and Sahak wrote upon theological subjects. Among the writers of the 8th century the chief place is held by John of Osdin and Stephanus of Siunia; and in the 9th century we find John the Catholikos, Thomas Ardzruni, and Miesrob of Hayotz-dsor. In the 10th century, Khosrov the Great, Ghevond or Leontius the Presbyter, Gregory of Narek, Moses of Kalkand, and Stephanus Asolik (Assoghik) may be mentioned; and in the 11th, Aristakes of Lastiverd, a national historian, and Matthew Yeretz (*i.e.*, the Presbyter) of Edessa, the biographer of Chrysostom.

The 12th and 13th centuries form a second great period of Armenian literature, during which the influence of Syriac is again perceptible. Gregory Magistros, who introduced the Arabic system of versification into his native language, Narses of Lampron, Mekhitar Kosh (see *Journ. Asiat.*, 1841), John Vanacan (*i.e.*, the Monk), Vardan the Great (*Journ. Asiat.*, 1867), Vahram, and Sempad, are a few of the numerous writers of note. From the 14th to the 18th century there is a falling off, the most important work, perhaps, being Thomas of Medzoph's *History of Timour*. In the 18th century a revival took place, which was mainly due to the Mekhitarists of Venice (see Langlois, *Notice sur le couvent Arménien de l'île Saint-Lazare de Venise*, Paris, 1863), and since then Armenian literature has acquired a development which is remarkable in the absence of national unity. Printing presses have been established in most of the cities where Armenians are numerous, the ancient writers have been published and studied, the vernacular literature has been enriched both by original productions and translations, and magazines and newspapers have been established in many of the centres of Armenian activity. The study of the Armenian language and literature by the savants of Western Europe has shared in the general development of Indo-European philology. The earlier labours of Rivola (1633), Villote, La Croze, Osgan, Villefroy, and Freret have been almost completely eclipsed by such men as Saint Martin (an Armenian by race), Dulaurier, Langlois, Boré, and Prudhomme in France; Nève in Holland; Emin, Patcanian, and Brosset in Russia; and Windischmann, Marle, Spiegel, Justi, Neumann, and Petermann in Germany.

See Somal's *Quadro della storia let. di Arm.*; Karikin, *Hist. de la lit. Arm.*; Patcanian, "Cat. de la lit. Arm.," in *Mélanges Asiat.*, vol. iv. Petersb., 1860; Neumann's *Versuch einer Gesch. der Arm. Lit.*; Alishan's *Tableau succinct de l'hist. et de la lit. de l'Arm.*, 1860; Hamachod's *Chronological succ. of Arm. Patriarchs* (in Armenian).

ARMENIAN VERSION. The Armenian version of the Bible was undertaken in the year 410 by Miesrob, with the aid of his pupils Joannes Ecclensis and Josephus Palnensis. It appears that the patriarch Isaac first attempted, in consequence of the Persians having destroyed all the copies of the Greek version, to make a translation from the Peshito; that Miesrob became his coadjutor in this work; and that they actually completed their translation from the Syriac. But when the above-named pupils, who had been sent to the ecclesiastical council at Ephesus returned, they brought with them an accurate copy of the Greek Bible. Upon this Miesrob laid aside his translation from the Peshito, and prepared to commence anew from a more authentic text. Imperfect knowledge of the Greek language, however, induced him to send his pupils to Alexandria to acquire accurate Greek scholarship; and, on their return, the translation was accomplished. Moses of Khorene, the historian of Armenia, who was also employed, as a disciple of Miesrob, on this version, fixes its *completion* in the year 410; but he is contradicted by the date of the Council of Ephesus, which necessarily makes it subsequent to the year 431. In the Old Testament this version adheres closely to the LXX., but, in the book of Daniel, it has followed the version of Theodotion. Its most striking characteristic is, that it does not follow any known recension of the LXX. Although it more frequently agrees with the Alexandrine text, in readings which are peculiar to the latter, than it does with the Aldine or Complutensian text, yet, on the other hand, it also has followed readings which are only found in the last two. Bertholdt accounts for this mixed text by assuming that the copy of the Greek Bible sent from Ephesus contained the Lucian recension, that the pupils brought back copies according to the Hesychian recension from Alexandria, and that the translators made the latter their standard, but corrected their version by aid of the former. The version of the New Testament is equally close to the Greek original, and also represents a text made up of Alexandrine and Occidental readings. This version was afterwards revised and adapted to the Peshito, in the 6th century, on the occasion of an ecclesiastical union between the Syrians and Armenians. Again, in the 13th century, an Armenian king, Hethom or Haitho, adapted the Armenian version to the Vulgate, by way of smoothing the way for a union of the Roman and Armenian churches. Lastly, the bishop, Uscan, who printed the first edition of this version at Amsterdam in 1666, is also accused of having interpolated the text, by adding all that he found the Vulgate contained *more* than the Armenian version. The existence of the verse 1 John v. 7, in this version, is ascribed to this supplementary labour of Uscan. It is clear from what has been said, that the critical uses of this version are limited to determining the readings of the LXX. and of the Greek text of the New Testament which it represents, and that it has suffered many alterations which diminish its usefulness in these respects.

ARMENTIÈRES, a well-built and flourishing town, in the department of Nord in France, on the Lys, nine miles N.W. of Lille. It carries on considerable manufactures of leather, cotton, cloth, linen, lace, soft-soap, beet-root sugar, salt, &c. Situated as Armentières is on the frontier, its annals are full of instances of military occupation and pillage, from the 14th century downwards. Population, 15,579.

ARMFELT, Gustav Mauritz, Baron, afterwards **Count**, eldest son of a Finnish nobleman, was born at Juva in 1757. He entered the army and gained the favour of Gustavus III., who appointed him to a post in the service of the Crown Prince, and afterwards made him general of a division of the army in the war against Russia. He was successful in his military operations, and also materially aided the king in quelling a conspiracy of the officers. In 1790 he signed the treaty of peace at Verela; and two years later, when Gustavus was mortally wounded by an assassin, Armfelt was named by him governor of Stockholm. But the regent Charles, the late king's brother, was not well disposed towards him, and he took an opportunity to leave the country as ambassador to Naples. While there he entered into a conspiracy to depose the regent. This was discovered; he was outlawed and condemned to death, and his associates were severely punished. The accession of Gustavus IV. restored him to his honours, and after the revolution of 1809, by which the ex-regent became king, he was made president of the military council. Being suspected of having a share in the poisoning of the prince of Augustenburg, he fled from Sweden and took refuge at the Russian court, where he received the highest honours. He died in 1814 at Tzarskoe-Selo.

ARMINIUS, James, a distinguished Dutch theologian, author of the modified Reformed theology that receives from him its name, was born at Oudewater, South Holland, 1560. Arminius is a Latinised form of his family name Hermanns or Hermannson. His father, a cutler, died while he was an infant, leaving a widow and three children. Theodore Æmilius, a priest, who had turned Protestant, adopting James, removed with him to Utrecht, but died when his charge was in his fifteenth year. Rudolph Snellius, the mathematician, a native of Oudewater, then a professor at Marburg, happening at the time to visit his early home, met Arminius, saw promise in him, and undertook his maintenance and education. But hardly was he settled at Marburg when the news came that the Spaniards had besieged and taken Oudewater, and murdered men, women, and children, sparing only certain matrons and maids, "who had been sold by auction to the soldiers at two or three dollars each." Arminius hurried home, but only to find all his relatives slain. In February the same year (1575), the university of Leyden had been founded, and was becoming a rallying point and nursery for the nascent literary genius, theological activity, and scholarship of the country. Arminius seized the opportunity thus afforded of pursuing his studies at home. The six years he remained at Leyden (1576–82) were years of active and innovating thought in Holland. The War of Independence had started conflicting tendencies in men's minds. To some it seemed to illustrate the necessity of the State tolerating only one religion, but to others the necessity of the State tolerating all. Richard Koornhert argued, in private conferences and public disputations, that it was wrong to punish heretics, and his great opponents were, as a rule, the ministers, who maintained that there was no room for more than one religion in a State. Casper Koolhaes, the heroic minister of Leyden—its first lecturer, too, in divinity—pleaded against a too rigid uniformity, for such an agreement on "fundamentals" as had allowed Reformed, Lutherans, and Anabaptists to unite. Leyden had been happy, too, in its first professors. There taught in theology William Feugueræus, a mild divine, who had written a treatise on persuasion in religion, urging that as to it "men could be led, not driven;" Lambert Danæus, who deserves remembrance as the first to discuss Christian ethics scientifically, apart from dogmatics; John Drusius, the Orientalist, one of the most enlightened and advanced scholars of his day, settled later at Franeker; John Kolmann the younger, best known by his saying that high Calvinism made God "both a tyrant and an executioner." Snellius, Arminius's old patron, now removed to Leyden, expounded the Ramist philosophy, and did his best to start his students on the search after truth, unimpeded by the authority of Aristotle. Under these men and influences, Arminius studied with signal success; and the promise he gave induced the merchants' guild of Amsterdam to bear the further expenses of his education. In 1582 he went to Geneva, studied there awhile under Theodore Beza, but had soon, owing to his active advocacy of the Ramist philosophy, to remove to Basle. After a short but brilliant career there he returned to Geneva, studied for three years, travelled, in 1586, in Italy, heard Zarabella lecture on philosophy in Padua, visited Rome, and, open-minded enough to see its good as well as its evil, was suspected by the stern Dutch Calvinists of Popish leanings. Next year he was called to Amsterdam, and there, in 1588, was ordained to the ministry. He soon acquired the reputation of being an elegant preacher and faithful pastor. He was commissioned to organise the educational system of the city, and is said to have done it well. He greatly distinguished himself by fidelity to duty during a plague that devastated Amsterdam in 1602. In 1603 he was called to a theological professorship at Leyden, which he held till his death in 1609.

Arminius is best known as the founder of the anti-Calvinistic school in Reformed theology, which created the Remonstrant Church in Holland (see REMONSTRANTS), and contributed to form the Arminian tendency or party in England. He was a man of mild and liberal spirit, broadened by varied culture, constitutionally averse to narrow views and enforced uniformity. He lived in a period of severe systematising. The Reformed strengthened itself against the Roman Catholic theology by working itself, on the one hand, into vigorous logical consistency, and supporting itself, on the other, on the supreme authority of the Scriptures. Calvin's first principle, the absolute sovereignty of God, had been so applied as to make the divine decree determine alike the acts and the destinies of men; and his formal principle had been so construed as to invest his system with the authority of the source whence it professed to have been drawn. Calvinism had become, towards the close of the 16th century, supreme in Holland, but the very rigour of the uniformity it exacted provoked a reaction. Richard Koornhert could not plead for the toleration of heretics without assailing the dominant Calvinism, and so he opposed a conditional to its unconditional predestination. The two ministers of Delft, who had debated the point with him, had, the better to turn his arguments, descended from the supralapsarian to the infralapsarian position, *i.e.*, made the divine decree, instead of precede and determine, succeed the fall. This seemed to the high Calvinists of Holland a grave heresy. Arminius, fresh from Geneva, familiar with the dialectics of Beza, appeared to many the man able to speak the needed word, and so, in 1589, he was simultaneously invited by the ecclesiastical court of Amsterdam to refute Koornhert, and by Martin Lydius, professor at Franeker, to combat the two infralapsarian ministers of Delft. Thus led to confront the questions of necessity and free will, his own mind became unsettled, with the result, that the further he pursued his inquiries the more he was inclined to assert the freedom of man and limit the range of the unconditional decrees of God. This change in doctrinal belief became gradually more apparent in his preaching and in his private conferences with his clerical associates, and occasioned much controversy in the ecclesiastical courts. The controversy was greatly embittered, and the differences correspondingly sharpened, by his appointment to the professorship at Leyden. He had as colleague Francis Gomarus, a strong supralapsarian, perfervid, irrepressible; and their collisions, personal, official, political, tended to develop and define their respective positions. Arminius died, worn out by uncongenial controversy, before his system had been elaborated into the logical consistency it attained in the hands of his celebrated successor, Simon Episcopus, but though inchoate in detail, it was in its principles clear and coherent enough. These may be thus stated:—

1. The decree of God is, when it concerns His own actions, absolute, but when it concerns man's, conditional, *i.e.*, the decree relative to the Saviour to be appointed and the salvation to be provided is absolute, but the decree relative to the persons saved or condemned is made to depend on the acts—belief and repentance in the one case, unbelief and impenitence in the other—of the persons themselves.

2. The providence or government of God while sovereign, is exercised in harmony with the nature of the creatures governed, *i.e.*, the sovereignty of God is so exercised as to be compatible with the freedom of man.

3. Man is by original nature, through the assistance of divine grace, free, able to will and perform the right; but is in his fallen state, of and by himself, unable to do so; needs to be regenerated in all his powers before he can do what is good and pleasing to God.

4. Divine grace originates, maintains, and perfects all the good in man, so much so that he cannot, though regenerate, conceive, will, or do any good thing without it.

5. The saints possess, by the grace of the Holy Spirit, sufficient strength to persevere to the end in spite of sin and the flesh, but may so decline from sound doctrine as to cause divine grace to be ineffectual.

6. Every believer may be certain or assured of his own salvation.

7. It is possible for a regenerate man to live without sin.

Arminius's works are mostly occasional treatises drawn from him by controversial emergencies, but they everywhere exhibit a calm, well-furnished, undogmatic, and progressive mind. Characteristic are such sayings as these in letters to his friend, Uitenbogaert:—"Truth, even theological truth, has been sunk in a deep well, whence it cannot be drawn forth without much effort." "I should be foolish were I to concede to any one so much of right in me, as that he should be able to disturb me as often as he had a mind. Be this my brazen wall, a conscience void of offence. Forward let me still go in my search after truth, and therein let me die with the good God on my side, even if I must needs incur the hatred and ill-will of the whole world." He was essentially an amiable man, who hated the zeal for an impossible orthodoxy that constrained "the church to institute a search after crimes which have not betrayed an existence, yea, and to drag into open contentions those who are meditating no evil." His friend Peter Bertins, who pronounced his funeral oration, closed it with these words,—"There lived a man whom it was not possible for those who knew him sufficiently to esteem; those who entertained no esteem for him are such as never knew him well enough to appreciate his merits."

The works of Arminius (in Latin) were published in a single quarto volume in 1631. The first volume of an English translation, with copious notes, by James Nichols, was published in 1825, the second in 1828, but the third and concluding volume is still due. A life was written by Casper Brandt, son of Gerard Brandt, the historian of the Dutch Reformation, and published in 1724; republished and annotated by the historian Mosheim in 1725; translated into English by the Rev. John Guthrie, and published in 1854.

(A. M. F.)

ARMISTICE, a temporary suspension of hostilities by mutual agreement between two nations at war, or their respective forces. An armistice may be either general or particular: in the first case, there is a complete cessation of hostile operations in every part of the dominions of the belligerent powers; in the second, there is merely a temporary truce between two contending armies, or between a besieged fortress and the force besieging it. A general armistice cannot be concluded by the commanders-in-chief unless special authority has been previously delegated to them by their respective governments; otherwise, any arrangement entered into by them requires subsequent ratification by the supreme powers of the states. A partial truce may be concluded by the officers of the respective powers, without any special authority from their governments, wherever, from the nature and extent of the commands they exercise, their duties could not be efficiently discharged without their possession of such a power. The conduct of belligerent parties during an armistice is regulated by the following general conditions, which, however, may be set aside by special agreement:—(1.) Each party may do, within the limits prescribed by the truce, whatever he could have done in time of peace. For example, he can raise troops, collect stores, receive reinforcements, and fortify places that are not actually in a state of siege. (2.) Neither party can take advantage of the armistice to do what he could not have done had military operations continued. Thus he cannot throw provisions or reinforcements into a besieged town, and neither besiegers nor besieged are at liberty to repair their fortifications or erect new works. (3.) All things contained in places, the possession of which was contested, must remain in the state in which they were before the armistice began. Any infringement by either party of the conditions of the truce entitles the other to recommence hostile operations without previous intimation.

ARMORICA. The Armorici were, in Cæsar's time, the Celtic inhabitants of the coast from the Loire to the Seine. The word appears to be composed of "*ar*," near, and "*mor*," the sea, and would originally be applicable to any maritime population. It is said to be akin to "Morini," and "Pomerania" (Po-more). In the Middle Ages the name Armorica was still further narrowed into an equivalent for Brittany. See Celtic Literature.

ARMS and ARMOUR. The history of arms and armour forms one of the most suggestive chapters in the history of civilisation. The use of stone weapons appears to have been universally characteristic of the earlier, as it is still distinctive of the ruder races of mankind. The forms of the weapons fabricated in this intractable material were of necessity few and simple. The commonest and most widely distributed type is that of the imperforate axe, varying from the roughly-dressed wedge of flint, to the finely-shaped and highly-polished lenticular "celt." They were fabricated of flint, diorite, greenstone, serpentine, indurated clay-slate, in short, of almost every material capable of being worked into the desired form, and of retaining the requisite sharpness of edge. Spear-heads and arrow-points were chipped in flint with such surprising dexterity and skill, that they were nearly as effective as those subsequently fabricated in metals, and not much inferior in form and finish. The highest efforts of the ancient stone-workers culminated in the short leaf-shaped knife-dagger of flint, suggestive of the form which afterwards became the characteristic weapon of the Bronze Age, the leaf-shaped sword. These knife-daggers of flint exhibit considerable variety of form, though always of the same type. They vary also in size, but seldom exceed about 12 inches in length. They are never ground or polished, but delicately chipped to a straight edge, while the flakes are so regularly removed from the convex portions of the blade as to give a rippled or wavy surface, and the corners of the handle are delicately crimped, thus producing an appearance of great beauty and finish.

Fig. 1.—Leaf-shaped flint Dagger.

The Bronze Age.—In the earliest interments in which the weapons deposited with the dead are of other materials than stone, a peculiar form of bronze dagger occurs. It consists of a well-finished, thin, knife-like blade, usually about 6 inches in length, broad at the hilt and tapering to the point, and always riveted to the handle by massive rivets of bronze. It has been found associated with stone celts, both of the roughly-chipped and the highly-polished kind, showing that these had not been entirely disused when bronze became available. A later type of bronze dagger is a broad, heavy, curved weapon, usually from 9 to 15 inches in length, with massive rivets for attachment to an equally massive handle. The leaf-shaped sword, however, is the characteristic weapon of the Bronze Period. It is found all over Europe, from Lapland to the Mediterranean. No warlike weapon of any period is more graceful in form or more beautifully finished. The finish seems to have been given in the mould without the aid of hammer or file, the edge being formed by suddenly reducing the thickness of the metal, so as to produce a narrow border of extreme thinness along both sides of the blade from hilt to point. The handle-plate and blade were cast in one piece, and the handle itself was formed by side plates of bone, horn, or wood, riveted through the handle-plate. There was no guard, and the weapon, though short, was well balanced, but more fitted, however, for stabbing and thrusting than for cutting with the edge. The Scandinavian variety is not so decidedly leaf-shaped, and is longer and heavier than the common British form; and instead of a handle-plate, it was furnished with a tang on which a round, flat-topped handle was fastened, like that of the modern Highland dirk, sometimes surmounted by a crescent-like ornament of bronze. A narrow, rapier-shaped variety, tapering from hilt to point, was made without a handle-plate, and attached to the hilt by rivets like the bronze daggers already mentioned. This form is more common in the British Isles than in Scandinavia, and is most abundant in Ireland. The spear-heads of the Bronze Period present a considerable variety of form, though the leaf-shaped predominates, and barbed examples are extremely rare. Some British forms of this weapon are of great size, occasionally reaching a length of 27 inches. The larger varieties are often beautifully designed, having segmental openings on both sides of the central ridge of the blade, and elaborately ornamented with chevrony patterns of chased or inlaid work both on the socket and blade. Arrow-points are much rarer in bronze than in flint. In all probability the flint arrow-point (which was equally effective and much more easily replaced when lost) continued to be used throughout the Bronze Period. Shields of bronze, circular, with hammered-up bosses, concentric ridges, and rows of studs, were held in the hand by a central handle underneath the boss. The transition period between the Bronze and Iron Ages in Central Europe is well defined by the occurrence of iron swords, which are simple copies of the leaf-shaped weapon, with flat handle-plate previously fabricated in bronze. These have been found associated with articles assigned to the 3d or 4th century B.C.

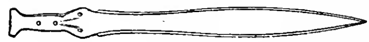


Fig. 2.—Leaf-shaped bronze Sword.

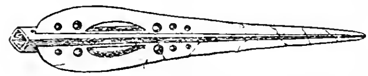


Fig. 3.—Bronze Spear head, length 19 inches.

The Greek Heroic Age.—The Greek sword of the heroic age is described by Homer as double-edged, long, sharp, and trenchant, the blade of bronze, and the hilt and scabbard adorned with gold or silver studs. In the Homeric combats, however, the spear, lance, or javelin always plays the principal part, and the sword is only used when the combatants meet at close quarters, the spear having failed to decide the contest. Both sword and spear appear to have been of the forms which are characteristic of these weapons in the Bronze Age of Central and Northern Europe. The bow of Pandarus is described as made of ibex-horn and strung with sinews. The arrow-head is the only part of the warrior's equipment which Homer expressly describes as of iron, and the mode of its insertion in a split in the head of the shaft, where it was made fast by a ligature of sinew, is precisely that which is still adopted by modern savages with their arrow-points of flint. The defensive armour of the heroic ages was also entirely of bronze. In consisted of helmet, cuirass, greaves, and shield. The helm was sometimes a simple casque, or close-fitting headpiece, but more frequently adorned with crest and plumes. The cuirass of bronze was often elaborately engraved and adorned with gold. The greaves covered the leg to the instep, and were either of bronze or some similar compound metal of great toughness and flexibility. The shield, round or oval in form, is described as of bronze, backed or covered with hide, and decorated with bosses and concentric rings of metal. We have a gauge of the size of Hector's shield in the lines—

> "Hector of the gleaming helm
> Turned to depart; and as he moved along
> The black bull's-hide his neck and ancles smote,
> The outer circle of his bossy shield."
>
> *Il.* vi. 116-118.

Greek Historic Age.—In the early historic ages the characteristic weapons of the Greek armies were determined by the military tactics of the period. The mode of fighting in heavy phalanx necessitated the use of long, heavy spears. The Hoplites when massed in phalanx stood sixteen deep, the men of each rank close together, shield touching shield, the pikes of each line, 21 to 24 feet long, projecting from 2 to 13 feet in front of the foremost rank at equal distances. The shield of the early monuments, though still large, is not nearly so large as that of Hector, usually reaching from the shoulder to the knee, and still retaining its round or oval form and bold convexity. On the early vases the shields are represented as adorned with a great variety of devices. We now find the helm having a lengthened neck-guard, side-guards for the face, frontlet, and prolonged crest, sweeping gracefully over the rounded top of the head-piece and falling down the back. At the time of the Peloponnesian war the linen corselet, so much in favour among the Egyptians, Assyrians, and Asiatics generally, was introduced instead of the heavy cuirass of the Hoplites, and a smaller shield substituted for the larger and heavier one previously in use, while the length of the sword was considerably increased. The light-armed troops were furnished with a light javelin provided with a strap or thong attached to the middle to assist in hurling it. The mounted troops were similarly equipped as to their defensive armour, and furnished with a longer sword, a javelin, and a short dagger.

Egyptian.—The strength of the Egyptian armies in the earliest times consisted of archers, who fought either on foot or from chariots. The Egyptian bow was somewhat shorter than the height of a man. The string was of hide, catgut, or cord. The arrows varied from 24 to 34 inches in length, and were usually of reed, winged with three feathers and pointed with heads of bronze. These were sometimes cast with sockets and sometimes with tangs. Arrow-heads of flint are occasionally found in the tombs along with those of bronze, and Sir Gardner Wilkinson remarks on this, that "flint arrow-heads were not confined to an ancient era, nor were they peculiar to Egypt alone; the Persians and other Eastern peoples frequently used them even in war." The Egyptian archers were provided with a falchion, dagger, mace, or battle-axe, for close combat; their defensive armour consisted of a quilted head-piece and coat, but they carried no shield, which would have been an impediment to the free use of the bow The infantry were classified according to the weapons with which they fought, as spearmen, swordsmen, clubmen, and slingers. The spears were 5 or 6 feet long, with large triangular or leaf-shaped heads of bronze, socketed and fastened to the shaft by a single rivet through the socket. The spearmen fought in close phalanx, and were furnished with shields of a peculiar form, rectangular below and semicircular above, like a round-headed door, about half the height of a man. Their shields were covered with bull's hide, having the hair outwards, strengthened by rims and studs of metal, and furnished with a round sight-hole in the middle of the semicircular upper part. They had quilted helmets, and cuirasses of bronze scales or quilted with bands of metal, but no greaves. The early Egyptian sword was of bronze, straight, double-edged, tapering from hilt to point, and varying from 30 to 36 inches in length. Axes, with short handle and an oblong or crescentic blade, with segmental openings, fastened to the handle and unsocketed, maces and clubs of various forms, and short, leaf-shaped daggers of bronze, were also used.

Assyrian.—The Assyrian sword, as represented on the monuments, resembled the Egyptian, but was worn on the left side, slung in a nearly horizontal position by the waist-belt. The bow was also a favourite weapon with the Assyrians, and lances, spears, and javelins, with oblong, leaf-shaped and unbarbed heads, constantly appear upon the sculptures. The shield was round and convex; the helm frequently conical, truncated or curved forward, and with pieces to protect the neck at the back and sides. Their cuirasses were close-fitting tunics made of many layers of flax, plaited or interwoven, and hardened and cemented with glue,—a species of linen corselet frequently referred to as in use also among the Egyptians, the Greeks, and the Romans.

Etruscan.—The arms and armour of the Etruscans were in the main similar to those of the Greeks. Their cuirasses, however, were provided with overlapping shoulder-guards, a peculiarity not observed in Greek armour. The shields were round and exceedingly convex, the helmets of very various forms, with a general tendency to a deep, bell-shaped contour, adorned with an excessively elevated and elongated crest, and sometimes with alated projections of considerable height, rising from opposite sides near the apex of the helm.

Roman.—The early Roman sword, like that of the Greeks, Egyptians, and Etruscans, was of bronze. We have no direct statement as to its form, but in all probability it was of the leaf-shaped form so universally characteristic of this weapon in bronze. We gather from the monuments that, in the 1st century B.C., the Roman sword was short, worn on the right side, suspended from a shoulder-belt, and reaching from the hollow of the back to the middle of the thigh, thus representing a length of from 22 inches to 2 feet. The blade was straight, double-edged, and obtusely pointed. On the Trajan column (114 A.D.) it is considerably longer, and under the Flavian emperors the long, single-edged *spatha* appears frequently along with the short sword. The characteristic weapon peculiar to the Romans, however, was the *pilum*. The form of this weapon and the mode of using it have been minutely described by Polybius, but his description has been much misunderstood in consequence of the rarity of representations or remains of the *pilum*. It is shown on a monument at St Remi, in Provence, assigned to the age of the first emperors, and in a bas-relief at Mayence, on the grave-stone of Quintus Petilius Secundus, a soldier of the 15th legion. A specimen of the actual weapon is in the museum at Weisbaden. It is a pike with a stout iron head, carried on an iron rod, about 20 inches in length, which terminates in a socket for the insertion of the wooden shaft. As represented on the monuments, the iron part of the weapon is about one-third of its entire length, and its junction with the wooden part of the shaft is fortified by a knob or swelling which is peculiar to this weapon. When used as a javelin at short distances it had a most embarrassing effect. Piercing the shield, the slender iron neck of the weapon bent with the weight of the shaft, which then dragged along the ground, so that the shield was rendered useless for defence. When used at close quarters it not only answered all the purposes of the modern bayonet, but when firmly wielded in both hands it was equally efficient to ward off sword-strokes, which fell harmless upon the long and strong iron neck of the weapon. Polybius states that the legionary receiving the sword-strokes, with cool steadiness, upon his *pilum*, soon turned the swords of the enemy into mere hacked and blunted strigils or skin-scrapers. Vegetius also describes the *pilum* in a modified form as used in the armies of the Lower Empire, and in a still more modified form it reappears as the *angon* of the Franks, to be noticed further on. The defensive armour of the Romans in earlier times resembled that of the Greeks as previously described, and was chiefly of bronze, consisting usually of helmet with crest and cheek-pieces, cuirass of breast and back plates, modelled to the form of the bust, and having a border of leather bands or straps, falling vertically so as to protect the lower part of the body. On the columns of Trajan and Antonine the cuirass proper is given to the chiefs only, the legionaries having their cuirasses of leather or linen, on which are sewn circular plates of metal, with shoulder-pieces and oblong plates descending vertically from the lower border of the cuirass. There are two varieties of shield on the Trajan column,—an oblong, rectangular, and highly convex form, peculiar to the legionaries, and an oval, flattened form borne by the knights and *velites*. In later times the oval shield was assumed by the legionaries. The Roman helmets in the time of the early emperors were simple skull-caps with a hollowed neck-guard, a small bar acting as a visor, and hinged cheek-pieces which fastened under the chin. In the declining days of the empire the helmet became deeper, the shield larger and more varied in form, the length of the sword was greatly increased, and uniformity of weapons and equipment was no longer observed.

Frankish.—The characteristic weapon of the Franks of the Merovingian epoch (450–760 A.D.) was the *francisca* or battle-axe, which they used as a missile. Procopius describes it as having a broad blade and a short haft, and it is said that the blow of an axe when hurled would pierce a shield or kill a man, and that the Franks rarely missed their aim. Agathias, the continuator of Procopius (535 A.D.), says they wear no body armour, few of them even having helmets, but they carry round shields, swords of the length of a man's thigh, axes having double edges, and darts which are used either for throwing or for thrusting. These darts had barbed iron heads, and were used as the

FIG. 4.—Iron head of Angon from a grave at Darmstadt, 38 in. long.

pilum was used by the Romans. When the *angon* was fixed in the enemy's shield the custom of the Frank was to bound forward, place his foot on the end of the dart as it trailed along the ground, thus compelling the enemy to lower his shield, when he killed him with his axe or sword. The Frankish sword was a short, straight, broad-bladed, double-edged weapon, somewhat obtusely pointed, and usually about 30 to 32 inches in length. The sword and *francisca* of Childeric, one of the first of the Merovingian kings (457–481), were discovered in his tomb at Tournay in 1653, and are now in the museum of the Louvre. The sword has a short, straight cross-piece at the lower end of the hilt, and the pommel is of the same form, but smaller. The Carlovingian epoch, though almost devoid of distinctive characteristics as regards the arms in use, is remarkable for the gradual change from infantry to cavalry, and represents the transition to the period of chivalry. The development of the two military orders of the knights or men-at-arms and the common infantry soldiers, serfs or peasants, may be said to have begun in the armies of Charlemagne, and the superior class of fighting men in his time had added to the ordinary equipment of the earlier Franks the helm and coat of mail.

Scandinavian.—The swords of the early Iron Age in Scandinavia are frequently found in the mosses of Schleswig, associated with objects bearing a strongly-marked analogy to those recovered from the graves of our own Pagan Anglo-Saxon ancestors, of the period dating approximately from the 5th to the 7th centuries of the Christian era. They are long, straight, double-edged, and often richly damascened. On the tangs of several of those found at Nydam are the names of the armourers some of which are of the Roman form. The grip of the hilt was circular, usually narrow in the middle, and the cross-pieces above and below were similar in shape. The sheaths were of wooden laths, adorned with tastefully-executed mountings in bronze. On one of the chapes an inscription in the earlier Runic alphabet occurred. Associated with these swords were flat, circular wooden shields, of 22½ to 44 inches diameter, having a single handle under the central boss, and bosses and mountings sometimes of iron, but more frequently of bronze. Helmets were rare, but chain-armour of interlinked iron rings, of alternate rows of riveted and welded rings, was in use. The sword of the early Viking time in Scandinavia was long and heavy, usually double-edged, with strong rectangular cross-piece, narrow grip, and massive square or triangular pommel. In the later Viking time single-edged swords were more common, and the pommel was frequently tri-lobed, and the cross-piece elongated so as to form a decided guard. The shields were usually circular or oval, often painted and adorned with devices, and conical helmets and coats of mail were common.

Anglo-Saxon.—The early Anglo-Saxon sword was usually about 3 feet long, straight, double-edged, broad in the blade, and rounded at the point, with hilt and grip and cross-piece like those of the early Scandinavian swords previously described. As the sword was not carried by any man under the rank of thane, it is not often met with in Anglo-Saxon interments. With them, as with the Franks, it was a horseman's weapon, and the common accoutrement of the infantry was a spear, an axe, a shield, and a *scramasax*, or heavy single-edged knife. The Saxon spear was a narrow, long-bladed weapon, varying greatly in form and dimensions, but generally characterised by the socket being slit or unclosed throughout its length. The axe was narrow-bladed and single-edged, and sometimes peaked at the back. The shield, which was circular or oval in form, was of wood, covered with leather, and furnished with a high conical boss, often terminating in a pipe or a button. Anglo-Saxon warriors of the 10th century are represented in the manuscripts as wearing hauberks of mail and rounded casques. The Ælfric manuscript, of the end of the 11th century, shows the tri-lobed sword-hilt and round shield.

Norman.—The arms and armour of the Normans at the period of the conquest of Normandy were, of course, Scandinavian. The Norman arms of the period of the conquest of England are portrayed on the Bayeux tapestry. The sword is still of the Scandinavian type, long, straight, double-edged, and somewhat tapering, and round or obtusely pointed with cross piece and pommel. The horsemen are armed with long lances as well as swords. On the tapestry the Normans are represented as well provided with archers and cavalry, of which the Saxons are apparently destitute. Maces and clubs appear also among the weapons; and axes, with shafts from 4 to 6 feet in length, appear in the hands of both Normans and Saxons. The Norman shield is large and kite-shaped, provided with arm-strap and handle, and adorned with emblazonments of badges or devices. Few examples of the older circular shield appear on the tapestry, and these few are Saxon. The body armour consisted of a long hauberk, ringed or trellised, with divided skirt, and having the hood and body in one piece. The helmet was deep, conically topped, and furnished with a nasal.

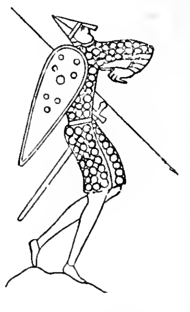


FIG. 5.—From the Bayeux tapestry.

English after the Norman Conquest.—The armour in use in England since the period of the Norman Conquest may be briefly divided into four groups, each associated with its own historical period. True mail armour of interlinked rings was generally adopted in the time of the Crusades, and its use extended to about the beginning of the 14th century. Towards the close of the 12th century the long plaited or mailed skirt, divided at the bottom, as we see in the Bayeux tapestry, had been superseded by a short-sleeved tunic, generally of chain-mail, reaching only to the knees, but sometimes covered with variously-shaped plates of metal. This short hauberk was confined by a belt about the waist, and furnished with a hood or coif, over which a close-fitting helm was worn. In the 13th century there was less uniformity of military equipment. The hauberk was again lengthened to the middle of the leg, and had a coif to cover the head, over which the massive helm, with or without a nasal, was worn, sometimes with a movable visor. The sleeves of the hauberk were prolonged, and mittens added to protect the hands; the lower limbs were covered with mail, the coverings above the knee being called *chaussons*, and those below the knee *chausses*. The sword was long, straight, and pointed, generally with a short recurved guard and rounded pommel. The shield was small, triangular, or heater-shaped; the helm massive, high, and flat-topped. After the middle of the 13th century secondary defences of plate for the protection of the joints began to be introduced; the hauberk was shortened, the mittens of mail were divided into fingers, the helm was often rounded at the top, and greaves and shoulder-plates were introduced. The period of mixed mail and plate armour extends from about 1300 to about 1410. The introduction of secondary defences of plate for the weaker and more exposed parts of the mail-suit gradually changed the character of the armour, until it produced the complete panoply of plate-armour. In the first half of the 14th century the sleeves of the hauberk were shortened, *demi-brasarts* were introduced for the protection of the back of the upper arm, and *vambraces* worn on the front of the lower arm, *roundles* were added in front of the shoulder-joints and at the elbows, and the greaves or *jambarts* were continued over the feet in laminated plates. The *bassinet* was now worn beneath the huge sugar-loafed helm, and had a *camail*, or curtain of mail, descending down the back for the protection of the neck, which subsequently assumed the form of a close-fitting tippet. By the middle of the century splinted armour had become common, and the cuirass with gussets of mail appears. As the second half of the century advanced, the arms and legs were cased entirely in plate, laminated *sollerets*, acutely pointed at the toes, covered the feet, while the body was protected by a long-sleeved hauberk of mail, reaching to about the middle of the thigh, with laminated *épaulières* or shoulder-guards, and *coudières* or elbow-guards. The long sword, with cross-guard, and the short dagger or *misericorde* were now in fashion, and heraldic crests were generally adopted before the close of the century. The first ten years of the 15th century were a period of transition, and from about 1410 the armour became a complete panoply of plate. The period of complete armour of plate which commenced about 1410 extended to the beginning of the 17th century. At the commencement of this period, or towards the middle of the first quarter of the 15th century, the body armour consisted of breast and back-plates of one piece, the *roundles* at the shoulders were replaced by plates resembling small shields fixed in front of the shoulder-joints, and a fan-like arrangement of plates protected the elbows. Below the waist the body was protected by the *taces*, a series of narrow, overlapping plates attached to a lining of leather. The crested helm, sometimes with the addition of a collar, was still in use in battle and tournament. The bassinet was more globular in form, and connected by a gorget with the suit of plate. By the middle of the century the same system of re-inforcing, or adding secondary protections to cover the weaker points, which gradually changed the mail into a complete panoply of plate, had effected considerable changes on the character of the plate-suits, until the corresponding defences of the right and left sides of the figure became totally unlike each other. The *tabard*, a short surcoat with short sleeves, emblazoned with the arms of the wearer, now commonly appears over the armour. By the end of this century the defensive system of plate-armour had reached its highest development. At the commencement of the 16th century, a species of armour of less rigid and cumbrous description often formed of small plates of metal quilted within garments of linen or other tissues, had come into fashion, skirts of mail also came again into use, while the armour generally became more massive and more richly decorated. Pointed or rounds *sollerets* gave place to *sabatons* cut off square at the toes, and plumes were generally attached to the helms. The *salade* and the *morion*, light open head-pieces, gave place to the closed helmet, with visor and beevor; the recurved finger-guard, with the long straight sword, and all varieties of the sabre, came into use; and two-handed swords and sword breakers (curious implements, with notches and springs for catching the blade of an antagonist's sword) were also used. As the century advances the decadence of armour begins to be evidenced by its assimilation to the forms of dress and prevailing fashions of the time. Mere surface ornamentation is more and more regarded; fluted, laminated, and puffed suits are fashionable and the gradual disuse of armour is foreshadowed in the increasing use of fire-arms, against which it afforded no sufficient protection. After the close of the 16th century it continued to be worn as much for display as for real service. Cuirasses began to be superseded by buff coats and jerkins, but demi-suits of plate were worn by cuirassiers far on in the 17th century. The variations of tilting arms and armour, and of horse

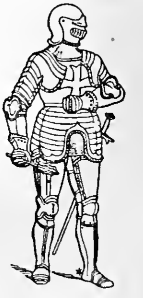


FIG. 6.—Suit of Plate, early in 16th century

armour, are too numerous to be specified in a short notice. For these and other details the works of Grose, Meyrick, Skelton, Stothard, and Hewitt may be consulted by those who wish to study them fully, while the copiously-illustrated works of Demmin and Lacombe, recently translated by Mr Black of the South Kensington Museum and Charles Boutell, are excellent popular manuals of the general subject.

Artillery.—The adoption of gunpowder as an agent in warfare gradually revolutionised the whole system of military tactics, and was not only the ultimate cause of the total disuse of defensive armour, but rendered obsolete the whole of the projectile machines and weapons of the Middle Ages. Bows and shields were the first to give way before it, as they were the oldest forms of weapons of offence and defence. Shields are not represented on English effigies after the last quarter of the 14th century, though the round Highland target survived with the broadsword till 1745. The long-bow, which became such an important weapon in the 13th and 14th centuries, was usually of yew, about five feet in length, and a practised archer would send an arrow of a yard long through his mark at a distance of 240 yards. The cross-bow, which is first mentioned by the Princess Anna Comnena, appears in an Anglo-Saxon manuscript of the 11th century. Its use against Christians was prohibited by the Lateran Council in 1139, although it was allowed against the infidels. The long-bow continued in use in England till the end of Queen Elizabeth's reign, and the cross-bow was only disused in the French army in the 17th century, so slow was the process of transition from one system to another, even after the superiority of gunpowder had been long well known. Gunpowder had been in use for centuries, however, before it was applied to projectiles. The Chinese used it in their fireworks at a very early date, and it is believed to have been introduced into Europe by the intercourse of the Arabs with the natives of the far East. The earliest receipt for its composition with which we are acquainted occurs in the *Liber Ignium ad comburendos hostes* of Marcus Græcus (846 A.D.), where it is described as including six parts of saltpetre, two of sulphur, and two of charcoal. A similar receipt occurs in the *De Mirabilibus Mundi* of Albertus Magnus, bishop of Ratisbon, 1280 A.D. Until about the beginning of the 14th century, however, it had not been applied in warfare to the purpose of throwing projectiles, and was probably regarded merely as an explosive mixture, like the "Greek fire" and similar preparations, employed to spread terror and conflagration. Large cannon were used on the Continent in siege operations, however, as early as the beginning of the 14th century. Cannon are first mentioned in England in 1338; Froissart alludes to them in 1340, and it is certain that they were used by the English at the siege of Cambray in 1339. At the same time experiments were being made at Tournay with long, pointed projectiles, and the duke of Brunswick had substituted leaden bullets for those of stone which were then in common use in his artillery. Carronades were used on board the French ships at the battle of Rhodes in 1372, and bronze cannon were cast at Augsburg in 1378. Towards the end of the 14th century there were *bombardes* in existence, capable of throwing balls of stone of 200 lbs. in weight. All early cannon were breech-loaders, and at first they were built of bar of wrought-iron hooped together. The well-known Scottish *bombarde*, Mons Meg, which was used at the sieges of Dumbarton and Norham in 1489 and 1497 is made in this way. So early as the beginning of the 15th century the prototypes of the modern *mitrailleuse* were invented. In Germany they were subsequently styled "death-organs," and Weigel mentions one which had as many as thirty-three pipes. In the 15th century cannon of a lighter kind than those used in siege operations began to be employed in the field, carriages with trails were introduced, trunnions were added to the guns, and iron balls became common. With the improvement in the manufacture of the gunpowder it was found that the increased velocity of the projectile made up for the diminution of its weight; and throughout the 16th century, the course of improvement was chiefly directed to the lightening of the enormous weights of the guns and projectiles, so as to secure facility of transport. So much progress had been made in this direction by the middle of the century, that, in 1556, the Emperor Ferdinand was able to march against the Turks with 54 heavy and 127 light pieces of artillery. At this period the French artillery were restricted by Henry II. to the following sizes:—Cannon throwing a projectile of about 34 ℔; culverins of three sizes, throwing projectiles of 15 ℔, 7½ ℔, and 2 ℔ respectively; and the falcon and the falconet, the former of which threw a projectile of about 1 ℔, and the latter of less than half a pound. In the second half of the 16th century mortars began to be used in Germany, and howitzers, or pieces for discharging hollow projectiles in a horizontal direction, came into use in England about the same period. At first the mortars were discharged by double firing, the artilleryman lighting the fuse of the shell with one hand and the priming of the mortar with the other. It was not until 1634 that the mortar was introduced into the French army; and towards the close of the 17th century the method of igniting the fuse of the shell by the discharge of the piece itself became general, and greatly simplified the use of the arm. Though Benjamin Robins (who died in 1742) is sometimes spoken of as the inventor of the greatest improvement of modern times,—the application of the system of rifling to artillery,—he was merely the first who treated the subject scientifically. There are rifled cannon of the 16th century in the museum of the Hague. One in the arsenal at Berlin, dated 1661, is rifled with 16 grooves, and one at Nuremberg, of 1694, has 8 grooves. But it was not till after the time of Benjamin Robins that, by the application of an armature of softer metal to the iron projectiles of the rifled guns, the difficulty was surmounted of enabling them at the moment of explosion to fit themselves tightly into the grooves of the rifling. The improvements of Paixhans in 1822, and of Armstrong in England and Krupp in Prussia, have brought the manufacture of these monster pieces of ordnance to the highest pitch of perfection. Krupp's cannon are made of cast-steel, and one of these, a breech-loader, exhibited in 1867, weighed close on fifty tons, and its shot, also of cast-steel, were somewhat over half a ton in weight. The most recent, and perhaps the most important improvement in the working of heavy ordnance is that of Captain Moncreiff, by which the recoil of the gun itself is utilised, so as to withdraw it under the parapet, and by means of a counterpoise to elevate it again, after it has been reloaded and laid by means of reflecting sight. These operations are thus conducted without exposing a man, and the gun itself is only exposed at the moment of delivering its fire.

Hand Fire-arms.—Hand-cannons appear almost simultaneously with the larger *bombardes*. They were made by the Flemings in the early part of the 14th century, and before the end of the century considerable bodies of troops were in existence armed with portable *culverins*. At the battle of Morat (1476) the Swiss army is said to have been provided with 6000 of these hand fire-arms. In England the yeomen of the guard were armed with them in 1485. At first these portable fire-arms were served by two men, but a smaller kind termed *petronels* were used by the cavalry. The long-barrelled *harquebus*, the prototype of the modern firelock, having the touch-hole on the right side of the barrel, with a pan for the priming, a trigger, and a pair of movable nippers, called *serpentine*, for holding the match, was invented in Spain in the time of Francis I. (1515–1547). The *muschite* (so named from the sparrow-hawk, like the *falcon* or small cannon) which was larger, heavier, and more powerful than the *harquebus*, came into use shortly afterwards, and was well known in England before the close of the 16th century. On account of its weight it was provided with a long rest, forked in the upper part and furnished with a spike to stick in the ground. The *musket* and *harquebus* when first employed by the French armies were contemptuously spoken of by contemporary writers, by whom they were considered inferior to arblasts and cross-bows. The wheel-lock, which was invented at Nuremberg in 1515, was but sparingly applied to the harquebus and musket on account of the costliness of its mechanism and the uncertainty of its action. The same objection applied to the *snaphaunces*, the precursors of the first flint locks, and even to the flint locks themselves, which were invented in France about 1640, and it was not till the beginning of the 18th century that the flint-lock musket finally superseded the old match-lock. In 1807 a Scottish clergyman, Alexander Forsyth, took out a patent for a percussion gun, though it was not till 1820 that it begau to come into general use. The system of firing the charge by a fulminate was followed by the invention of the needle-gun, the first model of which was constructed in 1827 by Jean Nicolas Dreyse, a native of Erfurt. Improvements in the mode of adapting the bullet to the rifled grooves successively led to the perfected system of the Minie rifle, by which the explosion of the charge expands the cup-shaped end of the conical bullet, and drives it into all the grooves, a process which was previously effected by hammering with the ramrod. The needle-gun was first made breech-loading in 1836, and since that time the improvements effected have been mainly directed to the combination of length of range with accuracy of aim and rapidity of fire. According to an official report, the results of the trial at Spandau of the needle-gun used by the different nations of Europe was as follows:—the Prussian, 12 shots per minute; the Chassepôt, 11; the Snider (England) 10; the Peabody (Switzerland), 13; the Werndl (Austria), 12; the Remington (Denmark), 14. Neither breech-loaders nor revolvers, however, are inventions of modern date. Both were known in Germany as early as the close of the 15th century. There are in the Musée d'Artillerie at Paris wheel-lock *harquebuses* of the 16th century which are breech-loaders; and there is, in the Tower armoury, a revolver with the old match-lock, the date of which is about 1550. A German harquebus of the 16th century, in the museum of Sigmaringen, is a revolver of seven barrels. Nor is rifling a new thing in fire-arms, for there was a rifled variety of the old harquebus of the 15th century, in whi h the balls were driven home by a mallet, and a patent was taken out in England for rifling in 1635. All these systems were thus known at an early period in the history of fire-arms, but it is only the perfecting of their mechanism and rifling, the improvements in the gunpowder and the cartridge, and above all the adoption of the system of firing by a fulminate, that have enabled them to be used with the precision, length of range, and rapidity of fire, that now form such striking features in the warfare of modern times. It remains only to notice the bayonet, the invention of which, about 1650, has been claimed for Puséygur, a native of Bayonne. The bayonet in its simple plug form, inserted into the mouth of the barrel, was adopted in France and England about 1675. In 1689 it was attached by two rings to the barrel by General Mackay, and the socketed bayonet was introduced by Vauban into the French army in 1703. In these days of precision of aim with long-range projectiles the bayonet, once the most decisive of modern weapons, has become of secondary importance.

Collections.—The formation of historical collections of arms and armour dates no further back than the commencement of the 16th century. The earliest is that made by Louis XII. at Amboise in 1502. The magnificent collection at Dresden was begun about 1553. The Ambras collection, now at Vienna, of which a series of illustrative photographs has been published by the Baron von Sacken, was commenced in 1570. There is also a splendid collection in the Imperial Arsenal at Vienna, which has been described, with illustrations, by Captain Leitner. The Musée d'Artillerie at Paris, catalogued by M. l' Haridon, is one of the richest and best organised collections in Europe. In the Armeria at Turin there is a fine collection, of which a catalogue has been published by Count Seyssel. The collection at Sigmaringen is catalogued and illustrated by Dr Lehner, and that of Munich by M. de Hefner-Alteneck. Of the remarkable collections at Tzarskoe Selo, St Petersburg, and at Madrid, there are no detailed descriptions. The collection in the Tower of London, which was classified by Dr Meyrick, and catalogued by Mr John Hewitt, contains about 6000 examples, from the commencement of the Middle Ages downwards. The most remarkable private collection ever formed in this or any other country was that of Llewelyn Meyrick at Goodrich Court. It is to be regretted that the opportunity of acquiring this collection in its integrity was missed by the Government. It may be noticed as an indication of popular interest in the subject, that a Museum of Arms, including specimens from the earliest period, has been recently established in Birmingham, containing, in addition to a series of fire-arms granted by the Government, a fine and extensive collection made in Italy by the Cavaliere Callandra, of which the guardians of the Birmingham Proof House have become the purchasers. If we except the National Museum of the Antiquaries at Edinburgh, which contains a fine series of stone and bronze weapons, and a few typical examples of the arms of later times, there is no public collection of arms and armour in Scotland. (J. AN.)

ARMSTRONG, JOHN, a physician, litterateur, and poet, the friend of Thomson, Mallet, and Wilkes, was born about 1709 at Castletown, Roxburghshire, where his father was parish minister. He graduated M.D. at Edinburgh university, and soon afterwards settled in London, where, however, his professional success was small. In all probability he paid more attention to literature than to medicine. He was, in 1746, appointed one of the physicians to the military hospital behind Buckingham House; and, in 1760, physician to the army in Germany, an appointment which he held till the peace of 1763. His latter years seem to have been embittered by disappointments, as is evinced by the tone of his writings, in which he particularly directs his sarcasms against his medical brethren and the reviewers. He died in 1779. Armstrong's first publication, an anonymous one, entitled *An Essay for Abridging the Study of Physic* (1735), was a satire on the ignorance of the apothecaries and medical men of his day. This was followed two years after by the *Economy of Love*, a poem the indecency of which damaged his professional practice. In 1744 appeared his *Art of Preserving Health*, a very successful didactic poem, and the one production on which his literary reputation rests. Along with this poem were published, in 1770, a number of shorter poetical pieces, under the title of *Miscellanies*, in which he displays considerable humour and powers of observation.

ARMY

ARMY, "a collection of armed men obliged to obey one man" (Johnson); "a collection of troops of all arms formed into brigades and divisions, placed under the orders of one commander, with a general and special staff and administrative departments; provided with all necessary war materiel, and destined to act offensively and defensively against the enemy" (Block, *Dictionnaire de l'Economie Politique*). Neither definition is quite satisfactory. The first is too comprehensive; the second excludes the forces of all but highly-civilised nations. The essential characteristics of an *army*, by which it is distinguished from other assemblages of armed men, are its *national* character—that is, its representing more or less the will and the power of the nation or its rulers—and its *organisation*. The degree of the latter must depend on the age and the state of civilisation; the armies of former days we should now call mobs. The art of war has kept pace with the arts of peace, and there is as much difference between the "armies" of the present and of the past as between an elaborate modern machine and an early stone implement. But armies of some kind have existed since the earliest periods of man's history. At no time has industrial accumulation, with its results, progress and civilisation, been possible unless accompanied by the will and power to defend it. No nation has made its mark in history that has not at some period of its existence been pre-eminently distinguished for martial spirit and proficiency in arms; or been allowed to throw its full energies into the pursuits of peace till it had proved what it was able and willing to do and endure in war. In studying the progress of military art we dwell in succession on the proudest days of all the great nations of the earth, and learn that when this art was neglected the fall of the nation was seldom far distant.

The art of war divides itself into two distinct branches—the first relating to the military institutions of nations, the manner in which armies are raised, their composition, characteristics, organisation, and government; the second to their employment in war. The first, commonly known as the administration or organisation of armies, is that of which this article treats. A modern army is a vast and complicated machine, so constructed that the whole aggregate force of its numerous parts may be exerted in any direction and on any point required. It is our province to describe this machine in a state of rest, explaining the construction, purpose, and combination of its several parts, but leaving its action to be treated of elsewhere (see WAR).

Early armies.

In the earliest stage of civilisation the army is identical with the tribe or nation. Every man is a warrior; even women and children accompany the expeditions, prepare and carry food, and bear such share as they are fitted for. In more settled communities the able-bodied men only take the field, while the women, the children, and the aged remain at home to watch the herds and till the fields. Production is still so small that no division of duties among the men is necessary. The armies consist of the whole male population, collected under their chiefs and heads of families, or under warriors who have specially distinguished themselves. Such were some of the earliest armies mentioned in history, and such are still the armies of the savage nations with whom our colonial empire brings us in contact,—well fitted for petty warfare between neighbouring tribes or nations, when the assailants confine themselves to raids for plunder and captives, but not for distant expeditions or prolonged operations. As population and industry increase, a division of labour becomes both possible and necessary. A select portion of the inhabitants are specially devoted to military service, either permanently or for a time, while the remainder give undivided attention to pacific pursuits. Standing armies and permanent organisation are thus introduced, and lead to improvements in administration and progress in the art of war, till finally we attain to the perfection of modern organisation.

Egyptian army.

History points to Egypt as the first country in which a regular military organisation was established, and the warrior class, as such, distinguished from the rest of the population. By its earliest laws the revenues of the state were divided into three equal parts, of which one went to the priests, one to the king, and one to the warriors. Sesostris seems to have been the great military organiser of Egypt. Trained by his father from childhood to war, he early distinguished himself in military expeditions against the Arabians and against Lybia, and mounted the throne with visions of universal conquest. To pave the way for such schemes, he gave Egypt a military organisation, dividing it into thirty-six provinces, and establishing a militia or warrior class, called *Kalasires* and *Harmatopoii*, to each of whom was allotted land sufficient for the maintenance of himself and his family. These formed the nucleus of the vast army, amounting, according to Diodorus Siculus, to 600,000 infantry, 24,000 cavalry, and 27,000 war chariots, with which he undertook the conquest of the world. We read that the command of this army was given to the companions of the king, who, like himself, had been trained to arms under his father, and that a strict discipline was maintained and a military code established which forbade corporal punishment, appealing to the higher instincts of the soldier; but of the details of organisation and administration by which so vast an army was moved and fed we can learn little. With this army, aided by a powerful fleet, Sesostris first subdued Ethiopia, and then extended his conquests eastward as far as the Ganges; thence turning northwards and westwards, he swept over the Punjab, the table-land of Tartary, and the north shores of the Caspian, and descended through Sarmatia and Dacia into Thrace. Finally, he overran Asia Minor, and having conquered the Assyrian empire and seated himself on the throne of Ninus and Semiramis, returned in triumph to Egypt after a nine years' absence, and devoted the rest of his life to the peace and prosperity of his kingdom. Such are the accounts handed down by the ancient historians; and if any faith is to be attached to them, it seems clear that he did actually raise and maintain large armies, and with them carry out prolonged and distant expeditions, extending over several years, without interrupting the industry and progress of his own country—facts which in themselves prove a high degree of national and military organisation.

Persian army.

The martial spirit of Egypt, however, seems to have expired with its first and greatest conqueror, and as a nation it has distinguished itself in the arts of peace rather than those of war: the country became the prey of conquerors and the battle-field of other nations, and the palm of military supremacy passed successively into the hands of the Assyrians, the Babylonians, the Medes, and the Persians. The first two nations present no special features in their military systems; their armies, like those of Egypt, consisted mainly of infantry, horsemen and chariots forming but a small though highly-prized element. But the Persian empire introduces us to a more highly developed military organisation, and a system of standing armies closely resembling those of modern times. Drawn from a hardy and nomadic race, its armies at first consisted mainly of cavalry, and owed much of their success to the consequent ease and rapidity of their movements. Constantly extending their power by fresh conquests, the warlike Persians established themselves as garrisons in the subjected provinces, gladly exchanging their own barren mountain lands for these rich and fertile countries, and for some time remained a distinctly conquering and military race. Their empire attained its highest power under Cyrus and Cambyses; the former, the founder of the great Persian empire, uniting on his head the crowns of Babylon, Media, and Persia, while the latter still further extended the empire by the conquest of Egypt. Cyrus seems to have been the founder of that complete military organisation of which we gather details from Xenophon and other writers. To each province of the empire was allotted a certain number of soldiers as garrison or standing army. These troops, formed originally of native Persians only, were called the king's troops. They comprised two classes: the one devoted exclusively to garrisoning the fortified towns and castles, the other distributed throughout the country. To each province was appointed a military commander, responsible for the number and efficiency of the troops in his district; while the satrap, a civil governor, was answerable for their subsistence and pay. Annual musters of these troops were held either by the king in person or by generals deputed for the purpose, and invested with full powers. This organisation seems to have fully answered its original purpose, that of holding a vast empire acquired by conquest, and promptly repelling inroads or putting down insurrections. But when a great foreign war was contemplated, the standing army was augmented by a levy throughout the empire, and each province and tributary nation furnished its quota of men, horses, and provisions. The extent of the empire made such a levy a matter of time. Thus the preparations for the invasion of Greece by Xerxes took three whole years; and the heterogeneous and unorganised mass of men of all nations so brought together was a source of weakness rather than strength. That the warlike Persians, whose reputation rose so high under Cyrus, who were distinguished for their powers of endurance, and a daring courage which despised stratagem and delighted in single combats, should within a century have failed so disgracefully against the Greeks, has often been matter of wonder. Something, doubtless, was due to the fact that their reputation was won over effeminate races, very different from their later antagonists; something also to the degeneracy induced among themselves by years of success and luxury. But it must also be borne in mind that the vast hosts over which the Greeks gained such easy victories comprised but a very small proportion of the true Persians—of the race which had given Cyrus his conquests. The cavalry alone seems to have retained its national character, and with it something of its high reputation, even to the days of Alexander. Nevertheless, the first contact between the Asiatic and the Greek proved that the crown of military glory had passed to the western nation.

Greek armies. The earliest knowledge we have of the military institutions of the Greeks is derived from the pages of Homer. They are glimpses only that we obtain, but they suffice to distinguish many of their characteristics. Their compact formations and subordination and silence in the ranks are contrasted with the looser formation and noisy attacks of the Trojans. Their armies consisted almost entirely of infantry. The leaders fought either on foot, like the rest, or from chariots; and single combats between the chiefs on the two sides were common, and often served to open the battle. We have sketched for us the traits of a hardy, independent, enterprising race, sometimes cruel and quarrelsome, but gallant, high-spirited, and intelligent, and well fitted to become distinguished as soldiers. How these qualities were developed, till the Greek armies and Greek tactics acquired a renown which has lasted to our day, we learn from the laws of Lycurgus and Solon, and from the ample details handed down by Xenophon, Thucydides, and other historians.

By the laws of Athens every free man was liable to military service. Athens. It was not only his duty but his distinction and privilege. The slave worked, the freeman devoted his time to military exercises and to the gymnasium. At eighteen his name was enrolled on the list of fighting men; for two years his duties were confined to home service, and especially to the guarding of Athens; from his twentieth to his fortieth year he was liable to service wherever the good of the state might require. The collectors of taxes, the singers at some theatres, and a few others, were alone exempted. The only privilege granted to the wealthy was that of serving in the cavalry. The infantry, of which the army was mainly composed, consisted of three classes. First were the heavy troops, "hoplitai," armed with a spear, a dagger, a corslet, and a large oval shield. These formed the phalanx or main line of battle, and were composed entirely of free citizens, natives of Attica. Secondly, the light troops, "psiloi," armed with javelins, but carrying little defensive armour, and no shields. These were destined for skirmishing and covering the movements of the phalanx, and were mostly slaves, who followed their masters, serving among the "hoplitai," to war. Thirdly, there were "gumnetai," or irregular light troops, carrying no defensive armour, but provided with javelins, bows and arrows, and slings, to harass the enemy; these usually consisted of slaves or foreign troops. Besides these there was another class, "peltastai," so called from the light shield or target (*pelta*) which they carried, and intermediate between the "hoplitai" and "psiloi."[1] The cavalry consisted entirely of the wealthier Athenians, and was intelligent and enterprising. Each of the tribes of Athens had its own military commander, chosen from itself, and elected for the year only; and an Athenian army thus obeyed ten chiefs ("strategoi") of equal rank. These commanded by turns for the day, while the ten together formed a council of war to consult and decide in cases of emergency. Practically the inconvenience of such a system was obviated by leaving nine of the ten behind, or by the appointment of a "polemarch," a sort of permanent chief of the staff, who carried great weight in the councils.

The Spartans owed much of their specially soldierly Sparta. qualities to the institutes of Lycurgus, which had for their aim to form a nation of warriors, and develop to the utmost those physical and moral qualities which render men invincible. Discipline, unquestioning obedience, uncomplaining endurance, and contempt of danger, were the principles inculcated on the young Spartan from his earliest years, while his body was strengthened by every exercise and trained to every fatigue. As with the Athenians, military service was the first duty of every citizen of Sparta. The age of enrolment was twenty instead of eighteen; but the service lasted till sixty, and was more severe. In peace as in war, the Spartan lived as if in presence of the enemy. War time was, indeed, his relaxation, for he was then accompanied by slaves, carriages, and beasts of burden, and relieved of every labour or fatigue, to keep him fresh for battle. Cavalry was held in disrepute in Sparta; their infantry was formed

[1] The distinction between the *psiloi* and the *peltastai* is not clear, and it would almost seem that they were the same class of troops, the first name being applied to them when used as light troops, the second when formed in close order and attached to the phalanx.

in five "moras," or regiments, corresponding to the five tribes; later, a sixth, which included a small force of cavalry, was added. The armies were usually commanded by the kings of Sparta; when one only was formed, one king remained at home. The king was accompanied by a body-guard, comprising the winners of the prizes at the athletic games, and had attached to him two polemarchs, or chief staff officers, and three administrative officers, who relieved him of all care of details, leaving him free to devote his mind to the great task of his command.

Greek phalanx. The phalanx, formed of the *hoplitai*, or heavy-armed infantry, drawn up eight deep, was the basis of all Greek tactics.[1] The Spartan and Athenian phalanx differed slightly in interior organisation and subdivision, but the general principles were the same. For marching and manœuvring the ranks stood at open order, that is, 6 feet apart; for attack at close order, or 3 feet apart; and for defence at locked order, or $1\frac{1}{2}$ feet apart. The number of men in each phalanx, and the number of phalanxes into which the battle-array was divided, varied according to circumstances; but from 2000 to 4000 seems to have been the usual strength of a phalanx. The *peltastai* and light troops and the cavalry formed round or in rear of the phalanx; the light troops remaining in front and harassing the enemy till the actual moment of collision, and then falling back to the flanks or rear. In counting the forces engaged in a battle, it was usual to reckon only the *hoplitai*, who answered to the knights and men-at-arms of the Middle Ages; but the *peltastai* and light troops generally equalled, and often considerably exceeded, the former in numbers. The Athenian phalanx was less compact than that of Sparta, but more formidable in its attack, the offensive being best suited to the national character of the former, while the passive courage and endurance of the latter shone especially in the defensive. At Marathon and in subsequent battles the Athenians advanced to the attack at a run, while the advance of the Spartans was always deliberate and slow. The Thebans, under the direction of Epaminondas, modified the phalanx, forming it on a narrower front, with greater depth, and the soldiers standing so close in the ranks that they could not turn. This gave more weight at the point of impact, and the Theban column of attack, fifty deep, crushed the Lacedemonian phalanx, only eight deep, when opposed to it at Leuctra and Mantinæa. Xenophon compares the effect to that of a heavy vessel striking a light one amidships with her bow, and dashing her to pieces by the collision. The Macedonian phalanx was a combination and adaptation of the various earlier Greek forms.

The Greek armies were essentially militia. A few guards and garrisons were maintained, but no standing armies like those of Persia; and the troops by whom such perfection in tactics was attained, and such brilliant victories were won, were only called under arms when occasion required, and returned to their civil life when the danger was over. By constant wars, however, this militia had acquired all the character of a regular army; and the Spartan forces especially differed only in not receiving pay for their services. Beyond their own country the warlike reputation and soldierly qualities of the Greeks made them highly prized as mercenaries, and large numbers adopted that profession. Thus we hear of Greek troops in the pay of the Egyptian kings in the time of Cambyses, and later the garrisons of the Persian towns in Asia Minor were mainly furnished by them; while Xenophon and the ten thousand Greeks who engaged under Cyrus the Younger did more to spread the fame of the arms of Greece than even the great victories of Marathon and Platæa, and, by exposing the weakness of the Persian empire, paved the way for the future conquests of Alexander.

Macedonian army. Macedon, inhabited by rude but hardy shepherds and hunters, and far behind its southern neighbours in civilisation, had made no mark in history till Philip ascended its throne. But this monarch, who combined the highest military qualities with a far-seeing shrewdness which was fettered by no strict principles of honour, had no sooner established himself than he devoted all his energies to raising the military power of his country and extending his authority. The experience of his wars with the Athenians and other nations of Greece taught him that he could only overcome them by a discipline and training superior to their own, and he early saw that such was not to be given to a mere militia force. He set himself, therefore, to form a standing army, to which he gave an organisation, copied, but improved, from that of his adversaries. By force of arms, by treachery, or by policy, he increased his power and influence till it embraced all Greece; and he was about to make war on Persia at the head of her united armies when his death put an end to his ambitious projects. But his son Alexander had all his father's military genius and ambition, and at the same time inherited the instrument he required in the highly-trained army so carefully prepared. Within a year he had chastised the Thracians in the north, stamped out the Greek revolt by the storming and destruction of Thebes, and received at Corinth from the representatives of the southern states the chief command over their united forces; and in the following year crossed the Hellespont at the head of an army of 35,000 men, and commenced that career of conquest which was not to cease till he had carried his victorious arms over India, and founded the largest empire the world had yet known. The army with which these astonishing campaigns were won was composed of native-born Macedonians, of their allies, and of mercenaries. The infantry was divided into heavy and light armed, the *peltastai* now forming a most important part of the force, besides auxiliaries or irregular troops. None but native Greeks were admitted into the phalanx or the cavalry. The cavalry, which was more numerous than that of the Spartans or Athenians, was also divided into heavy and light; the former carrying horse armour as well as body armour. The actual force with which Alexander crossed the Granicus, the frontier line, was 30,000 infantry and 4500 cavalry, of whom about 12,000 were Macedonians, 5000 foreign mercenaries, and the remainder Greeks and allies. Special attention was paid to recruiting, generals being left behind to attend to it, and numerous reinforcements were sent to Alexander during his expeditions, so that at the battle of Arbela his army amounted to at least 60,000 men. The tactical organisation of his army was adopted from the Greeks. The Macedonian grand phalanx, as finally formed by Alexander, numbered 16,384 heavy-armed infantry: it was formed 16 deep, each file of 16 men forming a *lochos* under a *lochagos*, who led the file, and thus became the front rank man. These files were variously grouped. Thus two files formed a *dilochie*, four a *tetrarchie*, two tetrarchies a *taxiarchie*, under a *taxiarch* or *centurion*, &c.; and 32 taxiarchies, or 256 files, formed a *simple phalanx* of 4096 men. Four of these, with a due proportion of peltastai, light troops, and cavalry, formed the *grand phalanx*. The depth of 16 was chosen as giving greater solidity than the Spartan phalanx, while admitting of more subdivision. To form a solid column the phalanx was doubled, giving a depth of 32; to extend its front, its depth could be reduced to one-half, still offering a firm line. The principal weapon was the *sarissa* or pike, 24 feet long, of which 18 feet extended beyond the grasp. Thus the pike heads of six ranks

[1] The various formations cannot here be described in detail.

projected beyond the front, and formed that bristling mass of spears which gave the phalanx its formidable appearance. The proportion of peltastai, cavalry, and irregular troops attached to the grand phalanx varied slightly, but as a rule the total about equalled that of the phalanx. Of these, the peltastai would form one-half, the cavalry and irregular troops about a quarter each. Thus the total strength of a grand phalanx and its auxiliaries amounted to about 32,000 men, and Alexander's army at Arbela was formed of two such. The Macedonian phalanx was the crowning point of Greek military organisation, and therefore has been described at some length; but a still greater military power was already rising in the West, before whose legions the phalanx itself collapsed, and to this it is now time to turn.

Roman army.

The early or legendary period of Roman history is enveloped in a darkness which hides the rise and first development of those institutions which ultimately gave to Rome the empire of the world. Her earliest military organisation is attributed to Romulus, who grouped the great families or clans ("gentes") in three tribes; each required to furnish 1000 foot soldiers and 100 cavalry, and in the force so raised is traced the origin of the Roman legion. But it is to Servius Tullius that the legend assigns the great classification, lasting to the time of the Cæsars, according to which the burdens and duties of military service were determined. The whole population was numbered and divided, according to wealth, into six classes; the class determining the amount of war-tribute to be paid by the citizen, his position in the army, and the armour he had to provide. The legionary infantry, *Triarii, Principes, Hastati*,[1] were usually drawn from the first four classes; the light troops, "*Velites*," from the fifth; while the sixth and poorest class was exempted from all military service and from the tribute. For voting purposes and for enrolment these classes were subdivided into centuries; and a certain number of special centuries of "equites" were formed from the patricians and most wealthy citizens, who were required to provide horses as well as armour, and formed the cavalry of the legion. Every five years a fresh census was held, and the classification according to property revised. Liability to service commenced at the age of seventeen, and lasted until forty-six; and no Roman citizen could aspire to any office until he had served ten years in the infantry or five in the cavalry. The manner of raising the annual levy of troops is minutely described by Polybius. Immediately after the election of the consuls, twenty-four military tribunes were chosen from among the citizens of longest and most distinguished service. The consuls having published the day on which all persons liable to service were to assemble at the capital, the military tribunes were apportioned to the several legions. The magistrates then proceeded to choose from the different tribes, in order determined by lot, those most fit for military service, and sent them, in groups corresponding to the number of legions, before the military tribunes, who selected in turn for their several legions till the required numbers were raised. The conscripts then took the military oath, *sacramentum*, and were dismissed until the appointed muster-day, when the legion was formed and organised. The youngest and poorest were made *Velites*, the next in age *Hastati*, the most powerful were selected for the *Principes*, and the oldest or richest reserved for the *Triarii*. The legion was commonly composed of 600 Triarii, 1200 Principes, 1200 Hastati, and 1200 Velites, with 300 cavalry,—making a total strength of 4500; the number of Velites, however, often varied considerably. When the classification was completed, the three classes of Triarii, Principes, and Hastati were divided into ten *manipuli* or companies each, and the cavalry into ten *turmæ* or troops; while the Velites were distributed among the thirty manipuli. A first and second centurion was then chosen and appointed to each manipulus; and these again chose each two "ensigns" from their manipuli. The centurions ranked among themselves according to the class to which they belonged; thus a centurion of Triarii ranked above one of Principes or Hastati, and the first centurion of each class commanded the whole of his class or one of the lines of battle of the legion. Originally Roman citizens only, belonging to the five upper classes, were admitted in the army, and the soldier equipped himself at his own cost, and received no pay. Afterwards, the socii or allies of Rome were included in her armies, and in the time of Polybius a consular army consisted usually of two legions, or 9000 Roman soldiers and about the same number of allies or socii. But under the pressure of the great Punic wars the consular armies were often doubled: at Cannæ two double consular armies, or nearly 80,000 men, were brought together; and at one period of the second Punic war as many as 23 legions were raised. The system of payment, too, dating from the prolonged siege of Veii, removed the reasons for exempting the poor from military service, and they were included in the levies, though usually detailed to the navy as an inferior service. Finally, when civil wars had shaken the old institutions, and everything was sacrificed to faction and party spirit, even slaves and criminals were enrolled, and the whole character of the army was changed. Other causes also tended to the same result. The system of raising the consular armies annually, and disbanding them at the conclusion of each campaign, required to be modified when distant wars were undertaken: legions were kept permanently under arms, and recruited annually by levies sent from Rome; ambitious generals found excuses for not disbanding the armies to which they owed their power, and by degrees a standing army was established; and these changes in the character of the army were accompanied by corresponding changes in its organisation and tactics. The distinction between the three ranks became gradually effaced, and the three corresponding manipuli were merged in the *cohort*. The legion was no longer divided into three lines and thirty manipuli, but into ten cohorts, and its force was raised from 4000 to 6000 men. The manner of fighting, too, was gradually changed, and the Roman soldier learned to trust less to his sword and heavy *pilum*, only useful at close quarters, and more to javelins and warlike instruments.

The turning-point in Roman military art is commonly fixed about the time of Marius, to whom the change in the organisation, as well as in the composition, of the Roman armies is attributed. But the evil effects did not make themselves felt immediately, and the legions, whose actions under Cæsar shed the brightest lustre on the Roman arms, were organised on the new system. So long as discipline and the old military spirit remained, the Roman armies retained their superiority, whatever their tactics. This spirit was too deeply implanted to die out soon; and whenever men arose worthy to command them, the Roman soldiery regained its reputation. But under a succession of weak and profligate emperors all discipline was lost: the legions, degenerated into a feeble militia, sold the empire which they were incapable of defending, and ultimately fell an easy prey to the rude and daring barbarians of the North.

The Roman armies owed their long and remarkable

[1] The "Hastati," so called from the "hasta," or spear, were comparatively lightly armed, and usually formed the first rank of the line of battle; the "Principes," heavily armed, formed the second rank; and the "Triarii," armed with shields, body armour, and short heavy spear ("pilum"), formed a third rank or reserve.

ascendency to three principal causes: discipline; care in the selection, training, and exercise of the soldiers; and readiness in adopting improvements, whether from friends or foes. In the first the Romans surpassed all other nations. The second especially attracted the attention of contemporary students of their military institutions; Hirtius, Vegetius, Josephus, all speak of the constant exercises by which, in peace as in war, the Roman soldier was trained and inured to war. "If," says Josephus, "we consider what a study the Romans made of military art, we must confess that the empire to which they have attained is not a gift of fortune, but a reward of virtue. They did not wait for war to handle their arms; nor, slumbering in the bosom of peace, move themselves only when awakened by necessity: as if their weapons were born with them, as if they formed part of their members, they allowed no truce to exercises; and these military games are real apprenticeship to combat. Each soldier tests his strength and courage every day; thus battles are neither new nor difficult to them; accustomed to keep their places, disorder never arises, fear never troubles their minds, fatigue never exhausts their bodies. They are certain to conquer, because they are certain to find enemies unequal to them; and one may say, without fear of mistake, that their exercises are battles without bloodshed, and their battles bloody exercises." Josephus said truly, they would never meet their equals. When they fell, it was not because their adversaries were superior, but because they themselves were no longer what they had been.

Early military institutions of Europe.

Hitherto war had been a progressive art. Each great military power succumbed in its turn to an organisation and a science superior to its own. But with the fall of Rome we seem to begin afresh. The nations by whom the overthrow of this great empire was effected were in the condition from which the Latins had emerged ten centuries before; and more than ten centuries elapsed before the lost ground was regained, and such highly-trained armies again appeared.

The early institutions of the Frank and German races, the new masters of Europe, were those of a free, proud, warlike people. The right to bear arms was the privilege of the freeman, the mark of his status in the community. No man could assume it till publicly pronounced worthy, and solemnly invested before the assembly of the people. From that time he was never separated from his arms. The same word (*wehr*) denoted a weapon and a freeman; even his plot of land (*were*) was named after that by which alone he held it, and his social existence ceased when no longer able to carry arms and mount his horse. Similarly, nation and army were convertible terms; the Longobards continued to call themselves an army (*Heer*) long after their settlement in Italy. Their organisation was rude and simple. The family was the basis of the social fabric; kindred families formed clans, and these again confederations (*Markgenossenschaft*), to which admission was only obtained by common consent. Finally, the kindred tribes or communities occupying a certain district (*gau*) formed a higher organisation (*gaugemeinde*), which usually included the whole of a particular race or stock, and had well-defined natural boundaries. For political and military purposes the gau or province was subdivided into "circles" (*Kreis*) and "hundreds," names which have continued to this day; the latter calculated to include as many households as would suffice to place a hundred warriors in the field. Kings and commanders were elected and were entrusted with absolute power in war time, but in peace every freeman claimed perfect liberty; all great questions were determined by the people in public assembly, and all conquests were the property of the community, to be shared equally among them. It is hard to imagine a greater contrast than that between the perfect freedom and equality of the early German institutions, and the tyranny and unequal rights of the feudal system which succeeded it.

Rise of the feudal system.

But we can trace the gradual transition. From early days the most adventurous youths attached themselves to the hero of the nation or tribe, to be instructed by him in peace and led to victory in war. Thus each great warrior collected round him a band of personal followers—retainers, whom he equipped with horses and armour, and rewarded with a share of the booty, and who in return followed him in all expeditions, and obeyed no law but his word. When conquests were effected by such bands, the land was the property of the chief, and was distributed by him as a reward to his followers. Gradually kings and chieftains increased their retinues, extending protection to those who obeyed them, and enriching them by grants of lands acquired by conquest or seizure. These grants soon ceased to be free gifts, rewards for past service, but were held to entail future service also; and the chiefs assumed the right to revoke them. As the power of the nobles and the number of their retainers increased, so did the number and power of the independent freemen decrease; a prey to oppression and exactions of all sorts, they attached themselves in self-defence to some neighbouring lord, surrendering their lands, and consenting to hold them of him as vassals. Finally, the lords increased their pretensions, assuming the titles of "suzerains" or "seigneurs," claiming absolute authority over the persons and property of their vassals, and requiring an oath of fealty from them; and the feudal system, with all its grinding tyranny, was established. Nations were broken up into small seignioralties, whose lords, at constant war with each other, only united to resist any interference with their privileges; and if occasionally a powerful ruler like Charlemagne succeeded for a time in establishing a real government, it was only personal, and collapsed as soon as the strong hand was removed. No great national undertakings, no great progress in the arts of peace or war, were possible under such conditions; and it was not till feudalism was nearly extinct that these arts emerged from the darkness of the Middle Ages.

The early Frank and German armies comprised the whole manhood of the nations, rudely organised by "hundreds," or by tribes and families. Some knowledge of tactics had been gained from their adversaries the Romans, and from deserters and escaped slaves in their ranks; but they usually adhered to their own national formation, the wedge shaped column of attack. The principal arm was infantry, divided into "heavy" and "light;" the light infantry being originally the *élite*, and trained to act with the cavalry, but afterwards degenerating into mere attendants of the latter. The transition from the national to the feudal system is seen in the armies of Charles Martel. These consisted in part of his personal followers, partly of mercenaries, and partly of national levies. At Tours the latter still formed the great bulk of the force, and fought, as of old, in heavy masses and with little tactical organisation. Under Charlemagne armies became more feudal, the chiefs and their retainers forming a larger proportion, the national levies a much smaller one; and the frequent levies ordered in his reign did much to extinguish the class of freemen, driving them to seek protection as vassals of the great nobles. The true feudal armies were formed entirely of the knights, men-at-arms, and vassals, who obeyed the summons of their suzerain, either at the call of the king, or for his own private wars, and whose service lasted variously for twenty or forty days or three months, at the end of which the army disbanded and returned home.

The change in the constitution of armies was accompanied by changes in their armament. As the equality of the old freemen gave place to the classification of the people into lords, gentlemen, and serfs, corresponding distinctions in arms and equipment followed; the horseman became the representative of the upper classes, the foot soldier of the serfs and peasants. The feudal system could only be maintained by the superior fighting power of the ruling class. All that money and art could do was therefore lavished on the equipment of the lord and his immediate retainers, while the peasant remained ill-armed and comparatively defenceless. The strength of armies was measured by the number of men-at-arms. Efforts to arm and train the mass of the people commonly originated with the kings, in their desire to form a more national force than the semi-independent feudal levies, and received small encouragement from the nobles. When they succeeded it was a sign of weakness in the feudal chiefs, and of a more popular government. In no country were the lower orders so warlike and used to arms as in England; and historians have shown how essentially popular was the rule even of our most absolute monarchs.

Two characteristics of feudalism were especially adverse to progress in military art: the undue preponderance given to one arm, numerically weak; and the impossibility of unity of action or combined organisation among so many independent and rival authorities. Among the causes tending to bring about a better military system must be reckoned the *Crusades*, those marvellous efforts of fanaticism that still excite a wonder and admiration mixed with pity. It is true they left no mark at all proportionate to the vastness of the efforts. The armies of the Crusaders, as they took the field, were mere tumultuary masses, as destitute of order and discipline as their leaders were ignorant of military science. But for the first time large bodies were kept continuously under arms, and some sort of organisation necessarily developed itself. The knights and leaders becoming conscious of their own numerical weakness, bestowed more care on the arms and discipline of their men, and learnt their value; and the first true infantry of the feudal times dates from the Crusades. An event of very different character, but not less exercising a most important influence, was the grant of the franchise to cities and towns, resorted to by Louis VI. of France in 1135 to establish a counterpoise to the power of the barons, and afterwards adopted in Germany and England. These enfranchised cities raised their own levies (*milice des communes*), and thus furnished the king with a military force independent of and antagonistic to the feudatories, and consisting mainly of an infantry superior in quality to the feudal vassals. Another cause was the ever-increasing employment of mercenaries, due partly to the growing wealth and luxury which made personal service irksome, partly to the proved unfitness of feudal armies for continuous operations. Lastly came the invention of gunpowder, which, though it exercised no immediate effect on tactics, and had little to do with the overthrow of feudalism, ultimately revolutionised the whole art of war.

Fall of feudalism. Rise of standing armies.

The fall of feudalism as a military system, though gradual, as all such changes are, may be said to have been accomplished in the middle of the 15th century. Two events occurring about that time gave it its death-blow—the defeat of the Burgundian chivalry by Swiss infantry in the three successive battles of Granson, Morat, and Nancy; and the establishment of "*compagnies d'ordonnance*" by Charles VII. of France. The first destroyed for ever the overwhelming prestige attached to the mailed horsemen, and restored infantry to the place which it had held in ancient armies, and has never lost since; from the second dates the origin of *standing armies* in Europe. Charles VI. had already sought to substitute a permanent national force for the foreign mercenaries, who were as great a curse to their employers as to their enemies; but the attempt was interrupted by his insanity, followed immediately by internal discord and disastrous wars with England. It was not till sixty years later that Charles VII., having firmly established his power by a series of successes over the English, carried out his father's idea; and (in 1445) organised fifteen "*compagnies d'ordonnance*," to be maintained in peace as well as in war. Each company consisted of 100 men-at-arms, or "lancers," with their attendants, viz., squire, groom or batman, and three archers—the whole force amounting to 9000 men. Three years later, he organised a corresponding force of infantry, 16,000 strong, named franc-archers. The superiority of a standing army over an assemblage of feudal militia was soon proved, and other states imitated the example of France. A change took place in the military system of Europe; the practice of calling out the feudal contingent ceased, and permanently paid troops, regularly disciplined and organised, were substituted for them. These troops were not always national. At first they were largely composed of the old bands of wandering mercenaries; but the proportion of foreigners decreased as the feudal spirit gave way to a more national one.

The development of the new system may be dated from the beginning of the 16th century. Armies, no longer undisciplined feudal levies, were permanently organised in companies and in regiments. The use of fire-arms became general, though it was long before the pike was entirely supplanted. The distinctive duties and value of cavalry and infantry were recognised, and regular tactics introduced for the different arms, the battalion (originally *battaglia*, battle array) becoming the recognised tactical unit for infantry, as distinguished from the administrative organisation by regiments and companies. "Articles of war" were issued to their several armies by Ferdinand of Spain, Francis I. of France, and Charles V., and a regular discipline thus established. From this time to the outbreak of the great French Revolution but little change took place in the manner of raising armies, though their tactical organisation varied according to the arms in use. Armies were raised mainly by voluntary enlistment, compulsory levies being only resorted to under pressure of war. Usually the king or his commander-in-chief contracted with a nobleman, of repute as a warrior, or of large possessions, to raise a regiment—the nobleman to receive a certain sum down and an annual allowance for its maintenance, and to have the command of it. He in his turn engaged "captains," some of whom brought companies with them, others raised companies under his authority, and others, again, merely commanded the men he himself had raised. Royal officers, "commissaries," were appointed to muster these regiments periodically, and see that the colonels fulfilled their share of the contract; and, on the other hand, to issue the pay and provide for the subsistence of the forces. The regiments were sometimes raised for a fixed time, and disbanded at the expiration of that time or at the close of the war; but as standing armies became general, they were maintained permanently, the command being transferred as occasion required; and, as the terms of the contract were always favourable to the colonel, the command of a regiment was a valuable piece of court patronage. The earliest form of organisation, both in the cavalry and infantry, was the company, originally representing the group of men who followed a knight to battle and fought under his banner, and later the bands of mercenaries who served under a "captain." These companies were afterwards grouped and organised in regiments, but for a long time each company continued to carry its own banner, indicating its real origin. Both companies and regiments varied in strength according

Progress in organisation.

to the habits of the country, and according to the wealth or personal influence of the leaders. In the days when men fought in compact masses, and one man's voice could thus control a large number, 500 and even 600 men was not an uncommon strength for a company; and in some nations the numbers never fell very low. In France, however, the policy initiated by Richelieu, and afterwards adhered to by Mazarin and Louis XIV., of breaking the power of the French nobility, and making them followers and dependants of the king, reacted on the organisation of the army; for it was found desirable to give employment to as many of the young noblemen as possible in the royal armies, and therefore to multiply the companies and commands, and the French companies sometimes fell as low as 30 men. As the undisciplined melée of feudal battles gave way to regular and scientific tactics, the necessity of bodies of constant and uniform strength was felt, and the battalion and squadron were introduced as the *fighting* formations of infantry and cavalry respectively. Originally battalions were dense masses numbering several thousand men, and composed of many regiments. As changes in arms led to the adoption of more extended formations, it became necessary to subdivide into smaller fractions, and battalions were gradually reduced in size till they became mere fractions of a regiment. Finally, when the advantages of uniform and permanent organisation were more fully understood, and large standing armies enabled such improvements to be introduced, regiments also were made of uniform strength, and the battalion became a fixed fraction, usually one-half or one-third of a regiment, but still retained its distinctive character as a tactical unit; while for administrative purposes, recruiting, clothing, payment, &c., the regiment was the unit. Similarly, the company remained the lesser administrative unit,—that is, the captain was answerable for the pay, equipment, and discipline of his company in camp and quarters; but on the parade-ground or battle-field the battalion was divided into a number of equal divisions not necessarily corresponding to the companies. In Frederick the Great's time a Prussian battalion consisted of five (afterwards four) companies, but on parade was divided into eight "zugs" (divisions); and the Prussian company column, now so famous, is merely a return to the old formations adopted when the company acted independently.

Tactical changes.

The tactical changes effected in European armies between the beginning of the 16th and end of the 18th centuries, consequent on alterations in arms, need only be very briefly noticed here. In the earlier wars of the 16th century the musketeers formed but a small proportion of the infantry, and the great bulk consisted of pikemen, whose power lay in weight and mass: deep formations were consequently the rule. The cavalry still fought principally with the lance. In the latter part of the century, during the great war of independence of the Netherlands, improvements in fire-arms led to the proportion of musketeers being increased, and the front of battle proportionately extended to give effect to their fire. Thus Maurice of Nassau usually formed his armies in battalions of 500 men, of 250 pikemen, and 250 musketeers each,—the pikemen ten deep in the centre, the musketeers on the flanks. The cavalry also adopted fire-arms, and were taught to trust more to fire than to the effect of the charge. During the Thirty Years' War (1618–1648) the proportion of musketeers was still further increased. The imperial armies under Tilly and Wallenstein still fought in heavy masses, but Gustavus Adolphus reduced his formations to six ranks. The bayonet, introduced about the middle of the 17th century, gradually superseded the pike, and led to a further reduction of the ranks to four. During the prolonged wars of Louis XIV.'s reign, and under the auspices of the great generals of that age,—Turenne, Condé, Eugene, and Marlborough,—considerable improvements were effected in the tactics and organisation of armies, and the permanent grouping of battalions and regiments into brigades and divisions was first introduced. Still further improvements were made during the Silesian and Seven Years' Wars (1740–63). Many changes ascribed to Frederick the Great are really due to Leopold of Dessau, who, under the first Frederick, formed the army which the second Frederick led to victory. He reduced the ranks of the infantry to three, trained them to manœuvre rapidly and with extraordinary precision, and was the author of the drill-book which has remained the basis of all European systems of drill. But the improvements in cavalry tactics were unquestionably due to Frederick himself, who taught them the true secret of their strength, shock and rapidity, and further developed their power by the introduction of horse artillery, able to move rapidly and accompany the cavalry anywhere.

At the close of Frederick's brilliant career every army in Europe had copied that of Prussia more or less closely. Infantry was organised in regiments of two or three battalions, each battalion 500 or 600 strong—this number being determined by the length of line which it was considered one man could effectively control. Cavalry was organised in regiments of four squadrons, each squadron from 100 to 150 strong. Artillery organisation was still in its infancy, a large part of the guns being attached to regiments, and the heavy guns often horsed and driven by contractors. But Gribeauval was laying the foundation in France of the battery organisation afterwards adopted by all nations. The Prussian army, proud of its brilliant series of successes, equally proud of its manœuvring power and drill, was looked up to by all Europe, and believed itself invincible, but in its pride forgot how much was due to the hand which had guided it. The French army had fallen very low in general estimation, and even the American war, and minor successful expeditions towards the end of the century, did little to raise it. The Austrian army was slow to adopt improvements, but had acquired a reputation for tenacity. England, recently driven out of her American colonies, was hardly acknowledged as a power on land.

French Revolution.

Such was the military condition of Europe when the French Revolution broke like a storm over the Continent, sweeping away old landmarks and old systems, covering the land for years with a flood, which, when it receded, left the whole face of the country changed. When, in 1792, the monarchs of Europe banded to crush the revolution, the military force of France was at a very low ebb. The old Royalist army was disorganised by revolutionary passions and frequent changes, and the constituent assembly had rejected the proposed "compulsory service" as at variance with the liberty of the citizen. But on the proclamation that "the country was in danger," volunteers flocked from all parts to join the armies, and a levy *en masse* was ordered to repel the invaders. Officials vied in proving their zeal by the numbers of recruits they forwarded to the frontiers, and patriotism and terrorism combined to fill the ranks. Within three years nearly 1,200,000 men were thus poured into the army, and sufficed to repel the invaders, and form the armies which, under Hoche, Moreau, and finally under Bonaparte, brought France forth victorious in 1797. But the long and bloody war had exhausted the supply, large as it was, and some new system of recruiting became necessary, for it was evident that voluntary enlistment would no longer suffice. In 1798, therefore, Jourdan brought forward and passed the law establishing *conscription*, the basis of all French military legislation since that date, and more or less of that of other countries also. Every citizen was declared liable to service for five years, and the whole male population, between the ages of twenty and twenty-five, was divided into classes and enrolled by name, to be called out as occasion required. It was the terrible power of the conscription that enabled Napoleon to carry on the gigantic wars which characterised his reign, and after losing in the snows of Russia the largest army ever put in the field, to reappear in a few months with another almost as large. Other nations of necessity followed the example of France, and the conscription became general. Prussia still further developed its power by reducing the period of service in the ranks, and passing her soldiers as soon as sufficiently trained into a reserve, thus gradually training the whole of her population. The "short service and reserve" system, the greatest revolution ever effected in this branch of military art, and characterised by a recent foreign writer on political economy as "the greatest, and in its ulterior consequences probably the most important, of the events of our century," owed its origin to the conditions imposed on Prussia by Napoleon at the treaty of Tilsit. Restricted to an army of 43,000 men, the Prussian statesmen evaded the spirit of the clause by sending the trained soldiers to their homes, to be recalled when needed, and replacing them with recruits. This system, by which every citizen becomes also a trained soldier, and there is no limit to the size of the armies save that of population, was at first only partially adopted by other countries. The prejudice in favour of professional armies — soldiers whose business it was to fight and do nothing else—was too strong, and doubts were felt whether these semi-citizen armies would stand the rough trials of war. But after Sadowa, other nations had no choice but to copy it or resign their military position. It is true the lesson was not learnt at once by all, but 1870 and 1871 enforced what 1866 had already taught; and within the last few years every great Continental power has reorganised its military institutions on the model of Prussia.

If we glance back at the history of military institutions in Europe since the fall of Rome, we find it divides itself into four well-defined periods. In the first or barbarous stage we have vast armies or hordes, formidable from their numbers and the courage of the warlike freemen composing them, but almost without tactics or organisation. In the second or feudal period we have armies nearly as numerous, but whose strength lay entirely in a small body of highly-equipped knights and men-at-arms,—the bulk of the army no longer freemen fighting for their country, but slaves fighting at their lord's command. Little progress has been made in tactics and organisation, and the fighting power of nations is exhausted in constant petty wars. In the third or "standing army" period we have small armies of highly-trained professional soldiers forming a class distinct from the rest of the population, tactics and organisation becoming a science and making vast progress. Lastly, under the conscription we have armies once more national, embracing the whole male population, more numerous than ever, but now trained and organised with all the science and skill of professional soldiers. Some remarks on the general principles involved in this branch of military art will serve as introduction to a more detailed account of existing armies.

The military institutions of a nation are governed by various considerations, the principal of which are geographical position, policy, national character, and wealth. A country like America, which is threatened by no powerful neighbours, can devote its whole energies to peaceful pursuits, and reduce its army to a mere police force. But a European state, surrounded by warlike and powerful nations, may depend for its very existence on its army, and must consequently keep pace with its neighbours, and develop its forces to the utmost that industrial and economical considerations admit of. Political economists class all military expenditure as non-productive. Perhaps it might more fairly be called indirectly productive, as necessary to the maintenance and extension of civilisation, and the protection and development of trade. Further, the value of property increases with increased security, and military expenditure within certain limits thus tends to repay itself. Broadly, however, it may be treated as a tax for insurance, and as so much withdrawn from the productive power of the nation. The object of all military institutions is to develop the highest amount of fighting power,—that is, attain the greatest security with least strain on the industry of the country,—the latter being measured not by the cost of the army as shown by the budget, but by the amount of productive labour withdrawn and disturbance produced. All questions, therefore, have to be considered under two aspects, military and economical—that of efficiency and that of cost.

Mode of raising armies.

The first question that presents itself is the manner of raising armies. There are two methods,—that of voluntary enlistment, and that of compulsory levies or conscription, the former once the universal system, but now retained by England alone; the latter adopted by all other European powers. By voluntary enlistment the burden of military duty is distributed evenly throughout the community, the soldier receiving fair wages for his service, while the citizen bears his share in the form of taxes. Personal liberty is not interfered with, the industry of the country generally is undisturbed, those members only are withdrawn who are likely to contribute least to its wealth, and the army becomes a useful school and refuge for the restless classes of the community. But the supply of recruits is fluctuating and uncertain, they are drawn almost entirely from the lowest class, every desired improvement is hampered by considerations of its effect on recruiting, and the army tends to become a class rather than a national one. Compulsory service gives unlimited command of men, introduces a higher class in the ranks, and raises the tone of the army generally; while military efficiency alone has to be considered in organisation. But it presses much more severely on the country. Military service becomes a tax inflicted by lot, falling with excessive weight on some, while others escape free. "Admit substitutes (or exemption by payment), and the hardship falls exclusively on the poor; insist on personal service, and the loss of time, which to the young man of fortune is nothing, and which to the lowest class of labourer is unimportant, because the pay while serving is as good as he would get elsewhere, becomes a very heavy tax on the skilled industry of the artisan or the professional man, or those who have business habits to acquire."[1] Hence in all countries where personal service is enforced, it is necessarily accompanied with provisions for softening its hardships and reducing its inequality. The time of service is reduced to a minimum, and a special short course is established for men of means and education above the average. Exemptions are permitted on personal or family grounds, and in Prussia these exemptions are carried so far that the ballot is practically done away with; and in some countries money payments are required from all who do not serve. The relative cost of the two systems depends upon the size of the army. So long as the numbers required are small and can be obtained at a fair

[1] Speech of Lord Derby, *Times*, 15th December 1870.

rate of wages, voluntary enlistment is the cheaper of the two; but when the numbers are large, and excessive wages are necessary to stimulate enlistment, compulsory service becomes economical. Such an army as England maintains is actually raised with less cost to the nation by the former system; but armies such as those of the Continental powers are only possible under the latter. So heavily, however, does the conscription press on the life of a nation, that it may safely be asserted that no nation ever did or will accept it, except of necessity.

Terms of service. The next great question is that of the terms of service. No nation can afford to keep constantly under arms the whole force which it may require to put forth in war. In olden times fresh armies were raised on the outbreak of each war. The great step in modern organisation was the maintenance of permanent *cadres* and the formation of trained reserves. Military forces are now divided into "standing armies," comprising those who are actually doing duty as soldiers, and forming in peace time the cadres and the school of instruction of the army; and "reserves," under which name are included all who pursue their industrial callings in peace, but are called to arms in war. Such reserves, however, may be of very different value, from the Prussian "reservist," a trained soldier in the prime of life, to the *garde mobile* or volunteer who has only attended a few drills; and their value is always closely connected with the system and terms of service. There are practically three systems. The first, or *long service* system is now almost obsolete,—it partly lives in England alone. Under this the soldier was engaged for life, or for a long term of years, remained with the colours so long as fit for service, and was then discharged, usually with a pension. It produced a highly-trained army, in which discipline, mutual reliance, *esprit de corps*, constancy under discouragement, and all soldierly qualities, were carried to their highest pitch. The soldier made the regiment his home, and knew no law but the word of his commander. But such an army was necessarily small, being maintained in peace as well as in war, and could form no reserve, as all remained with the colours till they were no longer fit for service. In war, therefore, it had to be increased, and its casualties replaced by untrained recruits; and its quality deteriorated when excellence was most required. Long service also tended to produce a class army, isolated from the life of the nation, and always a dangerous weapon in the hands of an unscrupulous ruler. Further, to condemn a man drawn by lot to lifelong service was felt to be incompatible with the maintenance of compulsory service; and when it was found by experience that soldiers could in three years be sufficiently trained for all purposes of war, and that by the application of short service armies could be trebled in numbers in war without increasing the cost in peace, the old long service armies disappeared from Europe.

The converse of this is the second, or *militia* system, actually in force in Switzerland and Canada, and to a certain extent in America. Under this no permanent army is maintained, but all, or a large proportion, of the inhabitants are liable to service, and undergo a partial training. The cost of such a force is very small, the industrial disturbance reduced to a minimum; yet the forces that are put in the field are formidable, in numbers at least. But its real economy is more than doubtful. History abounds with lessons that such forces can never carry on sustained operations against trained armies. They may show brilliant courage; but they want the mutual knowledge and reliance, the constancy in defeat, and the instinctive discipline which can be acquired by habit alone. The cost of putting them in the field is always disproportionately great. Opposed to trained armies, they invite defeat; opposed to similar forces, as in the great American war, decisive action on either side is impossible, and the war drags on till its cost far exceeds that of years of standing armies and peace preparations.

The third and intermediate system is that of *short service and reserves*, now adopted by all nations. The European details of its application vary, but the general principles are the same in all,—to maintain the cadres of a large army in peace, capable of expansion in war, and to keep the recruit in the ranks only so long as is necessary to make him a trained soldier, and then pass him into a reserve. It combines the numerical strength of the militia system with the organisation, training, and discipline of a long service army. Its practical application will be seen in describing the various armies of Europe.

The principles of *organisation* are comparatively simple. Organisation. Organisation is of two kinds, tactical and administrative; the first having reference to action on the battle-field, the second to general maintenance in peace as well as in war. Originally the two were often distinct; thus companies and regiments were originally administrative units, battalions tactical ones; and the two had not necessarily any connection. But the most perfect organisation is that which answers both purposes, and in this direction all modern improvements have tended; and as the battle-field is the ultimate object of all preparation, administrative considerations must give way to tactical ones when they clash, and all organisation must conform to the tactical requirements of the day. Great progress was made in this branch during the Revolutionary war. The origin of regiments and battalions has already been described. The first "mixed divisions," *i.e.*, divisions comprising troops of all arms, were formed in the Revolutionary armies of 1792, and in 1804 Napoleon organised "corps d'armée," each forming a complete army in itself, under the command of a marshal,—the necessity for such organisation arising from the size of his armies, which had grown beyond the immediate control of one man. This organisation was copied by other armies, and attained its highest perfection when combined by the Prussians with their territorial system—each corps d'armée being permanently located in and recruited from a particular province. A modern army usually comprises several such corps d'armée.

A Prussian *army corps*, which may be taken as the type of modern organisation, consists of a staff, two infantry divisions, a cavalry brigade, a regiment (seven batteries) of corps artillery, a regiment of engineers, and a number of administrative services. An *infantry division* consists of a staff, two infantry brigades, a rifle battalion, four batteries of artillery, and a regiment of cavalry. An *infantry brigade* consists of a staff and two regiments (six battalions); a *cavalry brigade* of a staff, three regiments (twelve squadrons), and a battery of horse artillery. The *engineers* comprise a pontoon train, a light field bridge train, a column of entrenching tools, siege materials, and a field telegraph; while nine reserve ammunition columns accompany the corps artillery. The administrative departments include the *commissariat*, charged with the supply of the troops, and having at its disposal five provision columns and a large amount of hired or requisitioned transport, and provided with a field bakery,—the *medical department*, consisting of a staff; three ambulance detachments, each having a staff of medical officers, 120 trained stretcher-bearers to attend to and carry off the wounded on the battle-field, a supply of medical stores, covers for wounded, and a number of ambulance waggons, fitted for the conveyance of wounded, and the medical staff attendants, tents, and all appliances for 12 field hospitals, each calculated to receive 200 wounded,—the *pay department*, charged with the military chest;—a *field post*, a depôt for sick and supernumerary horses, and other services. Such an army corps has a fighting strength of 25 battalions, or about 25,000 infantry, 5 regiments (about 3000) cavalry, and 96 guns, and a total strength of about 40,000 men, 12,000 horses, and 1400 waggons and wheeled vehicles.

The following table shows approximately the military resources of the great powers of Europe:—

Country.	Population.	Military Expenditure.	Army—Peace Footing.	Army—War Footing.			
				Active Army.	Depôt Troops.	Garrisons and Reserves.	Total.
Great Britain,	32,000,000	£23,000,000	190,000	225,000	95,000	350,000	670,000
France,	36,000,000	18,000,000	450,000	780,000	270,000	500,000	1,550,000
German Empire,	41,000,000	15,500,000	400,000	680,000	240,000	330,000	1,250,000
Russia,	82,000,000	21,500,000	750,000	850,000	150,000	300,000	1,300,000
Austria and Hungary,	36,000,000	10,500,000	275,000	600,000	150,000	220,000	950,000
Italy,	27,000,000	7,500,000	200,000	375,000	125,000	250,000	750,000

Note.—It is impossible to form anything but an approximate comparison, owing to the different conditions of service and varying organisation of the several armies. Under "depôt troops" are included all forces whose province it is to feed the active army. Under "garrisons and reserves" are included all forces organised for home defence, and not forming part of the field armies; but in several cases a large proportion of these are available as reinforcements to the active army if required. Only those forces that have received some training and have a permanent organisation are counted; thus the English volunteers are included, but not the German landsturm, or French reserves of the territorial army. The British troops serving in India have been included in the military forces of Great Britain, and the expenses borne on their account by the Indian revenue in the military expenditure; but not the native forces in India.

HISTORICAL SKETCH OF THE BRITISH ARMY.

The history of the military institutions of England may be divided into three principal periods, each marked by a system peculiar to itself: the Anglo-Saxon, or militia period, preceding the Norman Conquest; the feudal period, extending from that to the great Rebellion; and the period of standing armies, lasting from the Restoration to the present day.

Anglo-Saxon period.

Prior to the Norman Conquest the armed force of England was essentially a national militia. Every freeman was bound to bear arms for the defence of the country, or for the maintenance of peace. Military service was not a debt due to the king or earl, the obligation of a dependent to his lord, but the service owed by a free citizen to his country. To give some organisation and training to this levy, the sheriffs had authority to call out the contingents of their several shires for exercise. The thanes appeared on horseback, and the bulk of the people, armed with swords, spears, and heavy shields, or with bows and spears, formed the infantry. This force, termed the "Fyrd," was available for home service only, and could not be moved even from its county except in the case of invasion or great emergency; and it was principally to repel the invasions of Danes and others that its services were required. Yet even in those days the necessity of some more permanent force was felt, and bodies of paid troops were maintained by the king and some of the great earls at their own cost. Thus Canute kept up a household force (*huscarle*) of 6000 men, and paid troops also formed part of Harold's army at the battle of Hastings.

Norman Conquest and feudal system.

Although William professed to reign by right of inheritance, not of conquest, and to maintain the existing laws of the country, its military institutions underwent a rapid and complete change under him. The great slaughter of the Anglo-Saxon nobility at Hastings, and the frequent and unsuccessful revolts of the survivors, and consequent forfeiture of their estates, enabled William to make large grants to his followers; and with these he introduced the feudal system of military tenure. Henceforth military service was a debt due by the dependent or vassal to the lord of whom he held his land, not the free service rendered by a citizen to his country. And William took advantage of his exceptional position as a conqueror, and as the original granter of nearly half the lands of England, to carry the feudal system to a perfection which it had never attained on the Continent. Assuming that "the king is the universal lord and original proprietor of all the lands of the kingdom," he proceeded to divide the country into more than 60,000 military allotments or fees, to be held under tenure of "knight's service." By the conditions of knight's service the tenant of a fee was bound to attend his lord in war, with horse and arms, at his own cost, for forty days in each year,—the tenant of half a fee doing like service for twenty days. Where one man held many fees—and some of the great barons held several hundreds—he became responsible to the king as tenant-in-chief for military service in proportion to his grant, and required the same from his tenants.

This important change in the tenure of land and military system of the country was not effected easily or at once. To the original Saxon proprietors, who still held much of the land, the feudal system was a strange and intolerable burden. But the ever-growing preponderance of the Norman element, the dissensions among the Saxons themselves, which William skilfully made use of, the constant wars and revolts, and consequent necessity for improved military organisation, gradually overcame their resistance, and shortly before the Conqueror's death the new system was finally accepted throughout the country. Thus the king could command the services of 60,000 knights[1] and men-at-arms for forty days free of cost; and these feudal troops, unlike the Saxon levies, were bound to follow him anywhere. Such at least was the theory; but in practice modifications were soon introduced. Forty days might suffice to repel an invasion or crush a revolt, but not to prosecute a foreign war; moreover, many of the tenants' fees were subdivided, and the holders only liable to twenty or ten days' service. On the other hand, many holders of fees could not render personal service, or preferred submitting to a money penalty instead. Thus by mutual consent grew up a system of fines or "escuage," and with the money levied from those who failed to do service the king was able to hire mercenaries, or pay such of the feudal troops as were willing to prolong their service. From time to time proclamations and statutes were issued reminding the holders of knights' fees of their duties; but the immediate object was generally to raise money rather than to enforce personal service, which became more and

[1] The "knight of honour," the true knight, must not be confounded with the tenant of a knight-fee. Practically the latter were usually the "men-at-arms," only men of good family being admitted to the honour of knighthood.

more rare. Thus gradually departed the spirit of the feudal system, the principle that those who held the land should fight for it; armies lost their national character, the power of the king was increased, and the first steps laid towards the establishment of standing armies as instruments in his hand. The feudal system had not, however, abrogated the old Saxon levies, and while in the former we trace the source of our stipendiary forces, from the latter arose two national institutions,—the *posse comitatus*, liable to be called out by the sheriff to maintain the king's peace, and later the *militia* force. The *posse comitatus*, or power of the county, included all males capable of bearing arms, peers and spiritual men alone excepted; and though its primary object was to maintain peace and pursue felons under the command of the sheriff, it was also bound to attend upon summons for the military defence of the country. This levy was organised as an armed force by an Act of 27 Henry II. (1181 A.D.), and subsequently by the 13 Edward I. (1285 A.D.), commonly known as the "Statute of Winchester," which determined the numbers and description of weapons to be kept by each man according to his property, and also provided for their periodical inspection. This force was only liable to home service, but even in early days seems to have been used, as now, as a feeder to the army.

Under the Plantagenets. The armies with which our kings carried on their foreign wars consisted mainly of paid troops. Many, in the days of the earlier kings especially, were foreign mercenaries, and these were sometimes imported to England to the great discontent of the country. But the Edwards found that there was better material to be had in this country than abroad; and the army which Edward III. took to France, and with which he won the battle of Crecy, was composed exclusively of English, Welsh, and Irish. A muster-roll, still preserved, of the army with which he besieged Calais is interesting as giving the numbers and rates of pay of the different ranks. The prince received £1 a day, and the bishop of Durham, 6s. 8d. Then follow:—

13	Earls,	at 6s. 8d.	per diem.
44	Barons and bannerets,	at 4s.	,,
1,046	Knights,	at 2s.	,,
4,022	Esquires, captains, and leaders,	at 1s.	,,
5,104	Vintenars and mounted archers,	at 6d.	,,
15,480	Foot archers,	at 3d.	,,
314	Mechanics, gunners, &c., from 12d.	to 3d.	,,
4,474	Welsh foot,	at 2d.	,,

These armies were raised partly from those bound to serve by tenure, partly by forced levies, which, though illegal and often strenuously resisted by Parliament, were not unfrequent; but mainly by contracts entered into "with some knight or gentleman expert in war, and of great revenue and livelihood in the country, to serve the king in war with a number of men." Copies of the indentures executed when Henry V. raised his army for the invasion of France in 1415 are in existence. Under these the contracting party agreed to serve the king abroad for one year, with a given number of men equipped according to agreement, and at a stipulated rate of pay, the items of which are set forth, and agree generally with those given above. A certain sum was usually paid in advance, and in many cases the Crown jewels and plate were given in pledge for the rest. The profession of arms seems to have been a profitable one, and there was no difficulty in raising men where the commander had a good military reputation; Edward III. is said to have declined the services of numbers of foreign mercenaries, who wished to enrol under him in his wars against France. The pay of the soldier was high as compared with that of the ordinary labourer, and he had the prospect of a share of plunder in addition.

The funds for the payment of these armies were provided partly from the royal revenues, partly from the fines paid in lieu of military service, and other fines arbitrarily imposed, and partly by grants from Parliament. As the soldier's contract usually ended with the war, and the king had seldom funds to renew it even if he so wished, the armies disbanded of themselves at the close of each war. To secure the services of the soldier during his contract, Acts were passed (18 Henry VI. c. 19; and 7 Henry VII. c. 1) inflicting penalties for desertion; and in Edward VI.'s reign an Act "touching the true service of captains and soldiers" was passed, somewhat of the nature of a Mutiny Act.

Under Charles I. and the Commonwealth. The six centuries which elapsed between the Norman Conquest and the Rebellion may be treated as one period in the history of the military institutions of England. Though considerable changes had taken place, though the feudal armies in which the great nobles rode at the head of their retainers, and whose main fighting strength lay in the number of knights and men-at-arms, had given place to armies raised by contract, commanded by officers having no personal connection with the men, and in which the common infantry formed the real fighting strength, still these changes had taken place gradually, and fundamentally the principles remained the same. The army seldom came in collision with the nation. Latterly indeed, in Queen Elizabeth's time, the demands of the Irish wars had led to frequent forced levies, and the occasional billeting of the troops in England also gave rise to murmurs, but the brilliancy and energy of her reign covered a great deal, and the peaceful policy of her successor removed all immediate cause of complaint. But with the accession of Charles I. a new period commences, and we find the army a constant and principal source of dispute between the king and Parliament, until under William III. a standing army is finally established on its present constitutional footing. Charles wished to support his brother-in-law, the Elector Palatine, in his struggle for the crown of Germany, and for that purpose raised an army of 10,000 men. He was already encumbered with debts, and the Parliament refused all grants, on which he had recourse to forced loans to supply the funds. The army was sent to Spain, but returned without effecting anything, and was not disbanded, as usual, but billeted on the inhabitants. The billeting was in itself illegal, and was the more deeply resented as it appeared that the troops were purposely billeted on those who had resisted the king's loan. Finally, the disorders committed by these troops caused the king to issue a commission to certain persons, officers and others, to proceed against offenders "according to the justice of martial law,"—thus establishing martial law in England in time of peace. These three breaches of the law—forced loans, billeting, and martial law—all directly connected with the maintenance of the army, formed the main substance of the grievances set forth in the celebrated "Petition of Right." In accepting this petition, Charles gave up the right to maintain an army without consent of Parliament; and when in 1639 he wished to raise one to act against the rebellious Scotch, Parliament was called together, and its sanction obtained, on the plea that the army was necessary for the defence of England. This army again became the source of dispute between the king and Parliament, and later some of the hottest contests arose on the question of the command of the armed forces: finally both sides appealed to arms, and the parliamentary army, after having overthrown the monarchy, upset the Parliament also, and remained undisputed master. Under Cromwell, the force which had raised him to power was naturally augmented and encouraged. For the first time a real standing army, amounting at one time to 80,000 men, was maintained. This army of the Commonwealth differed in character from those which preceded or followed it, the men as a rule being taken from a better class, the officers from a lower one. The common levies of the first parliamentary armies were no match for the gentlemen who gathered round the royal standard, till Cromwell leavened them with a different stamp of men, mainly drawn from the yeomen and middle class, — earnest resolute men, whose stern fanaticism was able to turn the scale against the headstrong valour of the Royalists. This class served largely in Cromwell's army, and gave a tone to the whole, while the pay was sufficiently high to make it a desirable profession for others besides the poorest. But with the officers it was otherwise. The noble and gentle families who commanded the king's armies remained faithful to his cause, and Cromwell had to draw his officers from a class little above the men. Few will be found now to dispute Cromwell's capacity as a general and ruler, nor the high qualities of the army by which he maintained his power at home, and spread England's prestige abroad. But such an army could not be maintained without great cost and hardship to the people at large, and before Cromwell's death it had produced deeper discontent than even Charles's exactions.

On the Restoration this army was disbanded. The king feared and distrusted it, for it was formed of his enemies, and officered by men who had approved his father's execution, and it had made itself hateful to the nation. The permanent forces of the Crown were reduced to the "garrisons and guards" maintained by the king from the revenue allotted to him for carrying on the government of the country. The "garrisons" were commissioned to special fortresses,—the Tower of London, Portsmouth, &c. The "guards" comprised the sovereign's body guards (the "yeomen of the guard" and "gentlemen-at-arms," who had existed since the times of Henry VII. and VIII.); Monk's regiment of foot (now the Coldstream Guards), alone retained of the disbanded army; and two regiments of life guards and one of foot guards, raised principally from the cavaliers who had followed the king's fortunes. Even this small force, at first not exceeding 3000 men, was looked on with jealousy by Parliament, and every attempt to increase it was opposed. The acquisition of Tangiers and Bombay, as part of the dower of the Infanta of Portugal, led to the formation of a troop of horse (now the 1st Royal Dragoons) and a regiment of infantry (now the 2d or Queen's regiment), for the protection of the former; and a regiment of infantry (afterwards transferred to the East India Company, and now the 103d, or Bombay Fusiliers), to hold the latter. These troops, not being stationed in the kingdom, created no distrust; but when in 1670, on occasion of the Dutch war, 12,000 men were raised for the protection of the coasts, Parliament immediately petitioned that they should be disbanded as soon as peace was made. On several occasions during Charles's reign considerable armies were raised, but were mostly disbanded again when the occasion ceased. Several regiments, however, were added to the permanent force, including Dumbarton's regiment (the 1st or Royal Scots)[1] and the 3d Buffs; and on Charles's death in 1685 the total force of "guards and garrisons" had risen to 16,500, of whom about one-half formed what we should now call the standing army.

James II. was more obstinate than his predecessor in his efforts to increase the army, and Monmouth's rebellion afforded him the pretext. A force of about 20,000 men was maintained in England, and a large camp formed at Hounslow. Eight cavalry and twelve infantry regiments were raised, and given the numbers which, with few exceptions, they still bear. James even proposed to Parliament to disband the militia and further augment the standing army; and although the proposal was instantly rejected by the Commons, he continued to add to the army, and to billet them on the country, in defiance of the remonstrances of Parliament, till the Revolution deprived him of his throne and put an end to the contest. The army which he had raised was to a great extent disbanded, the Irish soldiers especially, whom he had introduced in large numbers on account of their religion, being all sent home.

The condition of the army immediately engaged the attention of Parliament. The Bill of Rights had definitely established that "the raising or keeping of a standing army within the kingdom, unless it be by the consent of Parliament, is against the law," and past experience made them very jealous of such a force. But James was making efforts to recover his throne, and seeking aid from France; Ireland and Scotland were disaffected, civil war was imminent, foreign war certain; and William had only a few Dutch troops, and the remains of James's army, with which to meet the storm. Parliament therefore sanctioned a standing army, trusting to the checks established on the power of the Crown by the Bill of Rights and Act of Settlement, and by placing the pay of the army under the control of the Commons. An event soon showed the altered position of the army. A regiment which was favourably inclined to James, and had therefore been ordered abroad, mutinied, and marched north, declaring for James. It was surrounded and compelled to lay down its arms; but William found himself without legal power to deal with the mutineers. He therefore applied to Parliament, and in 1689 was passed the first *Mutiny Act*, which, after repeating the provisions regarding the army inserted in the Bill of Rights, and declaring the illegality of martial law, gave power to the Crown to deal with the offences of mutiny and desertion by courts-martial. From this epoch dates the history of the standing army as a constitutional force.

Under William the army was considerably augmented. The old regiments of James's army were reorganised, retaining, however, their original numbers, and three of cavalry and eleven of infantry (numbered to the 28th) were added. In 1690 Parliament sanctioned a force of 62,000 men, further increased to 65,000 in 1691; but on peace being made in 1697 the Commons immediately passed resolutions to the effect that the land forces be reduced to 7000 men in England and 12,000 in Ireland. The war that quickly succeeded obliged Great Britain again to raise a large army, at one time exceeding 200,000 men; but of these the greater number were foreign troops engaged for the Continental war. On the peace of Utrecht the force was again reduced to 8000 men in Great Britain and 11,000 in the plantations (*i.e.*, colonies) and abroad. From that time to the present the strength of the army has been determined by the annual votes of Parliament, and though frequently the subject of warm debates in both houses, it has ceased to be a matter of dispute between the Crown and Parliament. The following table shows the fluctuations between that time and the present—the peace years showing the average peace strength, the war years the maximum to which the forces were raised:—

Peace.		War.	
Year.	Number.	Year.	Number.
1750	18,857	1745	74,187
1793	17,013	1761	67,776
1822	71,790	1777	90,734
1845	100,011	1812	245,996
1857	156,995	1856	275,079
1866	203,404	1858	222,874

Note.—Prior to 1856 the British forces serving in India are not included.

[1] This regiment has the oldest history of any in the world. Originally the "Scottish Guard" of the kings of France, it was formed in the 9th century, and constantly recruited from Scotland. In 1625 it was sent to England to attend the coronation of Charles I., and revisited it later to fight against the parliamentary army. On the Restoration it came permanently to England, and was named the 1st Royal Regiment.

During William's reign the small English army bore an honourable part in the wars against Louis XIV., and especially distinguished itself by its intrepidity at Steinkirk, at Neerwinden, and in the assault of Namur. Twenty English regiments took part in the campaign of 1694. In the great wars of Queen Anne's reign the British army under Marlborough acquired a European reputation. The cavalry, which had called forth the admiration of Prince Eugene when passed in review before him after its long march across Germany (1704), especially distinguished itself in the battle of Blenheim; and Ramilies, Oudenarde, and Malplaquet were added to the list of English victories. The army was permanently increased by one regiment of cavalry and eleven of infantry; and though the regiments were much reduced in strength during the following peace, the cadres remained untouched. During the reign of the first and second Georges an artillery corps was organised, and the army further increased by five regiments of cavalry and thirty-five of infantry. Fresh laurels were won at Dettingen (1743), in which battle twenty English regiments took part; and though Fontenoy was a day of disaster for the English arms, it did not lower their reputation, but rather added to it. Six regiments of cavalry and six of infantry shared under Prince Ferdinand the honours of the victory of Minden (1759), and the English infantry was especially thanked by the prince for its conduct on that occasion. About this time the first English regiments were sent to India, and the 39th shared in Clive's victory at Plassey. During the first half of George III.'s reign the army was principally occupied in America; and though the conquest of Canada may be counted with pride among its exploits, this page in its history is certainly the darkest. English armies capitulated at Saratoga (1777) and at Yorktown (1781), and the war ended in 1783 by the evacuation of the revolted states of America and the acknowledgment of their independence. Before passing to the great French Revolutionary wars, from which a fresh period in the history of the army may be dated, it will be well to review the general condition of the army in the century preceding.

Regiments were raised almost as in the days of the Edwards. The Crown contracted with a distinguished soldier, or gentleman of high position, who undertook to raise the men, receiving a certain sum as bounty-money for each recruit. In some cases, in lieu of money, the contractor received the nomination of all or some of the officers, and recouped himself by selling the commissions. This system—termed raising men for rank—was retained till very recently, and originally helped to create the "purchase system" of promotion. For the maintenance of the regiment the colonel received an annual sum sufficient to cover the pay of the men, and the expenses of clothing and of recruiting. The colonel was given a "beating order," without which no enlistment was legal; and was responsible for maintaining his regiment at full strength. "Muster masters" were appointed to muster the regiments, and to see that the men for whom pay was drawn were really effective. Sometimes, when casualties were numerous, the allowance was insufficient to meet the cost of recruiting, and special grants were made. In war time the ranks were also filled by released debtors, pardoned criminals, and impressed paupers and vagrants. Where the men were raised by voluntary enlistment, the period of service was a matter of contract between the colonel and the soldier, and the engagement was usually for life, but exceptional levies were enlisted for the duration of the war, or for periods of three or five years. The army was officered entirely from the upper ranks, the low rate of pay and the purchase system combining to exclude all but men of independent incomes. Appointments (except when in the gift of the colonel) were made by the King at home, and by the Commander-in-Chief abroad; even in Ireland the power of appointment rested with the local commander of the forces until the Union. The soldier was clothed by his colonel, the charge being defrayed from the "stock fund." The army lived in barracks, camps, or billets. The barrack accommodation in Great Britain at the beginning of the century only sufficed for 5000 men; and though it had gradually risen to 20,000 in 1792, a large part of the army was constantly in camps or billets—the latter causing endless complaints and difficulties. The drill of the army was mainly borrowed from that of Frederick, but the American war had trained many regiments to skirmishing. The administration was generally corrupt and defective, and the character of the army stood very low when England embarked on her long war with France.

Her first efforts in this war did not tend to raise it. After a campaign, fought with great gallantry but not much skill, the English army under the Duke of York was driven out of Holland, and that country annexed to France. But the appointment of the Duke of York to the post of Commander-in-Chief of the army was the commencement of a better era. He did much to improve its organisation, discipline, and training, and was ably seconded by commanders of distinguished ability. Under Abercromby in Egypt, under Stewart at Maida, and under Wellesley and Lake in India, the British armies again attached victory to their standards, and made themselves feared and respected. The energy and unbending resolution of Pitt seemed to communicate itself to the nation, and the threatened invasion of England excited her martial spirit to the highest pitch. Finally, her military glory was raised by the series of successful campaigns in the Peninsula, until it culminated in the great victory of Waterloo; and the army emerged from the war with the most solidly founded reputation of any in Europe.[1]

The events of this period belong to the history of England, and fall outside the province of an article dealing only with the army. The great augmentations required during the war were effected partly by raising additional regiments, but principally by increasing the number of battalions, some regiments being given as many as four. On the conclusion of peace these battalions were reduced, but the regiments were retained, and the army was permanently increased from about 20,000, the usual peace establishment before the war, to an average of 80,000. The Duke of York, on first appointment to the command, had introduced a uniform drill throughout the army, which was further modified according to Dundas's system in 1800; and, under the direction of Sir John Moore and others, a high perfection of drill was attained. At the beginning of the war, the infantry, like that of the Continental powers, was formed in three ranks; but a two-rank formation had been introduced in America and in India, and gradually became general, and in 1809 was finally approved.

Recent changes

In the Peninsula the army was permanently organised in divisions, usually consisting of two brigades of three or four battalions each, and one or two batteries of artillery. The Duke of Wellington had also brought the commissariat and the army transport to a high pitch of perfection, but in the long peace which followed these establishments were reduced or broken up. The period which elapsed between Waterloo and the Crimean war is marked by a number of Indian and colonial wars, but by no organic changes in the army, with perhaps the single exception of the Enlistment Act of 1847, by which short service,—*i.e.*, an original

[1] "Possédant les souvenirs de gloire et de succès les plus solides, sans contredit, parmi toutes les armées européennes."—(*L'Armée Anglaise*, by the Baron de Grancey, Paris, 1873.)

enlistment for 10 or 12 years, with power to re-engage to complete 21,—was substituted for the life enlistments hitherto in force. The army went to sleep on the laurels and recollections of the Peninsula. The Duke of Wellington, for many years Commander-in-Chief, was too anxious to hide it away in the colonies, and to save it from further reductions or utter extinction, to attempt any great administrative reforms. The force which was sent to Turkey in 1854 was an agglomeration of battalions, individually perhaps the finest the world had ever seen, but unused to work together, without trained staff, administrative departments, or army organisation of any kind. They fought with distinguished gallantry at the Alma and at Inkerman, but succumbed under the hardships, the privations, and the sickness of the winter before Sebastopol—a sacrifice to maladministration. The lesson was dearly bought, but was not thrown away. From that time successive War Ministers and Commanders-in-Chief have laboured perseveringly at the difficult task of army organisation and administration. Foremost in the work was Lord Herbert, the soldiers' friend, who fell a sacrifice to his labours, but not before he had done much for the army. The whole system of administration was revised. In 1854 it was inconceivably complicated and cumbersome. The "Secretary of State for War and Colonies," sitting at the Colonial Office, had a general but vague control, practically limited to times of war. The "Secretary at War" was the parliamentary representative of the army, and exercised a certain financial control, not extending, however, to the ordnance corps. The Commander-in-Chief was responsible to the sovereign alone in all matters connected with the discipline, command, or patronage of the army, but to the Secretary at War in financial matters. The Master-General and Board of Ordnance were responsible for the supply of material on requisition, but were otherwise independent, and had the artillery and engineers under them. The Commissariat Department had its headquarters at the Treasury; and the militia until 1852 were under the Home Secretary. A number of minor subdepartments, more or less independent, also existed, causing endless confusion, correspondence, and frequent collision. In 1854 the business of the colonies was separated from that of war, and the then Secretary of State, the Duke of Newcastle, assumed control over all the other administrative officers. In the following year the Secretary of State was appointed Secretary at War also, and the duties of the two offices amalgamated. The same year the Commissariat Office was transferred to the War Department, and the Board of Ordnance abolished, its functions being divided between the Commander-in-Chief and the Secretary of State. The minor departments were gradually absorbed, and the whole administration divided under *two* great chiefs, sitting at the War Office and Horse Guards respectively. Finally, in 1870 these two were welded into one, and the War Office as now existing was constituted.

Corresponding improvements were effected in every branch. The system of clothing the soldiers was altered, the contracts being taken from the colonels of regiments, who received a money allowance instead, and the clothing supplied from Government manufactories. The pay, food, and general condition of the soldier were improved; reading and recreation rooms, libraries, gymnasiums, and facilities for games of all kinds being provided. Special attention was directed to sanitary matters; large barracks were built on improved principles, more space allotted to the men; ventilation and drainage improved, and the rate of mortality greatly reduced. A large permanent camp was formed at Aldershott, where considerable forces were collected and manœuvred together. Various educational establishments were opened, a staff college established for the instruction of officers wishing to qualify for the staff, and regimental schools improved.

The Indian mutiny of 1857, followed by the transference of the government of India from the hands of the East India Company to those of the Queen's ministers, led to important changes. The East India Company's white troops were amalgamated with the Queen's army, and reorganised—a difficult task, and one which cannot yet be said to be completed.

Among recent alterations may be mentioned the localisation of the army, commenced in 1872, but which cannot produce its full effects for many years to come; the transference of certain powers over the militia from the lords-lieutenant to the Crown, in 1871, and the placing the militia and volunteer forces directly under the generals commanding districts; the abolition of purchase, in 1871; the introduction of short service (6 years in the ranks) by the Army Enlistment Act of 1870; the institution of annual autumnal manœuvres, at which considerable forces are collected and manœuvred against one another over extensive tracts of country; the formation of the Control Department, &c.; but these will be dealt with at length in the following pages.

British Army as it is.

Administration of the army

The supreme command of all the military forces of the nation is vested in the Crown, but can only be exercised through an intermediate and responsible agent. The entire administration, therefore, of the regular army and reserve or auxiliary forces is under the control and responsibility of the *Secretary of State for War*, who is assisted by two under-secretaries, the *Parliamentary* and *Permanent* Under-Secretaries of State. The actual army administration is divided among three great officers,—the Officer Commanding in Chief, the Surveyor-General of Ordnance, and the Financial Secretary. These officers are at the head respectively of the three great departments of the War Office, viz., the Military Department, the Control Department, and the Financial Department; their duties are defined by orders of Council of the 4th and 23d June 1870. The *Officer Commanding in Chief* is charged with "the discipline and distribution of the army, and of the reserve forces of the United Kingdom when embodied or called out for actual military service; the military education and training of the officers, non-commissioned officers, and men of the army, and of the reserve forces when assembled for training, exercise, inspection, or voluntary military duty; enlisting men for and discharging men from the army and army reserves; the collection and record of strategical information, including topography, in relation to the military circumstances of this and other countries; the selection of fit and proper persons to be recommended to Her Majesty for appointment to commissions in the army, for promotion for staff and other military appointments, and for military honours and rewards." The *Surveyor-General of the Ordnance* is charged with "providing, holding, and issuing to all branches of the army and reserve forces, food, forage, fuel, light, clothing, arms, accoutrements, munitions of war, and all other stores necessary for the efficient performance of their duties by such forces, of proper quality and pattern, and in proper quantities, according to the regulations governing the provision, custody, and issue of such supplies; exercising a strict control over the expenditure of such supplies, and seeing that they are properly accounted for by the several officers and others who may be charged with their custody, issue, and use; the custody of all buildings in which troops are quartered, and allotting quarters; providing transport for troops, and directing land and inland water transport, preparing the estimates for the above services, and causing the expenditure for them to be duly and carefully examined." The *Financial Secretary* is charged with "preparing the annual estimate for the pay of the army and reserve forces; collecting and incorporating into a general estimate for army services the estimates of the other departments of the War Office, and financially reviewing the expenditure proposed in such estimates; submitting for the instructions of the Secretary of State for War any proposed redistribution of the sums allotted to the different subdivisions of the votes for army services; finally, allowing all cash expenditure, and recording the same under its proper head of service in the annual account for Parliament; issuing all warrants for the payment of moneys, making all imprests to accountants and others, and seeing that accounts are duly rendered for the same; advising the Secretary of State on all questions of pay, retired pay, and pensions for the army and reserve forces." Any or all of the above-mentioned great officers may be in Parliament; and the Surveyor-General of Ordnance and Financial Secretary have usually seats in the Lower House.

Military Department.

The Officer Commanding in Chief is nominated by a letter of service, and holds his appointment during Her Majesty's pleasure, differing in this respect from the Surveyor-General and Financial Secretary, who are appointed by the Secretary of State, and removable at his pleasure. The appointment is therefore not a political one, and has been held by H.R.H. the Duke of Cambridge since 1856. He is assisted in his duties, and his orders are conveyed and executed through the agency of the *General Staff* of the army, comprising the Headquarter Staff of the Military Department at the War Office, and the general officers holding commands at home or abroad, with their subordinate staffs. The Headquarter Staff is subdivided into the *Adjutant-General's* Department, under the Adjutant-General to the Forces, a general officer of high standing, who is named directly by the sovereign, and is the chief staff officer of the Commander-in-Chief, and the channel through which all communications connected with the personnel, military operations, duties, discipline, and general efficiency of the army pass; the *Quartermaster-General's* Department,[1] under the Quartermaster-General to the Forces,—a general officer of subordinate rank to the Adjutant-General, but also appointed by the sovereign—whose duties embrace the movement and quartering of troops, roster of regiments for foreign service, and military questions connected with barracks; the *Military Secretary's* Department, under the military secretary to the Commander-in-Chief, who is the channel of correspondence on all matters connected with the appointment, promotion, exchange, and retirement of officers, and honours and rewards; the *Intelligence Department*, including the Topographical Department, under a Deputy-Adjutant-General, charged with the collection and registering of all strategical, statistical, and topographical information, whether relating to the British Empire or to foreign countries and armies; the *Recruiting Department*, under an Inspector-General of Recruiting, charged with the supervision of the recruiting throughout the kingdom; the *Auxiliary Forces Department*, under an Inspector-General of Reserve and Auxiliary Forces, embracing all questions connected with the militia, yeomanry, volunteers, and army reserves; and the *Military Education Department*, under the Director-General of Military Education, charged with the instruction and examination of officers, and matters connected with military colleges and regimental or garrison schools and libraries. The artillery and engineers have a distinct headquarter staff, subordinate, however, to the Adjutant-General.

Ordnance or Control Department.

The Surveyor-General of the Ordnance is appointed by the Secretary for War, and removable at his pleasure; the appointment is therefore a political one, and usually connected with a seat in Parliament. His subordinates and assistants in the performance of his duties are the staff of the Ordnance Department at the War Office, and the officers of the Control Department at the various military stations at home and abroad. The Ordnance Department is divided into the *Supply and Transport* Division, under a Director of Supplies and Transport, whose duties embrace questions connected with transport, food, forage, fuel and light, barracks, billets, and lodging; the *Artillery and Stores* Division, under a Director of Artillery and Stores, whose duties embrace all questions connected with the manufacture, maintenance, and supply of warlike stores of all kinds, and store and clothing accounts; the *Contracts* Division, under a Director of Contracts, who makes all necessary contracts at home, and examines those entered into abroad; and the *Clothing* Division, under the Director of Clothing, who has charge of the manufacture and supply of clothing for the army.

Finance Department.

The Financial Secretary is appointed by the Secretary for War, and removable at his pleasure; the appointment, like that of the Surveyor-General, is therefore a political one, and usually connected with a seat in Parliament. He is assisted by an Accountant-General and large staff of clerks in his department of the War Office, but has no staff or subordinates outside its walls.

Estimates.

The number of men to be maintained and the amount of money to be expended are determined by an annual vote of Parliament, based on the *estimates* laid before the House by the Minister of War. The minister, with the advice of the Officer Commanding in Chief, decides on the number of men that Parliament shall be asked to provide for the ensuing year, and the estimates are framed accordingly. To obtain the greatest possible accuracy, every subordinate department at home and abroad is called upon for a detailed statement of probable expenditure. These are examined and amended by the heads of the several departments and divisions at the War Office, and passed on to the Finance Department, where they are collected and incorporated into a general estimate, which is submitted to the Secretary of State, with the remarks of the Financial Secretary; and being revised and finally approved of, is submitted to the Treasury and included in the annual budget of the Chancellor of the Exchequer. The Treasury may, however, reduce any item that appears excessive. When the amount has been voted by Parliament, the Treasury authorises the Paymaster-General to honour the orders of the War Office to the extent of the vote. At home the necessary funds are obtained by warrants issued by the Accountant-General, under authority of the Financial Secretary, and paid by the Paymaster-General by means of orders upon the Bank of England; abroad they are obtained partly by remittances of specie, but principally by the negotiation of bills of exchange drawn upon the Lords of the Treasury by the local Control officers, acting in this respect on behalf of the Treasury. The army estimates, as laid before Parliament, are divided under a certain number of votes, and these again into sub-heads and items; and no money granted under one vote can be applied to a service included under another vote without the sanction of the Treasury. Within the limits of the vote, however, the War Office has the power of redistributing the sums allotted.

The following abstract of the army estimates for 1873–4 (which does not include, however, the cost of that part of the army which is serving in India), will indicate the classification under heads and votes, and the amounts allotted; and although these vary slightly from year to year, the general distribution of expenditure remains tolerably uniform:—

[1] The Adjutant- and Quartermaster-General's Departments have been recently amalgamated, but the subdivision of duties still remains.

1. *Regular Forces.*

Votes		
1.	Staff and Regimental Pay and Allowances	£5,072,500
2, 3, 4.	Divine Service, Law, and Medical Service	321,200
		£5,393,700

2. *Auxiliary and Reserve Forces.*

5, 6.	Militia and Yeomanry	£894,300
7, 8.	Volunteers—Army Reserve	553,500
		£1,447,800

3. *Control Establishments and Services.*

9.	Control Establishments, Wages, &c.	£389,000
10.	Provisions, Forage, Fuel. Transport, &c.	1,980,700
11.	Clothing Establishments and Services	743,100
12.	Supply and Manufacture of Warlike Stores,	1,070,000
		£4,182,800

4. *Works and Buildings.*

13.	Works, Buildings, and Repairs	£778,000

5. *Various Services.*

14, 15, 16.	Administration, Education, and Miscellaneous.	£363,700

6. *Non-effective Services.*

17, 18.	Pay of General Officers, and Rewards	£115,400
19.	Retired Officers—Full and Half Pay	527,900
20.	Widows' Pensions, &c.	147,300
21, 22, 23.	In and Out Pensions, and ditto for Wounds,	1,267,500
24, 25.	Superannuation Allowances	192,300
		£2,250,400

Total Effective and Non-Effective Services......£14,416,400

Enlistment of soldiers.

The whole of the military forces of England are raised by voluntary enlistment. Recruiting for the army is carried on partly by means of the large staff of non-commissioned officers attached to the brigade depôts, partly by means of pensioners receiving a special rate of pay while so employed, and partly by sergeants or parties sent out by regiments and corps for the purpose—the whole being under the superintendence of the colonel commanding the brigade district. Infantry regiments of the line recruit as far as possible within the districts to which they are attached; but the cavalry, artillery, engineers, guards, and rifles recruit throughout the country generally. Enlistment in the army is regulated by the annual Mutiny Act and the Army Enlistment Act; the former legalises the maintenance of an army, and lays down the number of men and manner of enlisting them; the latter fixes the period and conditions of service. By the Enlistment Act of 1870 men are enlisted for a first period of twelve years, which may be spent either entirely in the army, or partly in the army and partly in the reserve, as may from time to time be fixed by the Secretary of State for War. At present "short service" is fixed at six years in the army and six in the reserve for infantry, and eight years in the army and four in the reserve for the other branches. The Household cavalry, and a certain proportion in the other branches, are enlisted for "long service," *i.e.*, twelve years in the ranks.

On the completion of twelve years' army service, soldiers may be allowed to re-engage for nine years, making a total of twenty-one, at the end of which they are entitled to discharge with a pension. Those who are passed into the army reserve remain liable for the rest of their twelve years' engagement to be recalled into the ranks in case of war or national emergency, and to be called out for eight days' training in each year; but otherwise resume their positions as citizens, and are free to follow their callings.

A recruit for the army must be between 18 and 25 years of age, unmarried, free from physical infirmities, and of such height and chest measurement as may be laid down from time to time. The standard has frequently varied, having been used as a means of regulating the supply of recruits, but stood in 1873 at a minimum of 5 feet 5 inches for the infantry, 5 feet 6 inches for light cavalry and engineers, 5 feet 7 inches for gunners, and 5 feet 8 inches for heavy cavalry; the minimum chest measurement being 33 inches. For rifle regiments and for artillery drivers the standard is reduced to 5 feet 4½ inches, but increased chest measurement is required. Exceptions are also made in favour of artificers and others. When a recruit presents himself for enlistment he is asked certain questions as to age, and whether he has served before; if the answers are satisfactory, and he is otherwise suitable, he is given a shilling as enlistment money, and served with a notice warning him to attend before a magistrate for attestation. Within not less than twenty-four, and not more than ninety-six hours he is brought before the magistrate. If he then dissents from his enlistment, he may be discharged on payment of 20s. "smart money;" if he still wishes to enlist, he makes a declaration contained in the attestation paper as to his age, place of birth, trade, &c.; signs the attestation, and takes the oath of allegiance; and is thenceforth legally a soldier. No recruit, however, is finally accepted until he has been examined by a medical officer, and approved by an officer of rank detailed for the purpose. Formerly, recruiting was carried on largely at public-houses kept for the purpose; young men were entrapped by lying placards or by the misrepresentations of recruiting agents, and often enlisted whilst drunk, and then sent under escort to their regiments. Recently great improvements have been made in the recruiting service: the bounties formerly offered, and varying from £1 to £10, according to the demand for recruits, have been abolished, exaggerated placards forbidden, the recruiting taken away as much as possible from the public-houses, and the young soldier sent by himself to join his regiment. Under the system of long service the annual number of recruits required to keep up the army was from 8 to 10 per cent. of its strength, but in future the proportion will be largely increased. The average number actually raised annually was 16,000 in the ten years 1860–9, and 21,000 in the three years 1870–2; the largest number raised in any one year since the war being 28,000, in 1859.

Pay.

The rates of daily pay of the soldier and of the non-commissioned ranks are shown in the following table:—

Rank.	Infantry.		Cavalry.		Artillery.		Engineers	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Private	1	0	1	2	1	2½	1	1½
Corporal	1	3	1	6½	2	1	2	1¼
Sergeant	1	11	2	3	2	9	2	9½
Colour-Sergeants & Staff-Sergeants, from	2	5	3	1	3	3	3	3½
to	3	3	3	7	4	2	4	7½

The Household cavalry, horse artillery, and some ranks of the foot guards, receive a higher rate of pay, and the engineers usually earn working pay in addition. Every soldier further receives a free ration of bread and meat, valued at 6d. Taking into consideration the value of the ration, lodgings, clothing, fuel, and light, the pay and allowances of the infantry private represent an average annual value of about £38, and that of the cavalry private about £41, exclusive of any prospective advantages in the way of pension; while the corporals and sergeants range from £45 to £70. Comparing this with the annual receipts of the average labourer, which range between £35 and £45 in different counties of England and Scotland, and are much lower in Ireland, and bearing in mind that the soldier as a rule is called on to do less work, it is evident that his position on the whole is not a disadvantageous one. In addition to the above, the soldier may earn 1d. a day good-conduct pay after 2 years' service, 2d. a day after 6 years', 3d. after 12 years', and 4d. after 18 years' service. The amount to which the soldier is entitled is indicated by "good-conduct badges" worn on the arm; but these, with the corresponding pay, are liable to forfeiture for misconduct.

Discharge and pension

A soldier may claim his discharge at the expiration of his first or second period of service; or he may be discharged before the expiration of his service, either by sentence of court-martial or by order of the Commander-in-Chief for misconduct, or as an indulgence at his own request, or on reduction of the army, or as an invalid, if found unfit for further service. A soldier discharged after 21 years' service is entitled to a pension varying from a minimum of 8d. a day for a private, to a maximum of 2s. 6d. a day for a non-commissioned officer; every good-conduct badge the soldier was in possession of, or would have been entitled to, at the time of discharge, adding a 1d. a day to his pension. A soldier discharged on the completion of his first period (12 years), or discharged at any time for misconduct, receives no pension. If discharged as an invalid, on account of unfitness for service, he receives a temporary or permanent pension, varying, according to the nature of the disability and the manner in which it arose, from a minimum of 6d. a day for a year, to the full pension given above. Pensions for wounds are given on a special scale, according to the nature of the wound, the maximum being 2s. 6d. for a private and 3s. 6d. for a non-commissioned officer. Soldiers are also allowed to purchase their discharge as an indulgence, according to a fixed scale depending on length of service and character; £35 in the artillery and engineers, and £20 in the infantry being the maximum rates. After from 12 to 16 years' service such discharge is granted free.

Officers.

There are ten ranks of combatant officers in the army,—viz., field-marshals, generals, lieutenant-generals, and major-generals (classed as *general officers*); colonels, lieutenant-colonels, and majors (*field officers*); captains, lieutenants, and sub-lieutenants (regimental or *company* officers). The classification and promotion of officers is complicated by the system of *brevet* or *army* rank, by which an officer may hold a higher rank in the army than he holds in his regiment. Brevet rank is usually given for distinguished service in the field, or for length of service: it begins with the rank of major, and may be said to cease with that of major-general, as in that grade and in those above it all rank is army rank. Relative rank and command within the regiment, regimental promotion and duties, and pay, are determined by regimental rank; but rank, command, and duties outside the regiment, and army promotion, are governed by army rank. Thus a regimental captain may receive the brevet of major for distinguished service: he is called captain and brevet major, retains his place among the captains of his regiment, and continues to perform a captain's duties in his regiment; but on any duties where the officers of several regiments are mixed he takes his place as major, and would command captains of his own regiment, though senior as such to himself.

Purchase system.

Previous to November 1871 first appointments and regimental promotion in the cavalry and infantry were made under the purchase system. This system dates from the earliest days of the army, and arose partly from the mode in which regiments were originally raised. Every regimental commission had a fixed regulation price, varying from £450, the price of an ensigncy in an infantry regiment, to £7250, that of a lieutenant-colonelcy of Life Guards; in addition to which an over-regulation price, which sometimes even exceeded the regulation price, had sprung up, and become established by custom, though contrary to law. An officer on retiring received the regulation price of his commission from Government, and the over-regulation from the officer who succeeded him; and the step went to the senior qualified officer of the lower grade in the regiment who was able and willing to purchase it. An officer who could not afford to purchase rose with the others till he became senior of his rank, and there remained till a death vacancy or other "non-purchase step" gave him his promotion. Practically, however, the injury inflicted was less than at first sight appears, as the purchase system stimulated a rapid flow of promotion, by which the non-purchase officer profited also, and if he lost a year or two in promotion, he saved several thousand pounds. First appointments were given to gentlemen whose names were on the Commander-in-Chief's list, and to cadets from the Military College at Sandhurst, on passing the required examinations and paying the price of the commission; a certain number of commissions without purchase being given to those who passed high examinations at Sandhurst, and to young men whose fathers' services gave them special claims.

Purchase was abolished by warrant of 20th July 1871, Parliament voting the money to compensate the officers then holding saleable commissions, and a system of promotion by "seniority tempered by selection" was substituted by the present regulations.

First appointments.

First commissions as sub-lieutenants are now given to successful candidates at an open competitive examination, to non-commissioned officers specially recommended, to university students who have passed certain examinations, and to "Queen's" and "Indian cadets," and pages of honour. A certain number of first commissions as lieutenants are also given to lieutenants of militia regiments. The limits of age for candidates by competition are from 17 to 20; but this is extended to 22 in the case of university students and militia lieutenants, and 30 in the case of non-commissioned officers. The great majority of first appointments are given by open competition, examinations for the purpose being held periodically under the Civil Service Commissioners. The successful candidates receive commissions as sub-lieutenants, and are sent to the Military College at Sandhurst (or to their regiments, if in India) for a course of instruction; and after passing the required examination in military subjects at the conclusion of the course, and serving a certain time with their regiments, are eligible for promotion to the rank of lieutenant.

Promotion.

A lieutenant is eligible for promotion to captain after two years' service, but the actual time is usually much longer—from eight to eleven years; to qualify, he must pass an examination in regimental duties, drill, &c., and also a special army examination in military law, tactics, field sketching, and field fortification. Promotion to the rank of captain is usually by regimental seniority; the senior qualified subaltern in the regiment succeeding to a vacancy among the captains. A captain may become *regimental* major by succession to a vacancy in his own regiment, or by being promoted to a majority in another regiment, or on half-pay; and *brevet* major by promotion for distinguished service, or by seniority in the army. Before promotion to a regimental majority a captain must pass a practical examination in subjects connected with the command of a regiment or of a small mixed force in the field. The appointment as major to a regiment is made for five years only, but is renewable. A major may become *regimental* lieutenant-colonel by appointment to the command of a regiment, or to an unattached lieutenant-colonelcy; and by *brevet* for distinguished service, or by seniority in the army. Certain staff appointments also carry with them the rank of lieutenant-colonel on appointment, or on completion of five years' service in them. Regimental promotion ceases with the rank of lieutenant-colonel. When a vacancy arises in a regiment by death or by the promotion of an officer to another regiment, the step goes in the regiment; if it arises otherwise, it is filled up as seems best to the Secretary of State and the Commander-in-Chief,—regimental considerations, however, receiving full consideration. A lieutenant-colonel becomes colonel by *brevet*, by promotion for distinguished service, on appointment as aide-de-camp to the Queen, after five years' service in the command of a regiment, or an equivalent staff appointment, or eight years under certain conditions.

The promotion of general officers is by seniority, regulated by a fixed establishment, the numbers of which in 1870 were 71 generals, 115 lieutenant-generals, and 188 major-generals.[1] Promotions may, however, be made independently of the establishment for distinguished service. Field-marshals are appointed at the will of the sovereign, and without reference to seniority.

All promotions are made upon the recommendation of the Commander-in-Chief, with the approval of the Secretary of State for War.

Artillery and Engineers.

The Artillery and Engineers have always been on a different footing from the rest of the army. First appointments to these services are made through the Royal Military Academy, entrance to which is by open competitive examination. After a course of instruction in professional subjects, occupying three years, cadets are examined and finally classed, and receive commissions in the engineers and artillery according to their standing on the list. Those selected for the engineers are required to go through a further course of instruction at Chatham for two years before their commissions are confirmed. Regimental promotion in the two services is governed purely by seniority, and a separate establishment of general officers is maintained for them; in brevet promotion they are on the same footing as officers of the other branches.

Pay.

The rates of pay of the several ranks are shown in the following table:—

Rank.	Household Cavalry.	Foot Guards.	Infantry.	Cavalry.	Artillery.	Engineers.
Gen. Officer, a Colonel of a Regiment or Col. Commandant (annual).	£ 1800	£ 2000 or 2200	£ 1000	£ 1350[2]	£ 994	£ 990
General Officer, not a Colonel.........(annual).	450	450	450	450	450	450
Colonel..............(daily).	...	...	...	...	1 6 0	1 6 0
Lieut.-Colonel... "	1 9 2	1 6 9	0 17 0	1 3 0	0 17 11	0 17 11
Major.............. "	1 4 5	1 2 0	0 16 0	0 19 3	0 16 0	0 10 0
Captain............ "	0 15 1	0 15 6	0 11 7	0 14 7	0 11 0	0 11 0
Lieutenant....... "	0 10 4	0 7 4	0 6 6	0 9 0	0 6 10	0 6 10
Sub-Lieutenant.. "	0 8 0	0 5 6	0 5 3	0 8 0	0 5 7	0 5 7

Officers of the horse artillery receive a higher rate of pay, slightly in excess of that of the corresponding ranks in the cavalry. Officers of the engineers, doing duty as such, receive extra pay, usually amounting to one-half of their ordinary pay if serving at home, or equivalent to it if serving abroad or in the London district. Lieutenant-colonels of regiments, and other officers holding commands of wings, batteries, or depôts, receive "command pay" of from 3s. to 1s. 6d. daily. Captains holding higher rank by brevet receive 2s. a day additional; and lieutenants, after seven years' service, 1s. a day. Officers holding staff appointments receive the pay of such appointments in addition to their regimental pay or half-pay.

Officers holding certain appointments are "seconded"—that is, their place in the regiment is filled up, and they become supernumerary, their names being shown in italics in the *Army List*; but they still belong to the regiment, and rise in it in due course.

Officers who entered the purchase corps under the old system can retire by the sale of their commissions, receiving from Government the value, over-regulation as well as regulation, of the commission which they held at the date of the abolition of purchase. Within certain limits officers are allowed to retire on the full pay of their rank after thirty years' service,—the full pay of a lieutenant-colonel being reckoned at 20s. a day; and all officers have an unqualified right to retire on half-pay after twenty-five years' service. The rates of half-pay amount usually to about three-fifths of the full pay of the corresponding ranks. Pensions are granted to officers who have received wounds in action equivalent to the loss of a limb, at the rate of £400 a year to a lieutenant-general, £300 to a colonel or lieutenant-colonel, £200 to a major, £100 to a captain, and £70 to a lieutenant. Such pensions continue as long as the effects of the wound continue, and are held in addition to any pay or retiring allowances the officer is in receipt of. Gratuities, varying from three to twelve months' pay of the rank, are granted to officers who have received less serious wounds.

Retirements and Pensions.

Pensions are granted to the widows of officers killed in action, or dying of diseases contracted in the field, at rates varying from £60 (lieutenant's widow) to £200 (widow of colonel or lieutenant-colonel) in the former case, and £50 to £150 in the latter; and "compassionate allowances" are granted, at rates varying, according to rank of deceased officer and other circumstances, from £6 to £40 annually for each child. Such compassionate allowances, however, are not granted except in cases where it is shown that the means of the family are so limited that they actually require such assistance; and widows' pensions generally cannot be claimed as a right, and are not granted where the widow is left in affluence, or where the Secretary of State sees reason to withhold them on account of misconduct or other causes. A reduced rate of pension and compassionate allowances, ranging from £40 to £120 for the widow, and £5 to £20 for each child, is granted where the officer died under circumstances which do not entitle his family to the higher rates; but in such case the aggregate amount must not exceed the half-pay of the rank held by him at the time of his death. When an officer holding a saleable commission is killed in action, or dies within six months of wounds received, his family receive the value of such commission.

Strength, Composition, and Distribution of the Military Forces of the Empire (1873).

A. Regular Army—British Troops.

Description of Force.	Officers.	Non-Com. Officers and Men.	Troop Horses.	Guns.
Combatants.				
General Staff.......................	77	...	...	...
Cavalry, 31 Regiments..............	884	16,389	11,586	...
Artillery, 30 Brigades..............	1416	33,366	13,350	674
Engineers, 40 Companies, 3 Troops..............	793	4,856	422	...
Infantry, 148 Battalions, 70 Brigade Depôts..................	5298	120,169	...	...
Total Combatants	8468	174,780	25,358	674
Non-Combatants.				
Control Department and Army Service Corps..................	512	3,006	1,087	...
Medical Department and Army Hospital Corps................	1021	1,324	...	...
Chaplains' Department.............	78	...	...	...
Miscellaneous........................	93	546	...	...
Total Non-Combatants	1704	4,876	1,087	...

Total of all ranks, 189,828; of these 62,924 serving in India, 21,470 in the colonies, and 105,434 at home.

[1] The guards and line, artillery, engineers, and marines, have each their separate list. The total establishment will be increased by promotions from the Indian staff corps.

[2] In future to be only £1000.

B. Reserve and Auxiliary Forces.

	All Ranks
1st Class Army Reserve	7,993
2d ,, ,, ,,	23,804
Militia Artillery	15,735
,, Infantry	123,283
Yeomanry Cavalry	15,086
Volunteers—Artillery	30,750
,, Infantry, Mounted Rifles, &c.	130,000
Total Reserve and Auxiliary Forces	346,651

The addition to this of the regular army at home, 105,434, gives as the total of forces, active and reserve, within the United Kingdom, 452,085.

C. Indian and Colonial Troops.

	Men.	Horses	Guns
Indian Native Army.			
Infantry, 130 Battalions	101,134	...	...
Cavalry, 37 Regiments	18,575	13,587	...
Artillery, 6 Batteries	896	623	36
Engineers and Miscellaneous	4,385	...	...
Total Indian Army	124,990	14,210	36
West Indian Regiments (2)	1,822	...	...
Royal Malta Fencibles	373	...	..
Lascars, Hong-Kong and Ceylon	264	...	...
Total Indian and Colonial Troops	127,449	14,210	36

D. Colonial Militia, Volunteers, and Reserve Forces.

	Men.	Horses.	Guns.
North American Confederation	52,414	2081	48
West Indies	3,952	610	24
African Colonies	4,343	1143	19
Possessions in Asia	2,116	120	6
Australian Colonies	19,055	1703	43
Total	81,880	5657	140

Note.—The contingents furnished by Native Indian States under our protection are not included in the summary of our Indian forces; and the disembodied or untrained militia of Canada, amounting to about 600,000 men, has not been taken into account in the summary of Colonial Reserve Forces.

Staff.

The staff of the British army may be classed under three principal heads—

1. General Officers, commanding divisions, districts, brigades, &c.;
2. General Staff, including Adjutant-General and Quartermaster-General's Departments, brigade-majors, &c.;
3. Personal Staff, consisting of military secretaries and aides-de-camp.

Appointments to commands are made from the lists of superior officers of corresponding rank. Sometimes, however, commands are given to officers of lower rank than that of the appointment, in which case they receive local and temporary rank The command of brigades is usually given to colonels, with temporary rank of brigadier-general.

General officers are responsible for the discipline and efficiency of all the military forces within their commands. They are required to make annual inspections of every regiment or corps, and report minutely on them for the information of the Commander-in-Chief. They are assisted in their duties, and their orders conveyed to the troops, by the officers of the staff. Officers for the *General Staff* are selected exclusively from the regular army, and, except in cases of proved abilities in the field, must have passed through the Staff College. Admission to the Staff College is obtained by competitive examination, the number entering being limited to twenty annually. Candidates must have served not less than five years, and be reported to be thoroughly good regimental officers, qualified from general character, disposition, &c., for employment on the staff, and physically fit for its active duties. Before being allowed to compete, they are reported upon by a board consisting of the commanding officer and two next seniors of their regiment and corps, and also by a general officer, to whose staff they have been attached for a month on trial. Officers of not less than seven years' service may present themselves at the final examination without having studied at the college; but the same qualifications and certificates are required from them. After completing the course and passing the final examination, officers are attached during the following summer drill season either to the staff of a general officer, or to the other arms of the service.

Officers appointed to the *Personal Staff* are not required to pass through the Staff College, but have to undergo a qualifying examination.

Staff appointments are held for five years only, at the end of which time the officer reverts to his regiment or to half-pay. Most of the lower appointments are held by regimental officers who are temporarily withdrawn from their regiments, but still borne on its establishment. No effective field officer of a regiment, however, can hold a staff appointment, and no regiment of cavalry may have more than one captain and one subaltern, and no battalion of infantry more than two captains and two subalterns on the staff.

The following table shows the principal ranks and rates of pay of the staff of the army:—

		£	s.	d.
General	(daily pay)	£5	13	9
Lieutenant-General	,,	3	15	10
Major-General	,,	1	17	11
Brigadier-General	,,	1	8	6
Colonel on the Staff	,,	1	2	9
Adjutant- or Quartermaster-General	,,	1	17	11
Deputy do. do.	,,	0	19	0
Assistant do. do.	,,	0	14	3
Deputy-Assistant-, Adjutant- or Quartermaster-General, Brigade-Major, Assistant Military Secretary, or Aide-de-camp	,,	0	9	6

The Headquarter Staff receive a special higher rate of pay. These rates are in addition to the pay or half-pay of their regimental commissions. Staff officers also receive an allowance for horses, varying from two for the lowest ranks to eight for a general.

The staff are the assistants of the general in all his duties, and the channels through which his orders are conveyed to the troops. The duties of the officers of the Adjutant-General and Quartermaster-General's Departments, and of military secretaries, correspond generally to those of the same departments at headquarters; the Adjutant-General and his deputies or assistants being charged with the issue of all orders, and matters referring to drill, discipline, returns, duties, &c.; the Quartermaster-General, or his subordinates, with matters connected with the movement and quartering of troops, camps, military positions, reconnaissances, embarkations, and disembarkations, &c.; and the military secretaries with questions relating to promotions and appointments, miscellaneous confidential correspondence, and communications with the civil authorities. A brigade-major performs the duties of the Adjutant and Quartermaster-General's Departments within his brigade. The duties of an aide-de-camp are of a more personal nature. In the field he is employed to carry orders, &c.; in peace he attends his general at inspections and on all public occasions, and renders such services as his general requires of him. Officers of the General Staff, as a rule, are not under the rank of captains; aides-de-camp are appointed without regard to rank, but no officer may hold a staff appointment till he has served three years with his regiment or corps. Appointments to the General Staff are made by the Commander-in-Chief by selection from the qualified officers; appointments on Personal Staff are made on the recommendation of the general officer. The total numbers of officers employed on the staff of the army are 241 in the United Kingdom and colonies (British establishment), and 278 in India (Indian establishment). About two-thirds of the staff on the British establishment belong to regiments, and are borne on their establishments, the remainder being officers on half pay or unattached. In India the rules regarding staff appointments vary a little, and most of the appointments, with the exception of the higher commands, are filled from a special "staff corps;" but some are also held by officers from the British regiments serving in India.

Cavalry.

The cavalry consists of 31 regiments: viz., 2 of Life Guards and 1 of Royal Horse Guards, forming together the "Household Brigade;" 7 regiments of Dragoon Guards, 3 of Dragoons, 5 of Lancers, and 13 of Hussars.

The Household Brigade form the body-guard of the sovereign, furnishing the escorts on all state occasions. They are recruited regimentally, and take none but picked men, of good character, and over 5 feet 10 inches in height. They wear helmet, cuirass, and long jack-boots, and are armed with a breech-loading carbine and long straight sword, 40 inches in the blade. From the great size of the men, added to the weight of the cuirass, they ride very heavy—from 21 to 22 stone when equipped for service. They are quartered in or near London, and are only sent abroad in war.

The other regiments are classed as "heavy," "medium," and "light." The dragoons are classed partly as heavy, and partly as medium; the lancers as medium; the hussars as light. The heavies recruit from men of 5 feet 8 inches to 5 feet 11 inches in height, and ride, in "service marching order," from 19 to 20 stone; the mediums from men of 5 feet 7 inches to 5 feet 9 inches, and ride from 18½ to 19 stone; the lights from men of 5 feet 6 inches to 5 feet 8 inches, and ride from 17½ to 18½ stone. The dragoon guards, dragoons, and hussars are armed with breech-loading carbines and sword. The lancers carry a bamboo lance (9 feet long), sword, and pistol. The colour and facings of the uniform vary in different regiments, the dragoons mostly wearing red, while the hussars and lancers wear blue. The dragoons wear helmets, with the exception of the 2d Dragoons (the "Scots Greys"), who wear bearskins; the lancers, the lancer square-topped cap; and the hussars, a busby with plume and bag. The Household Brigade are the only cuirassed regiments.

A regiment of cavalry on war footing consists of 8 troops, forming 4 squadrons in the field, and numbering 1 lieutenant-colonel, 1 major, 8 captains, 12 lieutenants and sub-lieutenants, 5 regimental staff officers, 11 staff sergeants, 8 troop sergeants-major, 24 sergeants, 32 corporals, 8 trumpeters, 20 farriers, shoeing smiths, and saddlers, and 504 privates; in all, 27 officers and 607 men, with 559 horses. They take with them in the field 2 forge-waggons, 1 small-arm ammunition-cart, and 7 baggage and store-waggons. The peace establishment is 29 officers, 506 men, and 320 horses. Of the 28 regiments of the line, 9 are usually in India, and 19 at home. The principal cavalry stations in the United Kingdom are Aldershott, the Curragh (with Newbridge), and Dublin; at each of the two first there is a general commanding the cavalry, who also inspects all the cavalry regiments in that portion of the kingdom. The depôts of regiments serving abroad, and the riding establishment, are at Canterbury. Cavalry regiments are not connected with particular counties or districts, but recruit throughout the kingdom

The horses for the cavalry are mostly obtained by purchase from dealers, at the headquarters of the several regiments; no breeding establishments or special arrangements for securing a sufficient supply of a good class of horses, such as have been generally introduced on the Continent, exist in England. The horses are usually bought at four years old, £40 being the maximum government price; the average height is 15 hands 2 inches. Officers provide their own chargers, but are allowed to select from the troop horses under certain restrictions and on payment of £50; sub-lieutenants are provided with horses and horse equipments at the public expense.

The oldest cavalry regiments are the Horse Guards, raised by the Earl of Oxford, and first known as the Oxford Blues; and the two regiments of Life Guards, raised in 1661-2. The privates in these regiments were for the most part of good family, and were addressed as "Gentlemen of the Life Guards." The youngest regiments, the 19th, 20th and 21st Hussars, were formed from the European regiments in the East India Company's service at the time of the amalgamation.

Artillery.

The artillery, notwithstanding the great augmentations it has received of late years, consequent on the increased importance of its arm, still retains the title of the "Royal Regiment of Artillery." It consists of 205 batteries, forming 28 brigades, of which 5 brigades, or 31 batteries, are horse artillery; 10 brigades, or 83 batteries, are field artillery; and 13 brigades, or 91 batteries, are garrison or siege artillery. In addition to these, there is a depôt brigade of 12 batteries, and the "coast brigade" of 10 batteries. The battery is the true unit of our artillery, the brigade being rather a grouping for administrative purposes; in the field and horse artillery, the batteries are almost entirely independent.

The establishment of a battery of *horse artillery* on war footing is—1 major, 1 captain, 3 lieutenants, 1 assistant-surgeon, 1 veterinary surgeon, 2 staff sergeants, 6 sergeants, 12 corporals and bombardiers, 2 trumpeters, 10 artificers (including shoeing smiths), and 153 gunners and drivers; altogether 7 officers and 185 men, with 206 horses and 6 guns, 9 ammunition-waggons, and 5 forge, store, &c., waggons. The peace establishment varies; the present home establishment is 5 officers, 151 men, and 113 horses. The guns now in use are 9-pounder rifled muzzle-loaders, of wrought iron. In the horse artillery every man is either mounted, or carried on the limber or ammunition-waggons, to enable them to keep pace with cavalry.

A battery of *field artillery* on war footing has the same establishment of officers and non-commissioned officers, but more gunners and drivers, and fewer horses. The numbers are—7 officers, 197 men, 184 horses, 6 guns, 12 ammunition and 4 miscellaneous waggons. The peace establishment at home is 5 officers, 152 men, and 85 horses. The guns in use are 16-pounder rifled muzzle-loaders, drawn by 8 horses.

A *garrison battery* consists of 1 major, 1 captain, 2 lieutenants, 1 staff sergeant, 5 sergeants, 10 corporals and bombardiers, and 140 gunners. They are all dismounted, and are employed in garrisons in working the heavy guns, at sieges, and on other similar duties.

Besides the above, heavy batteries of position, mountain batteries, and ammunition columns are formed in war time. A heavy battery has 4 guns only, 40-pounder breech-loading rifled guns on the Armstrong principle. Mountain batteries are only organised when the nature of the warfare requires it, and their detail varies accordingly.

Artillery and infantry reserve ammunition columns are formed when an army takes the field, one being attached to each division. Their establishment is 4 officers and 138 men, with 4 artillery and 16 small-arm ammunition-waggons, 2 spare gun-carriages, 5 miscellaneous waggons, and 142 horses; carrying 360 rounds of gun, and 307,200 of small-arm ammunition.

The *coast brigade* is formed entirely of old soldiers of good character, drawn from the other brigades. It is broken up in small detachments, often numbering one or two men only, distributed along the coast; the men being employed to take charge of unoccupied forts and batteries, and of the guns and artillery stores in those which are occupied. The number of officers in the coast brigade is small, but there are 121 *master gunners*, ranking as warrant officers, attached to it, who take charge of the more important works and command the small detachments of coast brigade men.

The uniform of the whole of the artillery is blue with red facings; the horse artillery wear a jacket, the others a tunic. The head-dress for all is a busby with bag. The non-commissioned officers and gunners of the horse artillery, and the mounted men of the field batteries, are armed with the cavalry sword, the dismounted men with a sword-bayonet; the drivers carry no arms. Twelve carbines are carried with each horse battery, and 24 with each field battery. The garrison batteries are armed with breech-loading carbines and sword-bayonets.

The headquarters of the artillery are at Woolwich, the great arsenal for the whole kingdom. Two or three brigades are usually stationed there, besides the permanent depôt and riding establishment. Three horse brigades (15 batteries), six field brigades (43 batteries), and four garrison brigades (28 batteries) are stationed in India; four garrison brigades (28 batteries) in our colonies and foreign garrisons,—Gibraltar, Malta, Bermuda, Halifax, &c.; and the remainder distributed throughout the United Kingdom. The principal artillery stations besides Woolwich are Aldershott, Portsmouth, Dover, Dublin, and Plymouth. There is a second depôt at Sheerness; and a school of gunnery, with an extensive establishment, has been formed at Shoeburyness, for the double purpose of instructing officers and men in the higher branches of gunnery, and carrying on artillery experiments—the long reaches of sand near the mouth of the Thames being peculiarly favourable for this purpose.

The artillery are not connected with particular districts or counties, but recruit generally throughout the kingdom. The horses for the artillery are obtained by purchases made from dealers, or by officers specially appointed for the purpose, £45 being the maximum price allowed.

Engineers.

For purposes of administration, promotion, &c., the Royal Engineers form a single regiment or corps, consisting of 40 companies, 3 troops, and a large establishment of officers, not attached to any companies, but employed in superintending works and buildings, and in other professional and scientific duties. Of the 40 companies, four are "survey" companies, and two are attached for service with the postal telegraph; the remainder are employed in works and buildings, or undergoing instruction at Chatham. The war establishment of a company is 1 captain, 3 subalterns, 1 assistant-surgeon, 6 sergeants, 12 corporals, 2 buglers, and 100 privates (termed "sappers") of various trades, viz., carpenters, masons, bricklayers, smiths, painters, printers, telegraphists, &c.; in all, 5 officers and 120 men. The peace establishment is 3 officers and 93 men.

The three engineer troops are,—the field equipment troop, telegraph troop, and pontoon troop, each of which forms the nucleus of several similar ones to be raised in war. The war establishment of a *field equipment troop* is 6 officers and 233 men (of whom 100 are drivers), with 186 horses and 33 waggons and carts. It is divided into three sections, each of which carries the camp equipment and all necessary tools and implements for a company of engineers, and a "field park." The troop is kept together for convenience in peace time, but in the field would be broken up, and the sections attached to the companies of engineers. The field equipment troop carries mining and entrenching tools, sandbags, rope, gunpowder and fuses for mines and blasting, a portable forge, sets of carpenters', smiths', farriers', stonemasons', bricklayers', collar-makers', &c., tools and materials; also instruments, drawing materials, printing-press, and photographic apparatus.

A *telegraph troop* consists of 6 officers, 245 non-commissioned officers and men, with 24 carriages, 42 riding and 114 draught horses. Twelve of the waggons are fitted as wire waggons, and carry each three miles of insulated wire, on rollers, besides staples and telegraph poles for carrying the wire along trees or houses, or over obstacles. Four waggons are fitted as offices, with recording instruments (Morse). The troop is so organised that it can be broken up into three sections, each complete in itself. A certain proportion of the men are trained to act as signallers, and all the materials for visual signalling—flags for use by day, rockets and lime-lights for flashing signals by night—are carried with the troop.

A *pontoon troop* consists of 6 officers and 296 non-commissioned officers and men, with 31 carriages, 20 riding and 210 draught horses. It carries 22 pontoons, being sufficient to construct 120 yards of bridge, capable of bearing cavalry, infantry, and field artillery; and a supply of trestles for light field bridges.

It is further in contemplation to organise a railway battalion, composed of men trained to all duties connected with the construction, repair, and working of railways.

The daily pay of the several ranks has been already given; but in addition to this ordinary rate, officers, when regimentally employed, receive extra pay, usually equal to the ordinary pay, if abroad (or in the London district), or to one-half of it if at home; and the non-commissioned officers and men receive "working pay," varying according to their skill and to the nature of their employment, but commonly ranging between 1s. and 2s. a-day. The uniform of the Royal Engineers is scarlet, with blue facings, the head-dress a low busby and plume. The men are armed with a Lancaster breech-loading rifled carbine and sword-bayonet. In the engineer train the non-commissioned officers and sappers carry swords; the drivers carry no arms.

The sappers are recruited entirely from men of good character, able to read and write, and who have been brought up to, or served apprenticeship in, some suitable trade. All men on enlistment are sent to Chatham to go through a long course of training and instruction in the special duties connected with military engineering, such as siege operations, field works, mines, bridging, &c.

The headquarters and depôt of the Royal Engineers are at Chatham, where their great instructional institutions are established. The distribution of the force depends on the works in progress in different parts of the empire. A considerable number of officers are stationed in India, but no men. Thirteen companies are now stationed abroad in our colonies and foreign garrisons—Bermuda, Gibraltar, Malta, &c.; and 27 companies, with the three troops of engineer train, are at home. Two companies are employed, under the direction of the Post-Office, in the construction and maintenance of the telegraph lines throughout the country, thus acquiring in peace time the practical experience necessary to enable them to undertake the working of telegraphic communications in war and in an enemy's country; and four are permanently engaged on the great ordnance survey of the kingdom. The others are distributed throughout the principal garrisons; eight or ten usually remaining with the headquarters at Chatham.

The duties of engineer officers are very various. Besides the actual command and superintendence of their men, and their instruction in all branches of field engineering, they include the charge, construction, and repair of fortifications and barracks, the survey of the kingdom, the management of a number of scientific and experimental establishments, the development of all the scientific appliances of war, such as armour plating, torpedoes, field telegraphy and signalling, &c., Engineer officers are also largely employed under the civil government in connection with the educational departments, railways, prisons, &c.

Infantry.

The infantry consists of 3 regiments of Foot Guards (7 battalions), 109 of the Line (137 battalions) and the Rifle Brigade (4 battalions,)—total, 148 battalions.

The three regiments of guards are the Grenadier Guards, of 3 battalions; and the Coldstream and Scots Fusilier Guards, of 2 battalions each. These form together the brigade of foot guards. They are stationed principally in London, and rarely leave the country except for active service in the field; they furnish the guards on the royal palaces, and guards of honour on state occasions, receive a special rate of pay, and have certain privileges. Up to 1872 their lieutenants had the rank of captains in the army, and their captains that of lieutenant-colonels. This privilege, however, was abolished by a warrant of July of that year as regards officers entering subsequent to that date.

Of the line regiments, Nos. 1 to 25 have two battalions each, two rifle regiments (the 60th and Rifle Brigade) have four each, and the remainder one only. By the localisation of 1873, the single battalion regiments have been grouped in pairs to form "district brigades." The several battalions are altogether independent of one another in matters of command, internal economy, &c.; but recruiting is carried on for the brigade, and men or officers may be transferred from one battalion to another within it. A district brigade comprises two line battalions, a brigade depôt, and a certain proportion of reserve and auxiliary forces.

A battalion of infantry consists of eight companies. Its war establishment is 1 lieutenant-colonel, 2 majors, 8 captains, 16 lieutenants and sub-lieutenants, 1 adjutant, 1 paymaster, 1 quartermaster, 1 assistant-surgeon, 10 staff sergeants, 8 colour sergeants, 32 sergeants, 16 drummers, 40 corporals, 4 hospital orderlies, 10 pioneers, and 946 privates,—in all, 31 officers and 1066 non-commissioned officers and men. On service it takes with it 62 horses (of which 9 are officers' chargers and 53 draught horses), and 14 waggons and carts (3 ammunition carts, 1 entrenching tool waggon, 1 for quartermaster's stores, and 9 for camp equipment and baggage) The peace establishment varies. Most of the battalions at home are kept at a reduced establishment of 520 rank and file, the guards at 750, the battalions next for foreign service at from 700 to 820, and the battalions in India at 820.

The infantry is at present armed partly with the Snider (converted Enfield) rifle, and partly with the Martini-Henry, but will ultimately be armed entirely with the latter. This weapon, which was selected in 1870 after a careful and protracted series of trials, is a breech-loading rifle, 4 feet 1 inch long, weighs 8 ℔. 12 oz., and ranges up to 1000 yards. It is seven-grooved, bore ·451 of an inch, carries a bullet weighing 1 oz., and has been fired at the rate of 25 rounds a minute. The soldier carries 70 rounds of ammunition, viz., 20 in each of two pouches on the waist belt, 10 in expense bag, and 20 in a pocket in his valise. The bayonet (Elcho sword-bayonet) is a short heavy sword, with saw-back, which can be attached to the rifle as a bayonet, or used independently as a sword, or to cut up firewood, chop bushes, &c.

Although the regiments are named Rifles, Fusiliers, Light Infantry, &c., the organisation, armament, and training is the same throughout, the only distinction being in matters of dress. The two rifle regiments wear dark green; all the rest of the infantry wear red. The guards are distinguished by their tall bearskins; the fusilier regiments (9) wear sealskin caps, resembling the bearskins of the guards, but smaller. There are 9 Highland regiments, of whom 5 wear the kilt and bonnet; the others have minor distinctions in dress. The light infantry regiments, 11 in number, are distinguished by a horse-hair plume to the shako in place of a ball. The "facings" vary with the different regiments, but all "royal" regiments have blue.

All regiments now carry the valise equipment, substituted for the knapsack in 1870. It consists of a black leather bag slung from the shoulders by straps and fitted to lie in the hollow of the back, connected with a waist-belt and ammunition-pouches in such a manner as to distribute the weight evenly over the body, and cause it to hang direct on the shoulders. The greatcoat, when not worn, is strapped above it. The valise holds a spare shirt, pair of boots, socks, cap, towel, and other small articles, and when full weighs about 15 ℔; the total weight carried by the soldier, including arms, ammunition, and the clothes he has on, amounts to about 52 ℔.

Each battalion has four hospital orderlies, picked men specially trained to the care of sick and wounded, and relieved from all other duties; and ten pioneers, skilled artificers of various trades, who carry a complete set of carpenters' and other tools, and are employed, sometimes under the quartermaster of the regiment and sometimes under the engineers, in executing repairs and other works.

The guards and rifle regiments recruit through the country generally: the former maintain a high standard, usually 2 or 3 inches above that of the line; the latter take men of low standard, but require special chest measurement. The other infantry regiments recruit as far as possible within the brigade districts in which the depots are permanently stationed. Of the 141 line battalions, 50 are stationed in India, 20 in the colonies and foreign garrisons, and 71 at home; thus allowing one battalion at home and one abroad from each brigade. The chief foreign garrisons are Malta (7 battalions) and Gibraltar (5 battalions). The largest home stations for infantry are London (for the Guards), Portsmouth, Dublin, Cork, Plymouth, Chatham, Dover, and the camps of Aldershott, Colchester, Shorncliffe, and the Curragh.

The oldest infantry regiments are the Coldstream Guards (General Monck's regiment), the 1st "Royal Scots" (originally the "Douglas" regiment), the Grenadier and Scots Fusilier Guards, the 2d "Queen's" (raised for the defence of Tangier), and the 3d "Buffs" (raised from the London train-bands). These regiments were formed between 1660 and 1662. The principal augmentations made to the army between this date and the Crimean war have been already detailed. Second battalions were added to the regiments from 1 to 25 in 1857–59, and the 100th was raised in Canada in 1858. The nine regiments from 101 to 109 were formed from the European regiments in the service of the East India Company, on the transference of the powers of that company to the Crown.

Reserves and Auxiliary Forces.

The reserves are divided into classes. The "1st Class Army Reserve" consists—(*a*) of men who, after a service of not less than three years in the ranks of the army, have been passed into the reserve to complete the unexpired portion of their engagement; and (*b*) of soldiers who have been discharged by purchase or on completion of limited engagement, and have enrolled themselves for 5 years. The men of the 1st class reserve receive 4d. a-day, paid quarterly in advance, and an annual allowance of £1 for necessaries. In peace time they may be called out for 12 days' training annually, or to aid the civil power, receiving daily pay at the rate of 2s. in the first case, and 2s. 6d. in the second. In case of war or national danger, they may be recalled to service by proclamation, and attached to any regiment or corps of their own branch of the service, or formed into separate corps. They then resume their position in all respects as soldiers of the regular army, and are liable for service at home or abroad, and until completion of their term of engagement. The 2d class army reserve consists of enrolled pensioners,—men who have completed their second period of service in the regular army, and been discharged to pension. They receive no bounty, but an annual allowance of £1 for necessaries, and daily pay at the rate of 2s. or 2s. 6d. when called out for training or in aid of the civil power. They are subject to the same regulations as the 1st class, except that they are only liable for service within the United Kingdom.

By the Act of 1867, a *militia reserve* was created in addition to the above, consisting of men actually serving in the militia who voluntarily enrol in this reserve for a term of six years, during which they remain with their militia regiments in peace time, but in case of war may be drafted into the regular army. They receive an annual bounty of £1 in addition to their militia pay and bounty. Their number is limited to one-fourth of the effective strength of the militia, and in 1873 amounted to 28,286 men.

The first attempt to organise a reserve of men who had passed through the ranks of the army was made in 1843, when the enrolment of pensioners for home service in special cases was authorised by Parliament. The number was originally limited to 10,000, but afterwards increased to 20,000. In 1859 when the military power and threatening attitude of France caused the alarm in England which led to the volunteer movement, an effort was made to organise a more efficient reserve from men who had taken their discharges on completion of their first period of service, but the inducements offered were insufficient, and the scheme proved a failure. In 1867, after the proved success of the short service and reserve system in Prussia, a new Reserve Force Act was passed, which, with subsequent modifications, laid the foundation of the present first-class reserve; but it required increased inducements, and the Short Service Act of 1870, to give the reserve any importance. The militia reserve was formed as a temporary expedient, to be reduced as the army reserve increases. It has been objected to on the grounds that it entails increased expense without any real addition to the armed force of the country, as the men are merely passed from one force to another, and that it takes away the best men from the militia at the moment this requires to be most efficient. But, in the absence of a sufficient reserve of fully-trained soldiers, a reserve of partly trained men is essential. Practically the militia always has been the feeder of the line in war time, and it was thought better to enrol a number of men in peace time, when they could be selected, and all necessary preparations made for drafting them in at once in war, rather than adhere to the old system of offering high bounties at the last moment, and getting a worse class of men.

For auxiliary forces, MILITIA, YEOMANRY, and VOLUNTEERS, see separate articles.

Local Organisation of the Military Forces of the Kingdom.

The United Kingdom is divided into 10 military districts, or general officers' commands,—viz., England, 6; Scotland, 1; Ireland, 3.[1] Within the district the general officer's authority extends over all the military forces—regular, reserve, or auxiliary. These districts, again, are subdivided into 66 infantry brigade or sub-districts under colonels; of these 50 are in England, 8 in Ireland, and 8 in Scotland. Each brigade comprises 2 battalions of the line, a brigade depôt, 2 militia battalions, and such reserves and volunteers as are included in the sub-district; the average male population of the sub-districts being 200,000. The two line battalions are independent of the colonel of the sub-district. One is always abroad, one at some home station, usually a garrison or camp of instruction. But they draw their recruits and reserves from the sub-district, and supply the officers and non-commissioned officers for the brigade depôt, and for the staff of the militia and volunteers. The brigade depôt is the connecting link between the line battalions and the district. It is permanently established at some principal town in the sub-district, and is formed of two companies from each line battalion, under the command of a major of the home battalions. To it are attached 2 captains (adjutants of militia battalions) and a large staff of non-commissioned officers, who join the militia battalions when embodied, but at other times are employed at the depôt in recruiting and drilling recruits. The duties of the colonel of the district include recruiting for the line and militia, the training of recruits and of all reserve and auxiliary forces, the annual inspection of the militia and volunteers, the registry and payment of the army reserve and enrolled pensioners, and the care of arms and stores of reserve and auxiliary forces.

For cavalry purposes Great Britain is divided into 2, and for artillery into 12 sub-districts, under colonels, whose duties correspond in the main with those of the infantry colonels as regards recruiting and supervising the training of the auxiliary forces of their respective arms, but are more restricted, as they have no depôts and staff of regulars under their immediate command.

The colonel of the brigade depôt is especially charged with the measures for mobilisation in case of war. On the order being given, the army reserve and militia reserve men are collected at the depôt, and sent to the home battalion to complete it to war strength. The supernumerary men of the reserve, and all men of the field battalion that are unfit for immediate service, are drafted to the depôt, which is increased to the strength of an eight-company battalion, by calling in officers from the half-pay list, and by recruiting. At the same time, one, or, if necessary, both militia battalions are embodied. If an expeditionary force is to be despatched, the militia battalions relieve the regular army in all the home garrisons; and probably, as was the case during the Crimean war, in some of the foreign ones also.

Civil Departments of the Army.—Control Department.

The Control Department was formed in 1869 and 1870 by the amalgamation of the five formerly distinct administrative departments, viz., Commissariat department, Barrack

[1] This is exclusive of the four military stations or camps of Aldershott, Woolwich, Chatham, and the Curragh, to which no districts are attached.

department, Store department, Purveyors' department, and Military Train. At the head of the Control Department is the Surveyor-General of Ordnance, assisted by a director of supplies and transport, and a director of artillery and stores; the general duties of the department have already been defined in treating of the administration of the army.

The *personnel* of the Control Department consists of—(*a*), administrative officers, named controllers; (*b*), executive officers, divided into two sub-departments, and named commissaries and paymasters; (*c*), the non-commissioned officers and men of the Army Service Corps. The ranks of *administrative officers* are—controller, ranking with major-general; deputy-controller, ranking with colonel; and assistant-controller, ranking with lieutenant-colonel. Appointments as assistant-controller are made from commissaries in the supply and transport sub-department, or from combatant officers of the army. In the latter case the officers selected must have five years' full-pay service, be not under the rank of captain, not over 35 years of age (40, if belonging to the artillery,) and have passed through the Staff College or the advanced class at Woolwich. They serve on probation for two years, at the end of which, if found competent and willing to serve in the Control Department, they resign their military commissions, and receive commissions as assistant-controllers. Artillery officers are generally selected to fill the appointments in the artillery and store branch, but the great majority of appointments are made from the sub-departments, and but few from the combatant ranks of the army. Promotion to the higher grades is by selection, after a service of not less than ten years for the rank of deputy-controller, and thirteen years for that of controller, at least three years having been in the next lower rank. After thirty years' full-pay service, Control officers are entitled to retire; and retirement is compulsory at the age of 60.

Officers of the Control Department conduct their duties under the direct orders of the officer commanding the district or station, whose advisers and agents they are in all matters connected with the raising or issue of money, the supply of provisions, stores, and transport. They hold a position analogous to that of officers of the general staff, except that they are at the same time directly responsible to the Secretary of State for War for the proper conduct of their duties. Where the orders of the officer commanding appear inconsistent with the War Office instructions, it is the duty of the Control officer to point out the inconsistency, and apply for special authority from the commanding officer, which being granted, must be implicitly obeyed, and relieve the Control officer from the responsibility.

The *executive sub-departments* are the supply and transport sub-departments, and the pay sub-department. The ranks in the former are—commissaries, ranking with majors; deputy-commissaries, ranking with captains; and assistant-commissaries, ranking with lieutenants. The ranks are the same in the pay sub-department; but the officers are called paymasters instead of commissaries. First appointments in the supply and transport sub-department are conferred on civilians selected by open competitive examination, or subaltern officers of the army, and on deserving non-commissioned officers; the limit of age is 17 to 20 for civilian candidates, and 22 for subalterns of the army or militia. Retirement may be claimed after thirty years' service, and is compulsory at the age of 55.

The *Army Service Corps* consists of 12 transport companies and 11 supply companies, officered from the supply and transport sub-department. The establishment of a supply company is 2 officers, 27 non-commissioned officers, and 97 rank and file; of a transport company, 3 officers, 13 non-commissioned officers and 117 rank and file, with 91 horses and 26 carriages. In war time these would be largely augmented, according to the requirements of the army and the nature of the service. The supply companies consist of butchers, bakers, issuers, clerks, mechanics and tradesmen of various kinds; the transport companies of drivers, with a proportion of smiths, wheelers, saddlers, farriers, &c. The ranks of the Army Service Corps are filled by volunteers from the army,—men of good character, specially recommended, and of not less than two years' service,—or by recruits specially enlisted for it under authority from the Secretary for War. The rates of pay are nearly the same as in the cavalry, but the artificers and tradesmen usually earn working pay in addition. The uniform is blue. The supply companies are armed with breech-loading carbines and sword bayonets, the transport companies with cavalry swords.

The executive duties that devolve on the Control may be classed broadly under four heads—pay, provisions ("*munitions de bouche*"), stores ("*munitions de guerre*"), and transport; and officers of the sub-departments are selected as far as possible for service in the several branches according to their special training. The provision branch is the most important, and occupies the largest number of officers. In peace time the soldier is fed partly by the Control, partly by means of purchases made by himself. He receives a free ration from Government of 1 ℔ of bread and ¾℔ of meat, and in addition expends a sum varying from 3½d. to 6d. a day on groceries, vegetables, &c. Under certain circumstances the Government ration is slightly increased, and in the field it is raised to 1½ ℔ bread and 1 ℔ meat; and rations of groceries, spirits, and vegetables are also provided by the Control, though paid for by the soldier. The forage ration for a horse is 10 ℔ oats and 12 ℔ hay, with 2 ℔ extra oats to horses picketed out, and 2 ℔ oats and 2 ℔ hay additional to draught horses doing very heavy work. In peace time the army is supplied by contract, the contractor usually delivering the bread and meat or forage at the Control store, where it is inspected by a board of officers before issue. At some of the large camps and stations, however, ovens and slaughter-houses have been established, at which the bread is baked and the meat killed and prepared for the troops by the men of the Army Service Corps. When troops are encamped on flying columns, or for autumn manœuvres, iron field-ovens or steam baking waggons are commonly used; the former turning out about 480 ℔ of bread in a day of 12 hours, the latter about 900 ℔. Biscuit and salt meat are largely used abroad and at sea, but not at home. (For the supply of an army in the field, see article WAR.)

The *transport* duties of the army in peace time, when all the civil resources of the country are available, and most articles are delivered at the required point by the contractor, are very slight; but to be efficiently organised for the field, an army requires a vast amount of transport, of which the existing establishment would only suffice to form the nucleus. The British army is differently situated from the great Continental armies in this respect, that its operations extend over the most distant and varied countries, involving the most different conditions; and as the transport service must always be specially organised to suit the peculiar conditions of the theatre of war, it is impossible in peace time to maintain an establishment which shall be equally applicable in all cases. In some countries railways and water transport are largely available, and the duties thrown on the train are comparatively light; in other countries the local resources in carts and waggons, if properly organised, are ample, and a sufficient *cadre* of officers and superintendents is alone required; in others, again, the local resources are *nil*, and the army has to bring with it every man, horse, and waggon of the vast train it requires.

And the character of the transport varies as widely as the quantity required. In some countries large waggons are most suitable, in others, light carts only can be used; in others, again, recourse must be had to pack animals,—horses, mules, bullocks, camels, and elephants,—or to coolies and native carriers. Evidently no establishment can be framed that shall be equally suitable in all cases. The existing transport, therefore, is based on the requirements of an army operating in a civilised country, with good roads, where the transport can be mainly done by waggons; while for special expeditions, such as those to Abyssinia and Ashantee, special transport is organised. The waggon in common use is the "general service waggon," a strong four-wheeled (equirotal) waggon, drawn by four horses, weighing 16 cwt., and carrying a load of 30 cwt.

The transport companies at the disposal of the Control have to carry the equipment and baggage of the staff and departments, to horse and drive the ambulance and field hospital waggons, and, above all, to carry the supplies and reserve stores of the army, the bringing the daily supplies to the troops being the duty which taxes them most heavily.

The charge and issue of warlike stores is a duty of ever-increasing importance and difficulty in these days of scientific warfare. In most armies this duty devolves on the officers of the artillery, whose education specially qualifies them for it, and the question was warmly discussed when the Control Department was formed. It was ultimately decided to unite all supply duties under the Control, providing, however, by an admixture of artillery officers for the necessary scientific knowledge within the department.

The following table shows the establishment of officers of the Control Department in 1873, with their full pay, and the daily rates of half and retired pay to which they become entitled:—

Nos. (on Full Pay.)	Rank.	Full Pay.	Half Pay.	Retired Pay, after 30 years' service.
3	Controllers	£3 0 0	£1 10 0	£2 0 0
14	Deputy-Controllers*	2 0 0	1 1 0	1 13 0
40	Assistant-Controllers*	1 4 0	0 13 6	1 0 0
53	Commissaries*	0 18 6	0 10 0	0 16 8
135	Deputy-Commissaries*	0 11 6	0 7 0	0 11 8
142	Assistant-Commissaries*	0 9 0	0 4 6	0 7 8
12	Paymasters*	1 0 0	0 12 6	1 0 0
20	Deputy-Paymasters*	0 14 6	0 8 3	0 14 0
36	Assistant-Paymasters*	0 10 6	0 5 3	0 9 0
455, of whom 116 were abroad and 339 at home.				

Note.—In the ranks marked thus * the full pay is increased after five years' service in the rank by amounts varying from 2s. 6d. to 5s. daily. A reduced rate of retiring pay is allowed to officers of over twenty but less than thirty years' service, who are permitted to retire. In addition to the numbers shown above, 40 sub-assistant commissaries are appointed, on probation, at a rate of 6s. 6d. per day.

Medical Department.—Hospitals.

The Medical Department comprises 4 ranks of medical officers—viz., Surgeon-General, Deputy-Surgeon-General, Surgeon-Major, and Surgeon,—and the officers and men of the Army Hospital Corps; the whole being under a director-general at the War Office. The officers of the two higher grades are employed chiefly as administrative officers superintending districts or large hospitals; while the surgeons-major and surgeons are attached to regiments and corps, or employed as executive officers in the hospitals. Every battalion serving at home or in the colonies has one medical officer attached to it; and every battalion in India has one surgeon-major and two surgeons. First appointments in the Army Medical Department are given to candidates who possess two diplomas or licences for medicine and surgery, and, after attending a probationary course at a general military hospital, pass a satisfactory examination in military medicine, surgery, hygiene, and pathology. On appointment as surgeons they rank as lieutenants, and after 6 years' full-pay service, as captains. Promotion from surgeon to surgeon-major is by seniority, but officers may be specially promoted for distinguished service. Surgeons-major rank as majors on appointment, and after 20 years' full-pay service (in the two ranks), as lieutenant-colonels. Promotion from surgeon-major to deputy-surgeon-general, and from that to surgeon-general, is by selection of the Commander-in-Chief, with approval of the Secretary for War. Deputy-surgeons-general rank as lieutenant-colonels from the date of appointment, and after 5 years' service in the rank as colonels; and surgeons-general as brigadiers for three years, and afterwards as major-generals. The establishment and rates of pay of the several ranks are shown in the following table:—

No.	Rank.	Daily Pay.
		£ s. d. — £ s. d.
10	Surgeons-General	2 0 0 rising to 2 10 0
33	Deputy-Surgeons-General	1 10 0 ,, 1 17 0
439	Surgeons-Major	0 17 6 ,, 1 7 0
625	Surgeons	0 10 0 ,, 0 15 0
1107, of whom 476 are employed at home, 130 in the colonies, and 501 in India.		

All officers have a right to retire on half-pay after 20 years' service. Surgeons and surgeons-major must retire at the age of 55, and surgeons-general and deputy ditto at the age of 65. Officers retiring after 20 years' service receive a rate equal to half their full pay at the time; after 25 years' full-pay service, a rate equal to seven-tenths of full pay.

The *Army Hospital Corps* consists of 11 "captains of orderlies," 10 lieutenants, 264 sergeants-major and sergeants, and 1060 rank and file. They are employed entirely on hospital duties, and are under the direction and control of the medical officer of the station, though subject for discipline to the military authority. The officers and non-commissioned officers rank with the corresponding grades in the army, but their authority is confined to their own men and to patients and men attached to military hospitals on duty. Appointments of officers are made from the non-commissioned officers of the corps: the ranks of the corps are filled by volunteers from the army,—men of good character, able to read and write, of not less than two years' service, and not over 30 years of age; and by recruits, whose direct enlistment is specially authorised. They are variously employed as clerks, compounders of medicines, cooks, &c., but principally as attendants on the sick in the general hospitals in peace, or in field hospitals and ambulances in war.

Hospitals are either "general" or "station" hospitals: to the former special governors or commandants are appointed; in the latter the internal administration is under the senior medical officer. The Royal Victoria Hospital at Netley, whither all invalids from abroad are sent, is the largest *General Hospital;* it has a large staff, a medical school, and accommodation for 973 patients.

Station Hospitals are organised at all large military stations, for the sick of all regiments or corps quartered there. The hospital is under the immediate supervision of the principal medical officer, usually a deputy-surgeon-general, and all medical officers at the station are available for such general service in it as he may direct; but separate wards are allotted to the different regiments and corps, and their sick are kept as far as possible distinct, and under the immediate attendance of their own medical officers and orderlies. The hospital staff consists of the medical officers attached to regiments at the station, a certain number of medical officers specially attached to the hospital, the officers and men of the Army Hospital Corps, and the hospital sergeants and orderlies of the regiments at the station. At small stations a building or block is specially fitted as a hospital, and is under the charge of the medical officer of the regiment or corps. When an army is organised for service in the field, *field hospitals* and *ambulances* are formed. The latter consist of a number of ambulance waggons, light waggons specially constructed for the carriage of sick and wounded, with a sufficient staff of medical officers and attendants, and a company of "stretcher bearers," provided with stretchers; these are charged with the immediate removal of the wounded from the battle-field, their first dressings, and conveyance to the nearest field hospital. The field hospitals are provided with large hospital tents, beds, and all the requirements of an hospital, and a sufficient staff of medical officers and attendants, and either accompany the army in its march, or establish themselves in suitable places in rear. The ambulance waggon commonly used is four-wheeled, weighing 16 cwt., drawn by two horses, and constructed to carry eight wounded (two lying down and six sitting), besides a water keg, stretchers, and other medical appliances.

For care of sick and wounded in war, see article WAR.

The general health of the army has greatly improved of late. The disasters of the Crimean war first drew attention to the importance of proper sanitary arrangements in the field; but what, perhaps, aroused public attention still more strongly was the report of the Royal Commission of 1858, by which it appeared that the mortality in the army generally was twice as great, and in the foot guards three times as great, as in the corresponding classes of the civil population. Since then, improved barracks, better meals, gymnasia, recreation-rooms, and out-of-door amusements provided for the soldier, have reduced the death-rate to one-half; while the Contagious Diseases Act, severely attacked as it has been, has materially lowered the sick-rate at those stations where it is in force. The admissions from causes under its control have, within five years, been reduced to less than a third at some of the large stations; while a comparison of 14 stations at which the Act is in force, with 14 to which it has not been extended, shows 54·5 cases per 1000 men at the former, and 113·3 at the latter. The annual death-rate in the army generally averages about 14 per 1000. In 1870 Gibraltar, Malta, and Canada were the healthiest stations, showing a death-rate of only 8·7 per 1000. The United Kingdom came next, with a rate of 9·5; while in India the death-rate rose to 22·8. But to appreciate the improvement that has been effected in the health of the army, it is necessary to turn back to the fifteen years preceding the Crimean war, when the death-rate in the United Kingdom averaged 17·5, and that of the army generally 33 per 1000; while the death-rate in India averaged 62 per 1000 between 1837 and 1853, and 81 per 1000 in the twenty years preceding 1837

Veterinary Department.

The Veterinary Department is charged with the supervision of the sanitary condition of horses, and their treatment when sick; also the selection of such as are proposed to be cast as unfit for the service, and the examination of remounts. The grades are—staff veterinary surgeons, ranking as majors; veterinary surgeons, 1st class ranking as captains, and 2d class ranking as lieutenants; the whole under a principal veterinary surgeon, who ranks as a colonel. Candidates for appointment are required to pass an examination before a board of veterinary surgeons. Veterinary surgeons of the 2d class must have served five years, and passed a further examination, to be promoted to the 1st class; and a service of fifteen years is required for promotion to staff veterinary surgeons. All officers of the department are entitled to retire on half-pay after twenty-five years' service, and are placed on the retired list at the age of 55. The establishment (1873) and rates of daily pay of the several ranks are as follows:—

7	Staff Veterinary Surgeons........	£1	1	0	rising to	£1	3	0
35	Veterinary Surgeons, 1st class...	0	12	6	,,	1	0	0
70	,, ,, 2d class...	0	10	0	,,	0	17	6
112								

A limited number of acting veterinary surgeons are employed at the discretion of the Secretary for War.

Staff veterinary surgeons are employed to supervise districts or great military stations, the others are attached to cavalry regiments, horse and field artillery, &c. The uniform of the staff surgeons is blue, similar to that of officers of hussars, but with cocked hat and red plume; the veterinary surgeons attached to regiments wear the uniform of the corps, with cocked hat and red plume.

Chaplain's Department.

The Chaplain's Department is under the Chaplain-General at the War Office. Chaplains to the forces are appointed by the Secretary for War; they must previously be in holy orders, and belong either to the Church of England or Ireland, to the Presbyterian, or to the Roman Catholic Church, and must serve six months on probation before their appointment is confirmed. They are divided into four classes,—the first ranking as colonels, the second as lieutenant-colonels, the third as majors, and the fourth as captains. Promotion is governed by length of service, —chaplains being promoted to the third class after ten years, to the second after fifteen years, and to the first after twenty years; but for distinguished services any chaplain may be promoted to the next higher class without regard to length of service. Chaplains are entitled to retirement after twenty-five years' service. The establishment (1873) and rates of daily pay of the several classes are as follows:—

10	Chaplains, 1st class............	£1	0	0	rising to	£1	2	6
20	,, 2d class	0	17	6				
30	,, 3d class	0	15	0				
20	,, 4th class	0	10	0	,,	0	12	6
80								

Of these, fifteen are Roman Catholics and six Presbyterian. Chaplains are not attached to particular regiments or corps, but are stationed at the principal garrisons and military stations at home and abroad. Garrison chapels, used also in many cases as schools, exist at all the large stations. At smaller stations the troops attend divine service at the parish churches, and an allowance is made to a local clergyman for attending the troops, performing special services when necessary, and visiting the sick.

Education Department.

The educational establishments for the army consist of the military colleges, a staff of instructors for officers serving with their regiments, and army or regimental schools for the instruction of the non-commissioned officers and privates of the army and their children. The supervision of the education of the army rests with the Director-General of Military Education at the War Office.

Military Colleges.—The *Staff College* was established in 1858, with a view to train officers for employment on the staff of the army; replacing the "senior department" of the Royal Military College at Sandhurst, which had existed since the beginning of the century. The present building, near Sandhurst, was completed in 1862, and accommodates forty students. The qualifications and manner of admission of students have already been noticed (under "Staff"). The course lasts two years, beginning in February, and with vacations at Christmas and Midsummer. The subjects of instruction are military history and art, fortification, military administration and law, surveying and sketching, reconnaissance, mathematics (including a short course in mechanics and practical astronomy), sciences, and languages; a large part of the course being devoted to out-of-door work and practical instruction in the duties of staff officers in the field. The Staff College is open to officers of all arms of the service, and twenty students are admitted each year. At the end of the first year they are required to pass a qualifying examination; and at the end of the second, the final examination is held, at the close of which the names of the successful candidates are published in general orders, divided into two classes,—"Honours" and "Pass." Those officers who fail at the qualifying or at the final examination rejoin their regiments at once. The staff of the establishment consists of a commandant and ten professors, of whom four are military, the others civilians.

The Royal Military College, Sandhurst, was originated in 1786, and in 1801 was transferred from Marlow to its present site, and officially recognised by Parliament. This institution was formerly devoted to preparing young gentlemen for commissions in the infantry and cavalry, the ages of admission varying from thirteen to sixteen and eighteen at different periods. Now it is devoted to the instruction of young officers of these arms after they have passed the requisite examination for commissions, and before they are appointed to regiments. The course lasts a year, and the instruction is confined altogether to purely military subjects,—fortification, military sketching, tactics, military law, correspondence, and accounts. At the conclusion of the course the students are required to pass an examination in these subjects, and their commissions are dated according to the result,—those in the first class being antedated two years; those in the second, twelve months; and those in the third dating from day of examination. The present building accommodates about 150 students, and it will probably be necessary to increase it considerably. The staff of the establishment consists of a governor, with an assistant and five staff officers (paymaster, surgeon, &c.), and twelve military professors and instructors. A riding establishment and master are also kept up for the instruction of the students both of the Royal Military College and of the Staff College.

The Royal Military Academy at Woolwich was first established in 1741, and is devoted to the training of candidates for commissions in the artillery and engineers. The course of instruction, which lasts for three years, is mainly scientific and professional, mathematics playing an important part in it. The students are finally classed by the results of the examination held at the end of the course, those who pass the highest having the option of appointment to the engineers, and seniority in the army being determined by their position on the list. The present building accommodates about 250 students. The staff consists of a governor, with a secretary and adjutant, a "captain of cadets" and three "lieutenants of cadets" for purposes of discipline, and twenty-one professors and instructors.

Garrison Instructors.—For the instruction of officers serving with their regiments, and to enable them to qualify in the special examinations for promotion, staff officers, with the title of garrison instructors, are appointed to all the principal garrisons and military stations at home and abroad. Classes under these are formed for instruction in tactics, field fortification, military sketching and reconnaissance, and law. The course of instruction usually lasts four months, during which time the officer is struck off all other duties. At the close of the course an examination is held, and those who pass satisfactorily are certified as qualified for promotion. Garrison instructors hold the rank and receive the staff pay and allowances of brigade-majors, and are selected from officers who have passed through the Staff College. The establishment consists of one superintending officer (with rank and pay of assistant quartermaster-general) and seventeen garrison instructors, stationed at home or in the foreign garrisons on the British establishment, and one superintending officer and ten garrison instructors in India.

Army Schools are established in every regiment and detachment, for the purpose of giving to non-commissioned officers and soldiers, and to their children, a sound and useful education. These schools are divided into adult, grown children, infant, and industrial schools. To every regiment are appointed a schoolmaster and schoolmistress, and a certain number of assistant schoolmasters, pupil teachers, and monitresses, on a scale according to the number of men and children attending school. Batteries of artillery and detachments of other corps are allowed an acting schoolmaster, with such assistants as may be necessary. All soldiers, soldiers' children, and children of men belonging to the army reserve, of warders of military prisons, and of discharged soldiers holding military employments, are admitted free of charge to these schools; and children of pensioners and others indirectly connected with the army, on a weekly payment of 3d. Recruits, on first joining, are required to attend these schools; and soldiers who are candidates for promotion must obtain certificates of proficiency before they are eligible. Advanced classes are also formed for the instruction of non-commissioned officers. Army schoolmasters receive a rate of pay varying, according to service, from 4s. a-day on appointment to a maximum of 7s. a-day, and rank as non-commissioned officers next below the sergeant-major. Candidates are required to go through a course in the training schools of the Royal Military Asylum, Chelsea, admission to which is by competitive examination, open to non-commissioned officers and soldiers of the army (of good character and especially recommended), to civilian pupil teachers, and certificated schoolmasters. Before appointment the candidate must enlist for general service for twelve years.

Schoolmistresses are classed in three classes, receiving from £30 to £44 yearly. Candidates must be certificated schoolmistresses, or have been employed as teachers in an army school, and in the latter case must pass an examination before appointment. All first appointments are made to the third class, and promotions are made according to merit and services.

At all important military stations and garrisons large and commodious schoolhouses have been specially built; at smaller stations barrack-rooms are told off and fitted up for the purpose. Schoolmasters and mistresses are permanently attached to regiments, and accompany them from station to station, and the schools are under the immediate and constant supervision of the commanding officer. They are also periodically visited and examined by inspectors, who report to the director-general, for which purpose a staff of one inspector of army schools, two local inspectors (officers of the army, receiving an additional rate of pay for performing these duties), and twelve sub-inspectors, are maintained. The improvement that has taken place in the education of the army generally may be gathered from the reports and returns of the director-general, by which in appears that between the years 1858 and 1871 the proportion of "uneducated" fell from 40 per cent. to 12 per cent., and that within the last few years the number possessing a superior education has risen from 6 to 32 per cent. And although much of this is doubtless due to the spread of education throughout the country, a comparison of the educational statistics of the recruits with those of the army generally proves that still more is due to the regimental schools.

Garrison Libraries and *Regimental Recreation-Rooms* have also been established at the principal barracks at home and abroad, and are open to the troops on payment of a small subscription, which must not exceed threepence a month for a private soldier. The garrison library forms a central depôt from which the recreation-rooms are supplied with books. All the rooms are furnished, warmed, and lighted at the public expense, and the recreation-rooms provided with billiard and bagatelle tables, chess, backgammon, and other games. An annual allowance of £2, 10s. is granted by Government for each troop or company; this, with the subscriptions, forms a fund to defray the cost of purchase and repair of books in garrison libraries, and of games, newspapers, &c., for recreation-rooms. Many recreation-rooms have a refreshment bar attached to them, where the men are supplied with tea, coffee, and other light refreshments at a very low price. A garrison librarian, usually a non-commissioned officer or a pensioner, takes charge of the library, and a regimental librarian has charge of the recreation-rooms. These are managed by a committee composed of non-commissioned officers and privates; and the garrison libraries are managed by a committee consisting of members chosen from the regimental committees, under the approval of the officer commanding the station.

Scientific and Educational Establishments.

The *Department of Artillery Studies* was established to give officers of the artillery the means of continuing their studies after they have completed the regular course at Woolwich, and of qualifying by a special training for appointments requiring exceptional scientific attainments. The establishment consists of a director, an assistant-director, and two instructors of artillery, and a number of instructors and lecturers for mathematics, languages, and sciences. Its duties include the instruction of an advanced class of artillery officers, selected by competition, to qualify for scientific appointments; and the formation of classes in topography, astronomy, and languages, open to all officers of the artillery wishing to join them. A *School of Gunnery* is maintained at Shoeburyness for the purpose of giving practical instruction in gunnery to officers and men of the artillery, and carrying on all experiments connected with artillery and stores. The present site was selected for the school in consequence of the facilities afforded by the sands at the mouth of the Thames for artillery practice and firing at long ranges. The establishment consists of a commandant and brigade-major, with six instructors for the gunnery department; and two superintendents of experiments. Officers and non-commissioned officers are selected from brigades of artillery to go through a long course of instruction in gunnery, use of military machines, &c., and qualify as instructors to brigades and batteries; and squads of officers and men are sent there for instruction in the various branches of artillery service.

The *Royal Artillery Institution* at Woolwich was originally a private military society, but the present building was erected at Government expense, and the institution is now supported partly by the subscriptions of members, partly by a Government grant. It contains a museum, lecture theatre, laboratory, and a printing-press; and minutes of proceedings, containing papers on professional and scientific subjects, are periodically issued from it.

The *School of Military Engineering* at Chatham constitutes a special training school for officers of the Royal Engineers after they have passed through the course at Woolwich, as well as for recruits on first enlistment. Companies are also sent there previous to going abroad, and on return from foreign service, to keep up their knowledge. The establishment consists of a commandant and brigade-major, two discipline officers, and eleven officer instructors in construction, surveying, field fortification, telegraphy, &c.

The *School of Musketry* at Hythe was established shortly after the introduction of rifled fire-arms, to give a special training in the theory and practice of musketry to officers and non-commissioned officers qualifying to act as musketry instructors to their regiments, and to secure a uniform system of instruction and practice throughout the army. With this view also, squads of officers and men from all regiments in the service are periodically sent there for a short course. The establishment consists of a commandant, a deputy assistant adjutant-general, and five officer instructors. The commandant is also inspector-general of musketry, and exercises a general supervision over the instruction and practice throughout the army; for which purpose periodical reports are made to him from all regiments, and the annual musketry returns are carefully examined by him before being submitted, with his remarks, to the Commander-in-Chief. To secure sufficient attention to this important part of a soldier's training, musketry instructors are appointed in every regiment; and staff officers, formerly termed district inspectors of musketry, are appointed to the principal districts. Every recruit is required to go through a course of instruction and practice before being dismissed drill, and every trained soldier is put through an annual course, lasting about a fortnight, in which he fires 60 rounds at fixed distances from 150 to 800 yards. Extra pay of 1d. a day is given to those men who qualify as "marksmen," and additional rewards to the best shots of companies and battalions.

An *Army Medical School* was formed in connection with the great military hospital at Netley, to which candidates for appointments as surgeons are sent for a probationary course. The school is under the immediate direction of the principal medical officer at Netley, and has a staff of nine professors and assistant professors of military surgery, medicine, hygiene, &c.

The *Military School of Music* at Kneller Hall, Hounslow, was established in 1857 with the view of instructing non-commissioned officers and soldiers in music, and supplying competent bandmasters and trained musicians to the various regiments. The staff consists of one officer and a number of civil professors: the students, limited to 148, are soldiers selected for good conduct and promise of musical proficiency, and remain for two years.

The *Royal Military Asylum* at Chelsea (also known as the Duke of York's School), and *Royal Hibernian Military School* at Dublin, are establishments for the maintenance and education of a limited number of boys who are the sons of soldiers. Candidates for admission must be between the ages of 5 and 12 years, and they are allowed to remain till 14, or, if they belong to the band, till 15. They are then allowed to volunteer into any regiment they may select, or, if not fit for the service, are apprenticed to a trade or placed in some other civil employment. The

Royal Military Asylum at Chelsea is also a normal school and training institution for army schoolmasters.

Administration of Justice—Judge-Advocate-General's Department—Military Prisons.

Justice is administered by the commissioned officers of the army: by the commanding officer for minor offences, and by regimental, district, or general courts-martial for more serious crimes. (See MILITARY LAW.). The administration of justice as pertaining to *discipline* falls under the Adjutant-General's branch of the department of the Commander-in-Chief. But to ensure these disciplinary powers being exercised in strict conformity with the law, a *Judge-Advocate-General*, a legal adviser to the Crown and to the Commander-in-Chief, is appointed by patent. This officer is usually a lawyer of high standing, having a seat in the House of Commons, holding his office as a member of the Government, and quitting office with his party. His department includes a deputy judge-advocate-general, who is also a lawyer and civilian, and three deputy judge-advocates, military officers; of the latter, two are attached to the Judge-Advocate-General's office in London, and one to the Commander-in-Chief in Ireland. A separate Judge-Advocate's department is maintained in India, where deputy judge-advocates are appointed to every important command. All general courts-martial held at home are sent to the Judge-Advocate-General, to be by him submitted to the Queen for confirmation; and all district courts-martial, after having been confirmed and promulgated, are sent to his office for examination and custody. The Judge-Advocate-General and his deputy, being judges in the last resort of the validity of the proceedings of courts-martial, take no part in their conduct; but the deputy judge-advocates frame and revise charges, and attend at general courts-martial.

The punishments that can be awarded to officers and soldiers for various offences are detailed in the Mutiny Act, the Articles of War, and the Queen's Regulations. A commanding officer can "reprimand" a commissioned officer, but can award him no other punishment. Arrest is not, as in most armies, recognised as a punishment, but is merely a preliminary to further proceedings. An officer, on the commission of an offence, is placed under arrest—that is, deprived of his sword and confined to his room—until the matter has been investigated and disposed of, or sent before a court-martial. A commissioned officer can be tried by a general court-martial only, and can be sentenced to death, penal servitude, imprisonment, cashiering, or dismissal, reduction on list of his rank, or reprimand. A soldier, on commission of an offence, is placed in confinement—that is, deprived of his arms and confined in the guard-room. At "orders" (*i.e.*, commanding officer's office hours) the next morning he is brought before the commanding officer, and the case investigated in presence of the officer commanding his troop or company, the adjutant, and the prisoner. If the offence is a minor one the commanding officer disposes of it summarily; his powers including admonition, confinement to barracks for periods not exceeding 28 days, carrying with it punishment drill up to 14 days, imprisonment not exceeding 168 hours, and stoppage of pay for absence. Drunkenness is punished by fines ranging from 2s. 6d. to 10s. If the offence is more serious, the man is remanded to the guard-room while the necessary steps are being taken for bringing him to trial, and is finally tried by a regimental, district, or general court-martial, according to the nature of the offence. The punishments that can be inflicted by court-martial are death, penal servitude for any period not less than five years, imprisonment for any period not exceeding two years, dismissal from the service, stoppages of pay, and forfeitures of pay, medals, service, &c. Flogging has been abolished except on active service, as also branding, and all such disgraceful punishments. Practically, military offences, with very few exceptions, are disposed of by regimental or district courts-martial, and by sentences of imprisonment not exceeding six months. A non-commissioned officer can only be reduced and punished by sentence of court-martial.

Sentences of penal servitude awarded to soldiers are carried out in the convict prisons with other convicts; but sentences of imprisonment are usually carried out in the military prisons. Military prisons were established in 1844, in order to avoid the necessity of mixing soldiers sentenced for military offences with ordinary criminals in county gaols. They are of two classes, the larger ones being under a governor, and the smaller ones under a chief warder. They are under the control of the Secretary of State for War, and under the immediate supervision of the officer commanding on the station (acting as his representative) and of the military visitors,—field officers serving at the station, by whom the prisons are periodically visited, and all serious offences investigated and punished. They are also inspected from time to time by the Government inspectors of convict prisons. There are eight military prisons in the United Kingdom, and six in the colonies; and the number of prisoners has recently averaged about 12 per 1000. Besides these prisons, "provost cells" are provided in every large barrack, in which short sentences of imprisonment not exceeding 28 or 42 days are carried out under the charge of a provost-sergeant.

Barracks.

In the earlier days of the standing army the barrack accommodation in England was altogether insufficient for the force maintained, and such as there was, was miserably bad. A considerable portion of the army was constantly billeted, camped, or lodged in buildings hired for the time, and every proposal to build barracks was jealously opposed in Parliament. Thus, in 1704 the total accommodation in barracks was only sufficient for 5000 men, and in 1792 did not exceed 20,000; but during the long war with France, partly in consequence of the large force kept permanently under arms, and partly also in consequence of the fears aroused by the revolutionary spirit which had penetrated into many of the large towns, barracks were constructed in all parts of the kingdom, and after the peace the accommodation far exceeded the wants of the army. Many barracks were then dismantled and sold, and others were allowed to fall into disrepair; but little was done towards improving the condition of the existing barracks until the Crimean war brought the army into notice again, and attention was drawn to the heavy rate of mortality among soldiers in peace time, mainly attributable to the defective construction and overcrowding of barracks. New barracks on improved designs were then built, and existing ones altered and reappropriated, so as to allow each man at least 600 cubic feet of air, and, in addition, provide recreation-rooms and other resorts for the soldier during the day.

The following estimate of the number and size of rooms required for a battalion of infantry on peace establishment will show the accommodation provided in modern barracks:—*Officers.*—Messroom, 45 feet × 25 feet, and 18 feet high; ante-room, 24 feet × 18 feet; kitchen, servants' rooms, larder,—altogether 13 rooms and cellars, &c. Commanding officer's quarters—6 rooms, of from 16 feet × 14 feet to 18 feet × 16 feet. Two field officers' quarters — 3 rooms each; 30 officers' quarters of one room each (often made with a recess or bunk for the bed), and 15 rooms for officers' servants. *Sergeants.*—Messroom, 40 feet × 20 feet; kitchen and storehouse for ditto; separate rooms for 7 staff-sergeants and 40 company sergeants. *Men.*—32 rooms to hold 18 men each, 45 feet × 20 feet, arranged by companies in blocks of four, with an ablution-room attached to each block; 48 separate quarters for married soldiers, each 16 feet × 14 feet. *Offices, Stores, and Workshops.*—Orderly-room, commanding officer's, paymaster's, and quartermaster's offices,—4 rooms; quartermaster's store, 40 feet × 20 feet; provision and issuing stores, two rooms, 18 feet × 16 feet; armourer's, tailor's, and shoemaker's shops, 3 rooms, from 16 feet × 14 feet to 16 feet × 32 feet; guard-room, with prisoners' room and lock-up; cook-house, 40 feet × 20 feet, with separate apparatus for each company; women's washing-house, 66 feet × 20 feet; latrines partitioned and screened. *Schools, Recreation-Rooms, Canteens, &c.*—Where no garrison schoolroom exists, a building, 50 feet square, divided into 2 large and 4 small class-rooms for the school. Recreation-rooms—2 rooms, 40 feet × 20 feet, fitted with bar in one room, and bookcases in the other. Canteen—bar, including counter and space in front, 24 feet × 12 feet; sitting-room for men, another for non-commissioned officers, and quarter for canteen sergeant. Skittle-alleys and ball-courts are also usually provided. Where no garrison hospital exists, a complete hospital establishment, including medical officer's office, surgery, dispensary, and store-rooms, quarters for sergeant and orderlies, cook-house, wash-houses, &c., and wards for 10 per cent. of the force, are included in the barrack. In constructing barrack-rooms the beds are usually arranged in two rows, with a passage of 5 feet between the beds, and 1 foot between head of bed and wall; giving a width of 20 feet. The barrack beds are of iron, made to double in the middle; during the day they are folded back, and the centre of the room thus cleared. Straw mattresses, blankets, and sheets are provided by Government; also forms and tables for day use. The arms are kept in racks by the side of the bed; knapsacks, kit, and accoutrements on shelves and pegs over the bed; 5 feet lineal space and 600 cubic feet are allowed per man. In hospitals 1200 cubic feet are allowed. In cavalry and artillery stables 1500 cubic feet are allowed per horse; the stalls are 5 feet or 5½ feet by 9 feet, with 12 feet down the centre of a double stable, or 7 feet on each side where the horses stand head to head.

Since the formation of the Control Department the construction, maintenance, and repair of barracks have devolved on the Royal Engineers; but the charge of them when once finished and handed over, the allotment of quarters, and the supply, maintenance, and repair of all barrack stores and movable furniture, rest with the Control Department. The existing barrack accommodation in the United Kingdom, according to the new appropriation, is sufficient for about 122,000 men,—88,000 in Great Britain, and 34,000 in Ireland; and when the works now in progress, or about to be undertaken, are completed, this will be raised to about 135,000. Of this, however, about 2 per cent. must be deducted for small detached forts and coast batteries, which cannot be occupied without great inconvenience to the troops so dispersed, and a margin of at least 10 per cent. must be left for barracks and rooms only partially filled, so that the available accommodation will not exceed 120,000.

Arms, Equipment, and Clothing.

The arms issued to the several branches of the service are supplied partly by contract, but mainly by the ordnance manufacturing establishments. The principal of these is the Royal Arsenal at Woolwich (see article ARSENAL), divided into the carriage factory, laboratory, gun factory, and experimental branch. From these factories are produced the whole of the guns and gun carriages for naval as well as land service now in use, and the greater proportion of the ammunition and equipment belonging to them. Rifles, sword bayonets, and swords are manufactured at the Royal Small-Arms Factory at Enfield, and gunpowder at the Royal Gunpowder Factory at Waltham Abbey; a considerable quantity of powder, however, is also supplied by contract. The various articles worn and carried by the soldier in the field, or issued to him and under his care, are usually classed under the three heads of arms and accoutrements (or equipment), clothing, and necessaries. Of these, the first are supplied and maintained by Government (though the soldier is held answerable for damage by carelessness or neglect), and under no circumstances become the property of the soldier. The articles included under the second head (clothing) are issued periodically to the soldier, and expected to last a given time; during this time he is required to maintain them at his own cost, but at the expiration of the period, and when replaced by the next issue, they become his property. Lastly, the articles termed necessaries are supplied free to the soldier on first joining, but afterwards have to be replaced and maintained at his own cost. The articles supplied as "clothing" vary slightly in different branches of the service, but usually consist of a tunic, a pair of trousers or overalls, and two pairs of boots annually, and a second pair of trousers biennially. Head-dresses, greatcoats, and leggings are issued at intervals varying from three to ten years, but these articles do not become the property of the soldier when done with. All clothing is supplied from the army clothing depôt at Pimlico; a certain amount is manufactured there, but the greater part is obtained by contract, and only examined and stored there. The bulk of the clothing is sent to regiments ready made-up, in sizes according to a size-roll furnished by the regiment; but a certain proportion is sent in material unmade, and an allowance is made to the master tailor of the regiment for making up such articles, and fitting the clothing generally. "Necessaries" include serge frocks or stable jackets, forage caps, shirts, socks, towels, brushes, combs, and other small articles, of which a stock is always kept on hand by the quartermaster of the regiment, and supplied by him to companies as required. These articles can either be obtained (on payment) from the clothing depôt at Pimlico, or purchased independently; but in the latter case the articles must be compared and found equal to the sealed patterns, and the price must not exceed the Government tariff.

England, from its insular position, has always been a great naval power rather than a military one. On her own element she has for years maintained an empire more undisputed than any power or potentate has ever claimed on land. The rule of Napoleon in the height of his fame was not so haughty and despotic on the Continent as was that of England at sea. Men still living remember the times when the British flag was saluted by every sail that traversed the sea in any quarter of the globe, and no ship, of any nation, dared to pass a British man-of-war without striking its flag. It was to the victories of her navy, and especially to Trafalgar, that England owed her immunity from invasion. It is natural, therefore, that the fame and popularity of the navy should partly have eclipsed the deeds of the army. And yet the British army has a history of which any nation might be proud. If it cannot count such a list of victories as Napoleon emblazoned on the banners of France, neither has it suffered such disasters; and it may lay claim to the longest continuous history of any army in Europe. The French army dates all its traditions from Napoleon's time;

Character of the British army.

not a trace remains of the regiments that served under Turenne, and Condé, and Luxemburg in the glorious days of the old monarchy, and even the banner under which they fought is proscribed. The Prussian army was almost unknown until the time of Frederick the Great; and Austrian regiments have been so often changed that it is difficult to trace their antecedents. But many English regiments trace back an unbroken history of more than two centuries, and fought, under the numbers and the names they still retain, with William III. in the Netherlands, and with Marlborough at Blenheim, Ramilies, and Malplaquet.[1] And their traditions are not confined to Europe. India conquered and permanently held; every colony in the world at one time wrested from its owners; the British flag planted on the ramparts of Cabul and Peking; and her arms carried into the fastnesses of Abyssinia and the forests of Ashantee;—such are among the deeds that attest the valour and enterprise of the English army. From time immemorial the inhabitants of the British Islands have been distinguished for a determined bravery and a physical power exceeding that of any other nation.

Modern peaceful experiences have confirmed the opinion as to the physical superiority of the Briton, and in this respect no rival has yet been found to the highly-fed English navvy. The army is composed of Englishmen, Scotchmen, and Irishmen, in the proportion of about 75 per cent. of the first, 10 per cent. of the second, and 15 per cent. of the last. The Englishman generally is above the average of nations in height and physical power. Even when the standard for the army has been at its lowest, it has been several inches above that of Continental armies. His strength lies especially in the upper part of the body—in the chest, shoulders, and arms—and he is ponderous rather than active. His lower limbs are not always proportionately developed, and the Englishman as a rule is not a good marcher, nor is he so hardy as the inhabitants of many other countries. In temperament he is calm and rather stolid, not easily roused to enthusiasm, and not full of romantic visions of glory, though not so insensible to such emotions as is often believed; slow, somewhat wanting in resource, and apt to grumble and show his discontent under hardships. On the other hand, he has a strong sense of justice, of right, and of duty, which can generally be successfully appealed to. His spirits rise to danger; he can always be depended on for battle; and his courage, if less fiery, is of a more stubborn and enduring kind than that of any other race. The Scotchman is less ponderous in frame, but more sinewy and active,—a better marcher, and more capable of enduring hardships and fatigue; more impetuous in action, though capable of a restrained energy very different from the reckless valour of the Frenchman or Irishman. The Scotch regiments have always been distinguished by a strong national feeling and clanship, producing an *esprit de corps* that cannot be surpassed by any *corps d'élite*. The Irishman is active, gay, careless, more ready in resource than the others, and often more reckless in fighting; but, on the other hand, less to be depended upon, and more difficult to hold in the bonds of discipline.

The English officer is drawn exclusively from the upper classes. His early education, his habits, and his traditions all fit him to be a leader of men. His *physique*, his intelligence, and the spirit of enterprise, are developed by those athletic exercises and field sports which distinguish the aristocracy of England. The character which especially distinguishes him is a love of enterprise. Much of his spare time is spent in travelling, or in sports of a more or less dangerous character. Not a war takes place in the most distant and unhealthy colonies, but crowds of volunteers are found for it. There is not a country in the globe but has been explored and traversed by English officers for their amusement, and wherever a war takes place they flock to it. Not so devoted, perhaps, as the officers of some nations to the details of their profession, they yet carry out all that is required of them with rigorous exactitude and a high sense of duty. But it is in the field, and when thrown on their own resources, that they show to most advantage. Trained by our Indian empire and colonial possessions to the life of a conquering nation, command comes natural to them; and the youngest subaltern, suddenly called to a position of responsibility, raises armies and carries on wars, and dominates all around him by his daring and energy. The histories of Clive, Sir Herbert Edwardes, and others, repeat themselves on a smaller scale whenever the occasion offers.

The social life of the English officer is unlike that of any other army. Off duty, the gradations of rank almost disappear, and all meet on a footing of equality as gentlemen. Our mess system, envied and copied by foreign nations, is only possible where such freedom exists. The officers live together, dine at a table always handsomely furnished, and often rich with trophies and records of the old history of the regiment, at which the president, perhaps the junior officer, is for the time superior; and wherever stationed, and under all conditions, retain the forms of high-bred society. The discipline of the English army, once proverbial for cruelty and harshness, is now the very reverse, and there is perhaps no army in which officers and men stand together on a more pleasant footing.

Of the character of the English army in war it is almost unnecessary to speak; it has written itself in history in a series of battles, often won against heavy odds, from Crecy, Poictiers, and Agincourt, to Waterloo. The highest eulogiums passed on it have been wrung from its adversaries. "L'infanterie Anglaise est la meilleur du monde; heureusement il n'y en a pas beaucoup," was Bugeaud's comment. "Le soldat Anglais," says General Foy, "possède la qualité la plus precieuse dans la guerre, le calme dans la colère." Readers of military history will remember Napier's vivid picture of the assault of Badajoz, when the troops, unable to advance, and yet scorning to retire, remained in the ditches to be shot down by the garrison. And our account may well close with Foy's description of the British infantry at Waterloo:—"La mort était devant eux, la honte derrière. En cette terrible occurrence les boulets de la Garde Imperiale et la cavalerie de France victorieuse ne purent pas entamer l'immobile infanterie britannique. On eut été tenté de croire qu'elle avait pris racine dans la terre, si ses bataillons ne se fussent ébranlés majestueusement quelques minutes après le coucher du soleil."[2]

INDIAN ARMY.

The history of the armies of India is the history of our Indian empire, and as such, in its most striking features, is treated elsewhere. The present notice, therefore, is confined to those details of organisation which do not fall within the province of a general history.

[1] It is greatly to be regretted that, for some unexplained reason, only the battles fought after the middle of the 18th century are borne by regiments on their colours.

[2] An anecdote of the Indian mutiny, peculiarly characteristic of officers and soldiers, may serve as a pendant to the opinion given above. A detachment was holding an advanced post against the attacks of a vastly superior force. The enemy gradually enveloped the post, and threatened to cut the retreat of its defenders; but the defence was maintained unshaken. At last an Irishman, with more military instincts, perhaps, than the rest, exclaimed, "Och, captain, captain, we're surrounded!" The officer's reply came sharp and stern, "What the devil's that to you, sir; look to your front;" and the defence was continued.

For military purposes India is divided into three great sections—Bengal, Madras, and Bombay. Under the term Bengal must be included Bengal proper, Assam, the North-West Provinces, Oudh, and the Punjáb; under Madras, Burmah; and under Bombay, the province of Sindh. The army of India has always consisted of three native armies, corresponding to the three presidencies, each associated with a certain number of British troops, Europeans in the service of the late East India Company, and forces furnished by the Imperial Government. This separation into three distinct armies was the natural result of the original foundation of separate settlements and factories in India; and each retains to the present day its own separate history and traditions.

Bengal army

Half a century after the establishment of the associations of merchant adventurers, whose first charter bears date 1600, the English traders in Bengal were still restricted by the native princes to a military establishment, as guard, of an ensign and 30 men; and this Liliputian force may be taken as the germ of the splendid army which now occupies India from Peshawur to Calcutta. In 1681 Bengal received the first reinforcement from Madras, in the shape of a "corporal of approved fidelity and courage, with 20 soldiers;" and two years later a company was sent from Fort St George (Madras), raising the little Bengal army to a strength of 250 Europeans. In 1695 native soldiers were first enlisted. The English had by this time moved to Calcutta, and there entrenched themselves; and in the years 1701–2, the garrison of that now flourishing capital consisted of 120 soldiers and seamen gunners. In 1756 Fort William was captured by Surajah Dowlah, and the terrible tragedy of the Black Hole of Calcutta was enacted; but vengeance followed promptly. An expedition was at once despatched from Madras, and on the 23d June 1757 the battle of Plassey established the British supremacy in Bengal. The little force, not exceeding 3000 men, with which Clive gained this astonishing victory, was formed mainly of Madras troops, and the 39th regiment, recently despatched from England,—the first royal regiment sent to India, and which now bears the motto, "Primus in Indis." The Bengal army was represented by a few hundred men only; but from this date the military power and conquests of the Company rapidly increased. A company of artillery already had been organised in 1748; and in 1757, shortly before the battle of Plassey, the 1st regiment of Bengal native infantry was raised. In 1759 the native infantry had been augmented to 5 battalions; in the following year 3 troops of dragoons were raised; and in 1763 the total forces amounted to 1500 Europeans and 12 battalions of native infantry, giving a strength of 11,500 men. In 1765 the army was further increased; the European infantry was divided into 3 regiments, and the whole force was organised in 3 brigades, each consisting of 1 company of artillery, 1 regiment European infantry, 1 troop of native cavalry, and 7 battalions of Sepoys. In 1766, consequent on the reduction of some money allowances, a dangerous combination of the officers of the Bengal army took place, by which they agreed to resign their commissions simultaneously. This combination was promptly put down by the then Governor and Commander-in-Chief, Lord Clive, to whom the Bengal army may be said to owe its existence. He found Bengal a ruined commercial agency in 1756; he left it, ten years after, a powerful empire.

The constant wars and extensions of dominion which took place during the next thirty years led to further augmentation of the army; the number of brigades and of European regiments was increased to 6; and in 1794 the Bengal army numbered about 3500 Europeans and 24,000 natives.

Madras army.

The first armed force in the Madras Presidency was the little garrison of Armegon, on the Coromandel coast, consisting of 12 guns and 28 soldiers. In 1644 Fort St George was built and garrisoned by 100 soldiers, and in 1653 Madras became a presidency. In 1745, when Fort St George was surrendered to the French, its garrison consisted of 200 Europeans, while a similar number, with the addition of 200 "Topasses" (descendants of the Portuguese), garrisoned Fort St David. In 1748 the various independent companies of factory guards at settlements on the Coromandel coast and other places were consolidated into the Madras European regiment. In the following year, Clive, with only 200 soldiers and 300 Sepoys, seized and held Arcot, the capital of the Carnatic, and on three several occasions defeated the troops of the Nabob and their French auxiliaries. From this year the military power of Madras may be dated. In 1754 the first royal regiment, the 39th, was sent there, followed in 1758 by three others. In 1772 the Madras army numbered 3000 European infantry and 16,000 natives, and in 1784 the number of native troops had risen to 34,000.

Bombay army

The island of Bombay formed part of the marriage portion received by Charles II. with the Infanta of Portugal, and in 1662 the Bombay regiment of Europeans was raised to defend it. In 1668 the island was granted to the East India Company, and the regiment at the same time transferred to them. In 1708 Bombay became a presidency, but it did not play so important a part as the others in the early extension of our power in India, and its forces were not so rapidly developed. It is said, however, to have been the first presidency to discipline native troops, and Bombay Sepoys were sent to Madras in 1747, and took part in the battle of Plassey in 1757 In 1772 the Bombay army consisted of 2500 Europeans and 3500 Sepoys, but in 1794, in consequence of the struggles with the Mahratta power, the native troops had been increased to 24,000.

In 1796 a general reorganisation of the Indian armies took place. Hitherto the officers in each presidency had been borne on general "lists," according to the branches of the service to which they belonged. These lists were now broken up, and cadres of regiments formed. The colonels and lieutenant-colonels remained on separate lists, and an establishment of general officers was created, while the divisional commands were distributed between the royal and Company's officers. Further augmentations took place, consequent on the great extension of territory and the complete assertion of British supremacy. In 1798, at the outbreak of the war with Tippoo Saib, the native infantry in India had been increased to 122 battalions; and the force which General Harris took from Madras for the attack on Seringapatam consisted of 5000 Europeans, 14,000 native troops, 40 siege guns, 64 field guns, and the Nizam's contingent, numbering 6000 men. In 1808 the total force in India amounted to 24,500 Europeans and 154,500 natives.

The first half of the 19th century was a history of wars and annexations, and further augmentations of the army took place. Horse artillery was formed, and the artillery service increased to a most powerful footing. "Irregular cavalry" were raised in Bengal and Bombay, commanded by picked officers, and recruited from a better class of troopers, who received high pay, on the condition of finding their own horses and equipment. "Local forces" were raised in various parts from time to time, the most important being the Punjáb irregular force (raised after the annexation of the Punjáb in 1849), consisting of 3 field batteries, 5 regiments of cavalry, and 5 of infantry, and the Nagpore and Oudh irregular forces. Another kind of military force, which had been gradually formed, was that called "contingents,"—native troops raised by the native states under our protection. The strongest of these was that of Hyderabad, originally known as the Nizam's army, and consisting of two brigades of infantry and cavalry, with artillery. Changes were also made in the organisation of the army. The staff was enlarged, sanitary improvements effected, manufacturing establishments instituted or increased, and the administration of the army generally improved.

The officering and recruiting of the three armies was in all essentials similar. The officers were mainly supplied by the Company's Military College at Addiscombe (established in 1809), and by direct appointments under the patronage of the directors. The Bengal army was recruited from Hindustan, the infantry being mostly drawn from Oudh and the great Gangetic plains. The soldiers were chiefly high-caste Hindus, a sixth being Mahometans. The cavalry was composed mainly of Mahometans, recruited from Rohilcund and the Gangetic Doab. The only other elements in the army were the four Ghoorka regiments, enlisted from Nepaul, and the local Punjáb irregular force. The Madras army was chiefly recruited from that presidency, or the native states connected with it, and consisted of Mahometans, Brahmins, Mahrattas, Telingas or Gentoos, and Tamils The Bombay army was recruited from its own presidency, with some Hindustanis, but chiefly formed of Mahrattas and Mahometans; the Bombay light cavalry mainly from Hindustan proper

Indian mutiny

In the year preceding the great mutiny the Indian army had reached its highest strength. The establishment in the several presidencies was as follows:—

	Bengal.	Madras.	Bombay.	Total.
British Cavalry Regiments	2	1	1	4
,, Infantry Battalions	15	3	4	22
Company's European Battalions	3	3	3	9
European and Native Artillery Battalions..	12	7	5	24
Native Infantry Battalions..	74	52	29	155
Native Cavalry Regiments...	28	8	3	39

Including the local and irregular troops (about 100,000 strong), the total strength amounted to 38,000 Europeans of all arms, with 276 field guns, and 348,000 native troops, with 248 field guns,—truly a magnificent establishment, and, outwardly, worthy of the great empire which England had created for herself in the East, but inwardly unsound, and on the very eve of crumbling to pieces.

It would be impossible, within the limits of a short article, to do more than briefly summarise the causes which led to the great Sepoy mutiny of 1857. For many years the discipline of the Bengal army had been relaxed. The system under which the ablest regimental officers were withdrawn to staff and civil employ was incompatible with efficiency, the centralisation of the army administration was excessive, and the powers of commanding officers had greatly diminished. The supposed wrongs of Oudh stirred up the soldiers so largely recruited from that province, and the religious prejudices of those otherwise well disposed were inflamed by the secret emissaries of the disaffected. The Sepoys were told that the Government wished to force them to break their caste and abjure their religion, that they were to be sent across the sea to die in foreign and detested lands, or to be sacrificed on their own shores. Even the ridiculous endeavour to assimilate native to British soldiers in outward appearance was turned to account by these emissaries. The "greased cartridges" were but the spark which set the whole aflame. The miserable delusions spread, the loyally-disposed cast in their lot with the disaffected, feeling that when once a mutinous spirit had been shown all was lost to them as a military body, and the Bengal native army was in a short space of time only a chaotic mass of disbanded and mutinous soldiers.[1] The story of the rebellion is the history of those days, and cannot be treated in this place. Fortunately for our power in India, the mutiny did not spread to the Madras or Bombay armies; and in the darkest days our ancient enemies the Sikhs not only remained faithful, but came forward to render us powerful assistance.

Reorganisation.

By the autumn of 1858 the mutiny was virtually crushed, and the task of reorganisation commenced. On the 1st September 1858 the East India Company ceased to rule our Indian empire, and Her Majesty's Government took up the reins of power. On the important question of the reorganisation of the Indian army the opinions and advice of the most distinguished soldiers and civilians were invited. Masses of reports and evidence were collected in India, and by a royal commission in England. On the report of this commission the new system was based. They recommended the abolition of a local European army, and the amalgamation of the existing one with the royal army; that the native army should be enlisted for general service, and be of mixed nationalities and castes; that the irregular system should mainly obtain in the native cavalry; and that the native infantry should be mainly regular

The European force was permanently increased, while the native army was largely reduced. The Indian artilleries were transferred to the Royal Artillery, the Company's European cavalry became the 19th, 20th, and 21st Hussars, and their European infantry became regiments of the line numbered 101 to 109. The transference of the Company's Europeans to the Crown was not unattended with trouble The men considered that faith had not been kept with them, and a mutinous spirit was shown Ultimately they were offered their discharge, which a large number accepted.

The European officers of the native armies, and those officers and men who did not accept service in the new royal regiments, now formed with the native soldiers the new Indian army. The reorganisation of this by the Indian Government was a task of no ordinary difficulty, involving much besides reconstruction. Many of the levies hastily raised during the mutiny had to be disbanded, or formed into line regiments, and various miscellaneous corps had to be got rid of. The Government was further hampered by the necessity for providing for the large number of officers whose regiments no longer existed. In 1861 a "staff corps" was formed in each presidency, "to supply a body of officers for service in India, by whom various offices and appointments, hitherto held by officers borne on the strength of the several corps of the Indian forces shall in future be held." Promotion in this corps was to be by length of service,—twelve years to attain the rank of captain, twenty years that of major, and twenty-six years that of lieutenant-colonel. The staff corps was filled up by a large number of Indian and British officers holding various staff employments (the new regimental employments being counted as staff duty), and all kinds of civil posts and situations, and has been gradually opened wider, till it includes the great majority of the Indian officers. The new organisation of the cavalry and infantry of the Indian army was promulgated in 1863, but did not take effect in Bombay and Madras till 1864 and 1865. Cavalry regiments are on the "silladar" or irregular system; their establishment consists of 1 commandant, 1 second in command (also commanding a squadron), 2 squadron officers, 1 adjutant, 2 doing duty officers (Europeans), and 13 native officers, 444 non-commissioned officers and troopers, or "sowars." The infantry battalions have each 1 commandant, 2 wing commandants, 1 adjutant, 1 quarter-

[1] Of 74 native infantry regiments, 45 mutinied, 20 were disarmed, and 3 disbanded Six only remained true.

master, and 2 doing duty officers (Europeans), 16 native officers, and 696 natives of all ranks.

Present strength, composition, and administration

The total strength of the army of India in 1873 was 6162 European officers, 60,174 European non-commissioned officers and men, and 123,671 natives. The supreme military power is the Viceroy and Governor-General in council. The military member of that council is *de facto* War Minister, and the military department of the Government of India the War Department. The Commander-in-Chief of the army is the executive military power, and the responsible adviser of Government, as well as local Commander-in-Chief in Bengal. The Madras and Bombay Presidencies have military departments and local commanders-in-chief, but subordinate to the supreme Government of India; each presidency, however, has certain local peculiarities in its own military system and its own army departments. The army departments are the commissariat (charged with the supply of provisions, forage, fuel, light, and transport), the ordnance department (charged with the custody and supply of all warlike stores), the clothing department, medical department, stud department, &c. The commissariat is officered from the combatant ranks of the army, the subordinates being also drawn permanently from its ranks, and is a most excellent and powerful department. The ordnance department is officered from officers of the Royal Artillery, who, as "commissaries of ordnance," have charge of the various arsenals and magazines in the country. The whole of British India is divided into divisions and districts, and the command is exercised by royal or Indian officers according to a proportion fixed. The staff is selected from the officers of the British corps in India, the staff corps, and the Indian army, and the system is similar to that in England and the colonies, except that the tenure of brigade majorships is limited to three years.

The following table shows the detailed constitution of the army of India in 1873:—

	Bengal Army.	Madras. Army	Bombay Army	Total.
Europeans.				
Artillery—				
Horse Field Batteries...	33	13	12	58
Heavy and Mountain Batteries	4	1	1	6
Garrison Batteries......	11	6	5	22
Engineers—Companies.....	1	1	1	3
Cavalry—Regiments	6	2	1	9
Infantry—Battalions........	32	9	9	50
Natives.				
Artillery—Mountain Batteries................	4		2	6
Cavalry—Regiments........	26	4	7	37
Engineers—Companies.....	10	10	5	25
Infantry—Battalions..... .	60	40	30	130
Strength—Europeans	41,055	13,214	12,067	66,336
Natives...	62,955	33,963	26,753	123,671

The following gives the strength of the several arms:—

	European.	Native.
Infantry, ...	45,962	101,134
Cavalry, ...	4,347	18,575
Artillery—Men, . .	12,306	896
,, Guns, . .	370	36

The Punjáb field force of 4 batteries of artillery, 5 regiments cavalry, 4 regiments Sikh infantry, and 6 regiments Punjáb infantry, is included in the Bengal army. The "Hyderabad contingent," of 4 field batteries, 4 cavalry and 6 infantry regiments; the "Mysore" troops, of 6 regiments of cavalry and 4 of infantry; the "Nair brigade," of 2 battalions of infantry and four guns; and other minor local forces and contingents, are not included in the above.

The Bengal army is composed chiefly of Mahometans, Brahmins and other Hindu castes, Rajpoots, Jâts, Punjábees, natives of Trans-Indus, and hill-men. Some are regiments entirely of one race, as the Ghoorkas, while others are mixed entirely or by companies; but the composition of every regiment has been definitively laid down. There are no special restrictions on caste or race, but care is taken to prevent an undue preponderance of any class. Enlistment is purely voluntary. Recruiting is carried on by parties detached, or by non-commissioned officers and men on furlough. Pay and pension are fairly good, though depreciated by the general rise in prices; pension being obtainable by men invalided after fifteen years' service. The native officers are appointed from the non-commissioned officers, and though a respectable body of men, are not sufficiently educated. It is, however, contemplated to give natives of rank and position direct commissions. The British officers of the Indian army, generally, are obtained through the medium of the staff corps, which is filled by volunteers from the British army, and now supplies the native armies of India with regimental officers.

The Madras native army is composed of a few Christians, Mahometans, and Mahrattas, and a large number of Telingas or Gentoos, and Tamils. The infantry battalions are organised as in the Bengal army. The cavalry are mostly composed of Arcot Mussulmans, descendants of the soldiers of the Nawab of the Carnatic. This cavalry is not "silladar," as in Bengal or Bombay, and the native establishment is weaker, consisting of 12 native officers, 75 non-commissioned officers, and 300 privates. The army is recruited as in Bengal, but has a peculiar institution of its own, viz., the "recruit and pension boys" (sons of soldiers or pensioners) attached to each regiment, and transferred to the ranks when of sufficient age and approved of,—a valuable institution, and one which gives a powerful hold upon the fidelity of the men.

The Bombay army resembles that of Bengal in recruiting, organisation, and equipment. It is composed of a few Christians, some Brahmins and Rajpoots, and other Hindu castes, but mainly of Mahrattas and Purwarees, with a few Punjábees and natives of Trans-Indus.

It is difficult to draw comparisons between the soldiers of our Indian forces, recruited from so many different parts of the empire. The most warlike, undoubtedly, are the inhabitants of Scinde, the Punjáb, and Trans-Indus. Perhaps next come the men of Rohilcund, Rajpootana, Oudh, and the Mahrattas. These races possess a greater aptitude for military training, and are generally of a better physique than the inhabitants of the Southern Peninsula. But it is too much to affirm that the former are "born soldiers," the latter only "soldiers by education." The ploughshare has already replaced the sword in many parts, and more and more are once turbulent tribes becoming peaceful tillers of the soil. Of the actual value of native troops it is still more difficult to form a true estimate. The Sikhs, both as friends and foes, have proved themselves gallant soldiers, not unworthy of being matched with Europeans. The ordinary Sepoy, under the guidance of British officers, has furnished many examples of heroism and devotion. It is said that a Bengal regiment successfully stood the brunt of a charge from the French at the battle of Porto Novo in 1782; and the devotion of Clive's Sepoys at Arcot has passed into a proverb. At the siege of Delhi in 1857, native regiments sustained losses which few European troops could have borne, and crowds of men in hospital, with wounds only part healed, volunteered to join in the final assault. But without their English officers they are of little value; the Asiatic, as a rule, cannot face the European, and it would be dangerous to trust to them in a war against a Western invader. They are useful auxiliaries, and relieve the European soldier of much of the fatigue inseparable from the task of garrisoning so large an empire and protecting its frontiers. But the mutiny proved the danger of relying on them, and taught the lesson, never, it is to be hoped, to be forgotten, that our Indian empire must be held, not by native armies, but by British armies.

Many important changes and improvements have taken place since the great reorganisation of the Indian armies was commenced in 1858. The education of the whole army has been improved; musketry, gymnastic, and garrison instruction has been introduced; and strict tests are now required of candidates for the staff, and for promotion in all grades. Annual camps of exercise have been instituted, where large bodies of troops are massed, and opportunities for higher tactical training afforded. The commissariat department has been enlarged, the military account department remodelled, the *matériel* of war and its manufacture vastly improved. The new system of reliefs of British troops has greatly shortened the tour of Indian service, splendid barracks have been built, hill sanitariums extended, so that about 10,000 British troops are now located in the hills during the hot weather; by these means, and a liberal expenditure on sanitary requirements, the death-rate among European troops has been reduced to one-half. Other great questions still remain to be dealt with. The local peculiarities of the presidencies seem likely to give way before the increasing intercommunication throughout India. The staff corps was an expedient, and answered its purpose for the time as such, but experience has shown defects in its constitution. The officering of the native regiments will always remain a subject for careful and anxious consideration. The British rule in India may never again be put to such a severe test as that of 1857, but a wise government will not the less prepare for a day of danger which may yet come for our Indian empire.

Canadian Militia.

To complete the account of the military forces of the British empire some notice of the Canadian militia is necessary. Until recently Canada was one of the great military out-stations of the English army, and was garrisoned by a considerable force of British troops distributed throughout the Dominion. Recently these troops were gradually withdrawn, and the colony left to its own resources; and since 1871 the regular forces maintained in the Dominion have been reduced to the 2000 men forming the garrison of Halifax, which alone is still occupied as an imperial station. The defence of Canada is provided for by a large volunteer and militia force. By an Act passed in March 1868, all male inhabitants between the ages of 18 and 60 are liable to serve in the militia, exemptions being granted to judges, ministers of religion, professors, and a few others. The men thus liable are divided into four classes, denoting the order in which they would be called out for service—the first including all single men between the ages of 18 and 30; the second, single men between 30 and 45; the third, married men, or widowers with children, between 18 and 45; the fourth, all between 45 and 60. The militia is divided into an active and a reserve force. The active force includes the volunteers, and the regular and the marine militia. Its strength is fixed at 45,000, divided among the various districts in proportion to their population. The contingent must be furnished either by volunteers, or, if sufficient volunteers do not present themselves, by means of the ballot.

Service in volunteer corps lasts for three years, and in the regular militia for two years; the periods of training last from eight to sixteen days annually. Money is granted for this purpose by Government; and every year camps of instruction are formed in each of the eleven military districts into which Canada is divided, at which the militia of the district are assembled and trained. Two schools of military instruction for infantry officers are established in each of the provinces of Ontario and Quebec, and one in each of the provinces of New Brunswick and Nova Scotia. There are also two schools of gunnery, which have permanent batteries of artillery, at Kingston and Quebec. The infantry are armed with long Snider rifles, the cavalry with Spencer carbines and swords. The field artillery includes nine batteries, all well horsed. The "reserve militia" number 656,066 men, but have not hitherto been organised or drilled. The command of the whole force is vested in Her Majesty, who may call it to arms, wholly or in part, whenever necessary.

German Army.

By the "constitution of the German empire," bearing date the 16th April 1871, the land forces of all the states of Germany form a united army under the command of the emperor. The German army thus includes the contingents of Prussia, Bavaria, Saxony, Würtemberg, Baden, and a number of minor states, all raised and organised (with insignificant variations) on the Prussian model. The peace strength of the army is fixed at 401,659 men,[1] or about 1 per cent. of the population; and the budget is established on the basis of 257 thalers, or £38, 11s. per soldier present with the colours. The army is organised in 18 army corps, of which 14 are furnished by Prussia and the states whose contingents are amalgamated with hers, 2 by Bavaria, 1 by Saxony, and 1 by Würtemberg. As the Prussian army thus constitutes three-fourths of the military forces of the empire, and is the model on which not only the other contingents, but to a certain extent the armies of most European powers, have been formed, a detailed account of its organisation will serve as an introduction to the necessarily brief notices of the other armies of Europe.

The Prussian army, like the monarchy, is of comparatively recent origin. Its European reputation dates from the wars of Frederick the Great, but it was his father, Frederick William I., aided by Prince Maurice of Dessau, who really created the army which Frederick II. led to victory, and which numbered 70,000 men, admirably trained and equipped, when the latter ascended the throne. History of the Prussian army.

The infantry had been especially perfected by Prince Maurice; and under Frederick's care the cavalry soon rivalled, if it did not excel it. The gallant struggle against overwhelming odds, and the series of brilliant victories which marked the Seven Years' War, raised the reputation of the army to the highest pitch; and the superb force of 200,000 men which he bequeathed to his successor was justly accounted the best in Europe. It was hardly, however, a national army, and its excellence was owing rather to Frederick's genius, and to his system of discipline and instruction, than to the goodness of the material. The cavalry, it is true, and the hussars especially, were recruited almost entirely from the Prussian states, and from the sons of the small farmers or better class peasants; but the infantry was raised from all sources, and was largely composed of foreigners, deserters, and vagabonds of all kinds. With Frederick's death, the genius which had animated it, and which alone gave value to such heterogeneous materials, was gone. It still retained its imposing appearance and precision of movement, and its overweening self-confidence. But at the first encounter with the armies of Napoleon it

[1] One-year volunteers are not included in this number.

fell to pieces, and after a series of crushing defeats, Prussia found herself at the feet of the conqueror, shorn of half her territory, obliged to receive French troops in all her towns and fortresses, and only existing as it were by sufferance. But in these very disasters were laid the seeds of her future greatness. By the treaty of Tilsit the Prussian army was limited to 43,000 men. This limitation suggested to Scharnhorst what was known as the "krümper," or "short-service" system already described. The bitter humiliation and suffering endured under the French yoke aroused a national spirit which was capable of any sacrifices. Every Prussian was eager to be trained to fight against the oppressor of his country; and when Prussia rose in 1813, the armies she poured into the field were no longer mercenaries, but national armies, imperfectly trained and organised it is true, but animated by a spirit which more than compensated for these defects. At the close of the war her rulers, with far-seeing sagacity, at once devoted themselves to organise on a permanent footing the system which had sprung up under the necessities and enthusiasm of the moment. The conscription, compulsory personal service, and a three years' term in the ranks, with further periods in the reserve and landwehr, were then introduced; and though variations have subsequently been made in the distribution of time, the principles were substantially the same as those now in force. By the law of 1814 the periods of service were fixed at three years in the army, two in the reserve, and fourteen in the landwehr, and the annual contingent at 40,000 men. As the population increased, it was felt that the service was unequally distributed, pressing unnecessarily heavily on some, while others escaped altogether. Further, the experiences of 1859, when Prussia armed in anticipation of a war with France, aroused great doubts as to the efficiency of the landwehr, which then formed the bulk of Prussia's forces, and of whom many had been as long as ten years away from the colours. Accordingly, by the law of 1860 the annual contingent was fixed at 63,000, the period in the reserve was increased from two to four years, and that in the landwehr reduced from fourteen to five. The total armed force thus remained nearly the same (12 contingents of 63,000, in place of 19 of 40,000), but the army and its reserves were more than doubled (increased from 5 × 40,000 to 7 × 63,000) while the landwehr was proportionately reduced.

This change was not effected without great opposition, and led to a prolonged struggle between the king, guided by his able and ambitious minister Bismarck, and the parliament; for some time the king ruled and levied taxes in open defiance of parliament and the constitution, and it required the brilliant successes of 1866, and the position thereby won for Prussia, to reconcile the nation to the new law.

Military law of Germany.

By the present "military law of the German empire," every German is liable to service (*wehrpflichtig*), and must render such service personally. Neither substitutes nor purchase of exemption are allowed, and those who are physically unfit for the ranks may be required to render such other services—as hospital attendants, tradesmen, &c.—as they are capable of. Every German capable of bearing arms belongs to the army for seven years, commencing at the age of 21, and afterwards to the landwehr for five years. Army service is divided between the ranks and the reserve, three years being spent in the former and four in the latter. The annual contingent of recruits is not now permanently fixed, but is determined by the number required to keep up the peace establishment, and is estimated at from 120,000 to 130,000 annually. By fixing the total peace establishment instead of the annual contingent, the authorities have gained the power of largely augmenting the army without raising the budget or attracting public attention, as by passing men into the reserve before their time they can always increase the contingent required to complete the regiments, and thus the total number of trained men available in war. Thus, before the war of 1870, commanding officers of regiments were directed to send home a certain number of the most intelligent men after two years' service; and since the war a large proportion of the infantry have been subjected to two years' training only.

Per[manent] or[ganisa]tion.

The military organisation of Germany is based on the territorial divisions of the empire. With the exception of the Prussian guard corps, which is recruited generally throughout the kingdom, each army corps has a corps district (*Bezirk*) within which it is raised, recruited, and stationed. The first six army corps districts correspond to the six provinces of old Prussia, the 7th and 8th to the Rhenish provinces. The 9th, 10th, and 11th were formed from Hanover, Schleswig-Holstein, and the minor states annexed by Prussia in 1866; the 12th by the kingdom of Saxony, the 13th and 14th by Würtemberg and Baden, the 15th by Alsace and Lorraine, and the 16th and 17th (called 1st and 2d Bavarian army corps) by the kingdom of Bavaria. The following details apply strictly to the Prussian provinces only.

The corps districts are subdivided into division and brigade districts, and these again into landwehr battalion districts, corresponding to the civil *Kreis*, or circle. As a rule, for each infantry regiment there are two corresponding landwehr battalion districts, from which the former draws its recruits and reserves. The battalion districts, again, are subdivided into company districts, of which there are from 3 to 6 to a battalion. Every town and village has thus its appointed place in the general organisation, and this is indicated on notice boards conspicuously placed at all the entrances.

Raising annual contingent.

At the beginning of each year lists are prepared from the parish registers of all young men who have attained their twentieth year, and to these lists are added the names of those who, though still liable to service, have been allowed to stand over from previous years. In the spring, about May, the battalion recruiting commission commences its labours. This commission is composed of the landwehr battalion commander, the landrath or chief civil functionary, two officers, and a surgeon, as permanent members, and four local members taken from the more respectable inhabitants of the different villages.

The commission having notified the days of its visiting the headquarters of the several company districts, the youths are mustered there accordingly, and inspected. Those who are found physically unfit for any service are struck off the lists altogether. Others who are too young and unformed for military service are put back for a year. Many also are permitted to stand over on personal or family grounds, the commission being allowed great latitude in granting temporary exemptions.

Every young man can be called up three years in succession, and as a rule the majority of the recruits are put back one year at least on medical grounds, but at the end of the third he must either be definitely passed or exempted. Those who are exempted in their third year are passed into the *Ersatz* reserve, where they undergo no training, and are free of service in peace time, but in war can be called out and sent to the depôts to replace the casualties in the active army. Men below the regulation standard, but otherwise fit for the army, are passed into the *Ersatz*

[1] The contingent of recruits for 1872-3 was fixed at 190 per battalion. As the peace strength of the battalion, exclusive of the permanent cadres, is about 450, it is evident these cannot all receive their full three years' training.

reserve; as also only sons of widows, and others who are the sole supports of families, or who have, or have lost, brothers in the army. Although exemptions are much more charily granted in the third than in the first and second years of liability, they are still sufficiently numerous to soften materially the hardships of compulsory service. Finally, after all "exemptions" and "adjournments" have been made, there remain those passed as fit for service, and from these the required number are chosen by ballot. But the ballot is almost nominal. In 1862, for instance, when the number coming of age amounted to 227,000, only 69,000 were left on the lists for the ballot—63,000 being the required contingent — and in many districts the ballot was not applied at all. In 1867, 262,000 came of age, 110,000 were passed for the service, and about 100,000 taken. The system of exemptions is so elastic that practically the recruiting commission can select, by a process of elimination, those best fitted for service, and abolish the element of chance. A margin of about 10 per cent., however, is usually allowed; those who draw the lucky numbers are passed into the *Ersatz* reserve, but remain liable for a year to fill any accidental vacancies in the peace establishment.

The men drawn for the army are then told off to the different branches of the service; men with good chests and good feet to the infantry, men accustomed to horses to the cavalry, gamekeepers and foresters to the rifles, men of high standard to the guard, those of inferior physique to the train, carpenters and mechanics to the engineers, and a certain proportion of shoemakers, tailors, saddlers, &c., to all regiments and corps. The guards recruit throughout the kingdom generally; the cavalry, artillery, fusiliers, and rifles throughout their own corps districts; while the infantry regiments draw their recruits as far as possible from the corresponding landwehr battalion districts. The proceedings of the battalion recruiting commissions are revised by brigade commissions, who distribute the recruits to regiments and corps, and these again by a corps commission. The final decision and allotment to regiments is usually completed about September. From that time the men are called recruits, and amenable to military law, but are given passes until the 15th October, the date on which they join their regiments.

These conscripts form the great bulk of the army; but there are other classes, also, serving under varied conditions. Of these the most important are the "one-year volunteers," young men of means and education who, on condition of passing certain examinations and bearing all expenses of clothing, equipment, &c., are allowed to pass into the reserve after one year's service only. This system is a great boon to the middle and professional classes, who thus materially reduce the interruption which the full term in the ranks would cause in their education; and every effort is made to render the service as light as is consistent with thorough instruction. Many of these pass the requisite examinations for officers' rank, and become officers of landwehr, or qualify as non-commissioned officers, and serve as such if recalled on mobilisation. A certain number of youths enter voluntarily for three years, gaining the privilege of serving at an earlier age, and choosing their own regiments. The non-commissioned officers are mostly "re-engaged men." Re-engagements are allowed for various periods, and each squadron or company has several "*Capitulanten*," smart young men, who have engaged to prolong their service in the ranks with the object of getting promotion. In the cavalry it is common for men to engage to serve four years instead of three, in consideration of which their time in the reserve is reduced by one year, and that in the landwehr by two years. Finally, there are a certain number who serve for a given number of years in return for advantages received in the way of education or maintenance from Government; such are the pupils of the non-commissioned officers' school and of the school of forestry, &c.

After completing his term in the ranks the soldier is passed into the reserve, retaining, however, his place in his regiment, borne on its books, and liable to be recalled to it in case of war. The *reservist* is supposed to take part in at least two manœuvres, not exceeding eight weeks, during his term of reserve service. On completing his seven years' army and reserve service he leaves his regiment and passes into the landwehr, and is taken on the lists of the corresponding landwehr battalion for the remaining five years of liability. The landwehr battalion is the basis of the local organisation, both for recruiting and mobilisation. As a rule, to each three-battalion regiment of the line is attached a two-battalion landwehr regiment. These two are connected as closely as possible; they bear the same number, the line regiment draws its recruits from the battalion districts, furnishes the staff for their cadres, and passes its men into their ranks.

In peace time the landwehr battalions exist only in cadre, viz., a commanding officer, adjutant, and three clerks and orderlies per battalion, and a sergeant-major and two non-commissioned officers per company. These are charged with keeping the registers of the names and addresses of all reserve and landwehr men in their districts, and on mobilisation the whole labour of summoning, collecting, and forwarding the men to their destination falls on the landwehr battalion commander and his staff. The fusilier reserve landwehr battalions form a peculiar feature in local organisation. Each army corps has a fusilier regiment, which does not draw its recruits from a particular subdistrict, but, like the cavalry and special corps, from the corps district generally. But to each fusilier regiment is attached a reserve landwehr battalion and district, bearing the same number, but used to equalise and fill up the regiments throughout the corps district generally, remedying deficiencies in the regimental quotas of recruits or reserve men, and forming, in fact, a great central depôt of recruits and reserves. It has always for its district some important town or centre of commerce, where the floating population is largest and local attachment weakest, and whence also the communications to all parts of the province are easiest, and is allowed a considerably larger staff.

The following is an approximate estimate of the resources in men at the disposal of the German empire:—

Standing army, ...	400,000
Reserves of the army, . . .	450,000
Landwehr, ...	500,000
Total trained men, . .	1,350,000

When the army is mobilised, about 1,250,000 of these are embodied, and 100,000 remain still available of men not trained, but registered and liable to be called out; then there are the next year's contingent of recruits, 120,000, and *Ersatz* reserve, which cannot be estimated under 800,000,—making, with her trained soldiers, a total of about $2\frac{1}{4}$ millions.

Prussian Army.

The Prussian army is divided into *field troops*, who in peace time form the standing army and the school of instruction in arms for the nation, and in war time, augmented by the reserves, become the active army; *Depôt troops* (*Ersatztruppen*), who have no existence in peace time, but in war time are formed of cadres supplied from the field troops, and filled up by recruits and reserve men, and whose duty it is to maintain the active army at full strength; and *garrison troops* (*Besatzungstruppen*), principally formed of the landwehr, and existing only in cadre in peace time, but who are embodied and take up the garrison duties and home defence when the active army takes the field, and also occasionally reinforce it.

The *field troops* consist of—

115 Regiments of Infantry.
14 Battalions of Rifles.
73 Regiments of Cavalry.
14 Brigades of Artillery.
14 Battalions of Pioneers.
14 Battalions Military Train.

Infantry.—The infantry is classed as guards, grenadiers, fusiliers, and line. The nine regiments of guards are composed of picked men, and are in every way *troupes d'élite;* four of them are maintained at a special increased peace establishment. The grenadier regiments only differ from the line in name and in some trifling badges, relics of former times. The fusiliers are the representatives of the old light infantry, and are specially intended for outpost duty, skirmishing, &c. The men are chosen for activity and intelligence, and their armament differs slightly, but in organisation they are the same as the line. A fusilier regiment is attached to each army corps.

An infantry regiment has three field battalions, of which the third is called the fusilier battalion. A battalion consists of four companies, and has a peace strength of 552 of all ranks, and a war strength of 1022. A regiment on war footing numbers 60 officers, 3000 men, 73 non-combatants, with 105 horses and 19 waggons. Besides the three field battalions, a fourth or depôt battalion, 1240 strong, is formed on mobilisation. This includes a company of tradesmen 200 strong, who are required to supply all clothing, &c., and execute all repairs required by the battalions in the field. The depôt battalion is formed partly of the next contingent of recruits, who are called out at once on mobilisation, and partly of the oldest classes of reserve men, or, if these do not suffice, of the youngest class of landwehr; any men in the field battalions who, from want of instruction or other causes, are not considered fit for immediate service, are also transferred to the depôt. The field battalions always maintain direct communication with it, and as soon as their losses amount to 10 per cent. of their strength, draw on it for the necessary reinforcements.

The Prussian infantry stands in three ranks on parade, the third rank being composed of picked shots (*Schützen*), who formerly did all the skirmishing. But for drill and manœuvring the common formation is that of company columns, the company being divided into two "*Zugs*" or subdivisions, standing at six paces' distance, and the third rank being withdrawn and formed into a separate *Zug* (*Schützenzug*), two deep, in rear of the others. The Prussian drill, which for many years was the model for Europe, has lately become so again, and since 1866 the company column formation, by which more independence is given to the captains, and greater freedom of movement to the battalion generally, has been adopted by most armies.

The Prussians were also the first to adopt the breech-loader, which they used with marked success against the Danes in 1864 and the Austrians in 1866. Up to 1870 they were armed with the needle-gun, the earliest, but probably also the worst, form of breech-loader; but their losses from the French chassepôt convinced them of the necessity of an improved weapon, and the infantry is now being armed with the Mauser rifle. The infantry soldier of the line carries a long breech-loading rifle, with bayonet always fixed, a short sword, and 80 rounds of ammunition; a reserve of 20 rounds per man is also carried in the battalion ammunition waggon. Fusilier regiments, and fusilier battalions of other regiments, are armed with a shorter rifle without bayonet, but carry a sword which can be fixed and used as such when required. The uniform is a dark blue tunic, grey trousers with red stripe, helmet of black leather, with brass ornaments and spike (*Pickelhaube*), and boots into which the trousers are generally tucked for marching. The different army corps are distinguished by the colour of the shoulder cords. The knapsack is of brown calfskin, rather large, but shaped to fit the back. The belts of grenadier and line regiments are white, those of fusilier regiments black.

Rifles.—The rifles (*Jäger* and *Schützen*) are not organised in regiments, but form independent battalions, of which the guard corps has two and the other army corps one each. Their organisation, and peace and war establishment, are almost identical with that of a line battalion, but on mobilisation each battalion forms a fifth or depôt company, which performs the same duties as the depôt battalion does for the line regiments. They are recruited by picked men chosen throughout the army corps district. Unlike the rest of the infantry, they always stand in two ranks; and they are further distinguished by carrying a short rifle, and by their green tunics with black belts. The rifle battalions of the guards are mainly recruited from the rangers of the royal forests.

Cavalry.—The cavalry consists of 73 regiments, of which 10 are cuirassiers, 26 dragoons, 19 uhlans (or lancers), and 18 hussars. The cuirassiers and lancers are classed as heavy cavalry, dragoons and hussars as light cavalry. The cavalry of the guard numbers 8 regiments, of which 2 are cuirassiers, 2 dragoons, 3 uhlans, and 1 hussars, and are all carefully-picked men.

The organisation and establishments of all cavalry regiments are alike. In peace time they consist of 5 squadrons of 4 officers and 135 men each; in war the regiment takes the field with 4 squadrons of 150 men each, while the fifth squadron remains behind to form the depôt. The total strength of the 4 field squadrons is 677 men and 706 horses, and of the depôt squadron 267 men and 112 horses. The depôt includes an artificers' detachment of 54 men. A cavalry regiment thus requires a very small augmentation in war, and the field squadrons are completed at once from the fifth or depôt squadron, they sending to it their recruits and untrained or unserviceable horses. Owing to the terms of service usual in the cavalry, the actual proportion of "reservists" is much smaller than in the infantry, but they still far exceed the number required to complete the regiments, and accordingly are used to form the staff escort, field gendarmerie, field post and other special corps, and to furnish non-commissioned officers to the military train.

The Prussian cavalry first won its reputation under Frederick the Great, and his brilliant cavalry leaders Ziethen and Seydlitz. In the battles of Hohen Friedberg, Rossbach, and Zorndorf the cavalry decided the fortunes of the day, and gloriously verified their old motto—

Wenn alles wankt und schwankt
Dann wäge nicht und zähle nicht, dann d'rauf![1]

In recent campaigns they have more especially distinguished themselves by their intelligence and enterprise as scouts and outposts, covering the movements of their own armies with an impenetrable screen, while constantly feeling the enemy and reporting his movements. But their desperate charges at Mars la Tour and Rezonville, where they sacrificed themselves to check the enemy and give breathing-time to their own overmatched and exhausted infantry, will always be classed among the most heroic deeds in the annals of cavalry.

[1] "When fortunes are shaking and brave men are quaking,
Then stay not and weigh not, but down on the foe!"

The light cavalry (hussars and dragoons) are armed with breech-loading carbines and swords. In the heavy cavalry, 16 men per squadron carry carbines, the remainder pistols. The cuirassiers are armed with a long heavy sword (*Pallasch*), and wear a black cuirass weighing 16 ℔, and supposed to be bullet-proof. The uhlans carry a lance and the usual cavalry sword. The cuirassiers use saddlery of the "German" pattern, very cumbrous; the rest of the cavalry use the "Hungarian" saddle. On the whole, the Prussian cavalry ride slightly heavier than the corresponding troops in England. Great attention is paid to the selection of horses for the cavalry, and constant efforts are made, by the importation of valuable stallions and brood mares, to encourage the breeding of a suitable class of horses. The remounts are bought by commissions appointed for the purpose, and either sent direct to the regiments, or, if too young for work, to the remount depôts, where they are carefully broken. In war time the necessary augmentation is obtained partly by purchase in the market and partly by contracts previously made in peace time. If these measures are not sufficient, the Government has the power of compulsory purchase. For this purpose all the horses in the kingdom are registered and periodically inspected, and returns kept of those considered fit for military service. On the order for mobilisation the owners may be summoned to attend with their horses; these are inspected by a military board, who select as many as they require, and take possession at once; and a mixed board afterwards determines the compensation to be given to the owners.

Artillery.—The artillery of an army corps consists of two regiments of field artillery and a regiment of garrison artillery. One of the two field artillery regiments is organised in two divisions (*Abtheilung*) of four batteries (two heavy and two light) each; this furnishes the divisional artillery, one *Abtheilung* to each infantry division. The other consists of three divisions, two of field and one of horse artillery, of three batteries each; and furnishes the corps or reserve artillery, and the horse artillery, which is attached to the cavalry divisions. A field battery on peace footing has only 4 guns, with 114 men, 37 horses, and 2 waggons. In war time it has 6 guns, with 155 men, 125 horses, and 10 waggons. A horse battery has a war establishment of 6 guns, 154 men, 207 horses, and 10 waggons. On mobilisation a depôt division is formed for each army corps, consisting of 1 heavy, 1 light, and 1 horse battery, and a detachment of artificers. Further, a *Colonnen Abtheilung*, consisting of 9 ammunition columns (of which 5 carry artillery ammunition and 4 small-arm ammunition) is formed, and attached to the field artillery. The regiment of garrison artillery is composed of two divisions of four companies each, with a peace strength of 108, and a war strength of 209 men per company.[1] On mobilisation the field artillery is augmented by men of the reserve, and by men drawn from the garrison artillery regiment; the garrison artillery is principally reinforced from the artillery men in the landwehr. Sometimes the number of companies of garrison artillery is doubled. The Prussian artillery are armed with rifled breech-loading guns of cast steel, the heavy batteries with the 6-pounder gun, throwing a shell weighing about 15 ℔; the light batteries and horse artillery with the 4-pounder gun, throwing a 9 ℔ shell. The extreme range of these guns is about 5000 paces, but their effective range does not exceed 2500. A heavy battery carries 134 rounds per gun, a light battery 157 rounds; and the corps ammunition columns carry a further supply of about 100 rounds per gun.

[1] Four army corps have only a division of garrison artillery instead of a regiment

Pioneers.—Each army corps has a battalion of pioneers, of four companies, of which the first is the pontoon company, the second and third sapper companies, and the fourth the miner company. The men of each company are thoroughly instructed in their own special duties, but know also the duties of the other companies sufficiently to be able to assist if required.

The peace establishment of a company is 146 men. In war time the second sapper company remains behind, and forms three garrison companies, and a depôt company is also formed. The other three companies, augmented to a war strength of 218 men, take the field, and furnish the *personnel* for a light field bridge train or pontoon train, and an entrenching tool column, which also accompany the army corps. Further, four railway detachments and four field telegraph detachments are formed for the whole army. The railway detachments are formed from the railway battalion, which was organised immediately after the war of 1870-71, and is composed entirely of men trained to the various duties connected with railways, the officers and non-commissioned officers being qualified to act as railway managers, station-masters, &c. On mobilisation they receive their augmentation from reserve and landwehr men who are actually holding these positions on the various lines; and in war time they are charged with constructing, repairing, and working or destroying the lines in an enemy's country. The field telegraph detachments, in the same way, are trained in peace time to everything connected with telegraphy; in war they carry a light line, which they lay down as required, or work the existing lines.

Military Train.—The train is a mere skeleton in peace time. The battalion which is attached to each army corps is little but a cadre maintained for instructional purposes, and only numbers 240 men of all ranks, while the train soldiers attached to an army corps on war footing amount to 3500. The men are only subjected to six months' training, and by the constant renewal the number passed into the reserve is enormously increased; additional men are drawn from the cavalry reservists. In war time the train battalion is broken up altogether, and forms a number of separate detachments, viz., five provision columns, three ambulance detachments, a horse depôt, a field bakery column, and an escort squadron, to take charge of the five *Fuhr Park* columns which are organised of hired or requisitioned transport. Further, nearly 1000 train soldiers are sent to the various regiments (65 to an infantry regiment, 37 to a cavalry regiment) to drive the regimental baggage train, act as servants to staff and field officers; 800 to the artillery, principally as drivers, &c., for the ammunition columns; and 300 to the pioneers, for the pontoon and tool train; and 400 to the various administrative services. The whole of the transport in the Prussian service is departmental,—that is, is told off to certain special departments and duties, and is not available for general service. Thus the regiments have their regimental transport, the artillery their ammunition columns, the commissariat their provision columns, the medical department their field hospital and ambulance train, &c.

Depôt and Garrison Troops.—The *depôt troops* have been described in speaking of the field troops whom they have to feed. The *garrison* or *reserve troops* have no such immediate connection with the active army, and are almost entirely formed of the landwehr; they are specially intended for home defence and garrisoning the fortresses, but are also used to maintain communications, and relieve the active army of all detachments to its rear, and sometimes, as in the latter period of the Franco-Prussian war, are organised in divisions, and pushed forward to reinforce the active army. Every battalion district forms a landwehr battalion, and every army corps district forms a reserve rifle company, one or two reserve cavalry regiments, and three reserve batteries, from the landwehr men on its lists. The garrison companies of sappers and the garrison artillery have already been spoken of, and are more closely connected with the active army than the rest of the garrison troops. The officers for the landwehr and reserve regiments are supplied partly from the field troops, partly from one-year volunteers who have qualified, and non-commissioned officers of the army who have retired with the rank of landwehr officers, and partly from the half-pay list. In addition to the forces above named, a certain number of "garrison battalions" are sometimes formed from the surplus landwehr men, and some of the *Ersatz* reserve. This was done in the war of 1870–71 to relieve the depôt troops of the garrison duties which had devolved on them in consequence of the landwehr being sent to the front. The organisation and armament of the landwehr are generally similar to those of the field troops, but the infantry wear a broad flat-topped cap instead of the distinctive *Pickelhaube*.

The total war strength of the 14 army corps composing the Prussian army is

	Men.	Horses.	Guns.
Field Troops,	524,335	161,913	1428
Depôt Troops,	186,598	17,801	264
Garrison Troops,	200,552	26,047	246
	911,485	205,761	1938

The general organisation of the Prussian army remains the same in peace and war. The king is the Commander-in-Chief, and exercises his authority through the War Ministry. The War Ministry is divided into a number of departments, of which the principal are the Central Department, which includes the minister's office; the General War Department, which deals with all questions of organisation, mobilisation, quartering, training, &c., and all strategical and purely military questions; and the Military Finance Department, which deals with all questions of pay clothing, equipment, and supply. Directly under the king and the War Minister come the commanders of the army corps districts into which the kingdom is divided. In peace time each corps command comprises two divisions, a rifle battalion, a brigade of artillery, and a battalion of pioneers and of train; each division consists of two infantry brigades and one cavalry brigade; each infantry brigade consists of two line regiments (exceptionally three) and one or two landwehr regiments; each cavalry brigade of two or three cavalry regiments. On the order for mobilisation the regiments are completed to war strength, the depôts formed, and the landwehr or garrison troops organised. A few slight alterations are made to equalise the army corps (the details of the war strength of which have been already given) to a uniform strength of 25 battalions, and a portion of the cavalry and one or two batteries of horse artillery are withdrawn from each corps to form separate cavalry divisions. The active army then takes the field, with the same organisation and under the same officers, corps and divisional commanders, brigadiers, staff, &c., that they have been accustomed to in peace.

Mobilisation. The instructions for mobilisation are minute and complete. Every year a "paper mobilisation" scheme is drawn up, showing the number of men and officers required to place every corps and detachment on war footing, and whence these would be obtained, and showing also on what duties the officers and men actually present would be employed. This scheme is completed at the army corps headquarters, and after revision by the War Minister, is approved and promulgated. Every individual thus knows beforehand what would be his duties in case of war, and the pith of the system lies in two short sentences in the "Secret Instructions"—"Every person in authority should know in peace what will be required of him on the order to mobilise, and must expect no further orders. All orders which have to be issued are to be kept ready in peace." The steps to be taken on mobilisation are detailed day for day. On the first day the War Ministry acquaints the commanders of army corps and principal military authorities, and also telegraphs direct to the commanders of landwehr battalion districts, to summon the reserves. On the second and third days the landwehr commanders complete the written summons, which are kept always ready, notifying to each man when and where he is to join; and these are sent out by aid of the civil authorities. The reserves for the field troops are called in first, the landwehr men one or two days later. On the fourth and fifth days the reserve men assemble, and are forwarded to their regiments, whence a few officers and non-commissioned officers have been sent to take charge of them. Meanwhile the regiments have formed their depôts, drawn the reserve clothing and equipment from their stores, and get everything in readiness to receive their augmentation men. Most regiments are complete and ready to take the field by the seventh day. As soon as the reserve men have all been despatched, the landwehr men are collected, and equipped from the stores at the headquarters of the battalion district. The landwehr battalions are mostly completed about the eighth day. The reserve cavalry and some of the administrative departments take a little longer, but in 1870 the mobilisation was so far completed that the movement of the army corps to the front could be commenced on the ninth day. The commanders of army corps, divisions, &c., accompany their commands, and are replaced in their local commands by temporary (*stellvertretende*) officials.

Appointment and Promotion of Officers.—The Prussian army draws its officers mainly from the *Kleinadel* or lesser nobility, corresponding to the country gentry of England. Promotions from the ranks are very rare, and generally carry with them retirement or transfer to the landwehr. A certain number of young men of middle class obtain commissions, but principally in the scientific corps or in the landwehr. First appointments are obtained either from the cadet schools or by entering the ranks as *avantageurs*. More than one-half the officers enter by the latter system. A young man seeking a commission obtains a nomination from the colonel of a regiment, which admits him to serve as a private, but with recognition of his being a candidate for the rank of officer, and as such he is called an *avantageur*. He is usually required to sleep and mess with the privates in their barrack-room for the first two months; after that he has more liberty given to him, and is sometimes received at the officers' table. After six months' service, and passing an examination in the subjects of a liberal education, he becomes qualified for promotion to the rank of *Porte épée Fähnrich* (swordknot ensign), a sort of intermediate position between the commissioned and non-commissioned ranks. After six months' further service in this rank he is sent to a military school for a ten months' course of instruction, at the close of which he is required to pass an examination in purely military subjects; and then becomes qualified for a commission, subject to being accepted by the officers of the regiment as worthy of admission among their number. The career of those youths who enter from the cadet schools does not differ materially from the above. The great majority enter as "avantageurs," and serve their time as already described, only passing the first or ensign's examination before they enter, and being appointed to regiments by the king, instead of obtaining nominations from the colonels. A certain number who pass through the higher classes of the cadet school enter the army at once as *Porte épée Fähnrich*, and serve their probation in that rank only; while a very few, the *selecta*, who take the highest honours, are given commissions direct. Promotion in the army depends solely on the will of the king, but in the main is governed by seniority; but exceptions are made in favour of officers of the general staff, who commonly receive a step of rank on completing a term of duty in any staff appointment, aide-de-camps of higher generals, instructors at the cadet and war schools, and officers who have specially distinguished themselves in the field. As a rule, promotion to the rank of captain is by seniority in the regiment, but above that rank by seniority throughout that branch, or by selection. Officers are also freely transferred from one branch to another; thus, after the battle of Gravelotte, the command of the rifle battalion of the guard was given to an engineer officer. Especial attention is bestowed on the selection of officers for the general staff. These are generally taken from those who have passed through the War Academy at Berlin, the highest educational establishment in the Prussian army. Candidates for admission to this academy must have served at least three years with their regiments, must pass a qualifying examination, and must be favourably reported upon by their commanders. The course lasts three years, and those officers who give proof of sufficient abilities are afterwards employed for a time on various military works, under the immediate supervision of the chief of the staff, who thus acquires a personal knowledge of the character and abilities of all staff officers. Occasionally officers specially recommended are taken direct from their regiments; but they are always tested by the chief of the staff before receiving appointments. The anxious care bestowed on the selection of officers for these important duties has borne its fruit: the Prussian staff has made itself a world-wide reputation, and to it and to the genius of its chief, Von Moltke, may be awarded a large share in the success of the Prussian arms. The army is equally fortunate in its corps of officers generally,—men who unite the power of command and the high qualities of an aristocracy with the most thorough knowledge of their profession and devotion to it. The pay of the Prussian officers in the lower ranks is small, usually about half that of the corresponding ranks in the English army, and lower than in most of the Continental ones; but the higher ranks are well paid, probably better than in any other army, if the relative value of money and cost of living are considered.

The strength of the Prussian system lies in its close localisation and permanent organisation. The first secures the strongest possible *esprit de corps* and the greatest simplicity and speed in mobilising; the second that familiarity of every individual with his position, duties, and surroundings, which is essential to the smooth working of so complicated a machine as a great national army. It is to these, coupled with the careful training, the subordination of everything to the army, and the ever-watchful foresight with which every contingency is studied and provided for beforehand, that the remarkable successes of the Prussian armies are to be attributed, rather than to the excellence of the material or to the special military qualities of the nation. Physically the Prussian soldier is not much if at all above the average. It is true that the guards and some of the regiments from the northern provinces are exceptionally fine, but the army is very unequal, and men of practical experience have declared the German, as a rule, to be not equal in power or in endurance to the Frenchman.[1] In quick aptitude for war the Frenchman has always had the advantage. Generally, where the two have met on equal terms the Frenchman has been victorious; and even through the disasters of the late war, impartial witnesses have asserted that, man for man, the Frenchman was the better. But such natural qualities as the Prussian soldier possesses have been developed to the utmost by a civil education superior to that of any other nation, and by a military training, physical as well as mental, which may well serve as a model to all armies. He is docile, temperate, simple in his tastes and aspirations; and though not so demonstrative as his French neighbour, and with no fanatical enthusiasm, has a deep love of his country and loyalty to his king. If not easily excited to heroism, neither is he easily discouraged. No Englishman can forget that memorable march, when the Prussian army, unshaken by the disaster of Ligny, undeterred by the difficulties of the road or the enemy thundering in their rear, pushed on with indomitable energy through all obstructions to succour their hard-pressed allies at Waterloo. The Prussian army, more than any other, is the *élite* of a nation; and so long as the nation consents to submit to the burdens of her present military system, and her affairs are guided by chiefs as able and far-seeing as her present rulers, she will hardly forfeit the position she has won as the first military power of Europe.

Saxon Army.

The kingdom of Saxony, with a population of $2\frac{1}{2}$ millions, furnishes one strong army corps (29 battalions of infantry and 6 regiments of cavalry) to the German army. The Saxons were long renowned as a warlike race, and played a prominent part in all the wars of Northern Europe; and her princes twice mounted the throne of Poland. At the outbreak of the wars of the French Revolution she maintained an army of over 30,000 men, and at first sided with Prussia. After the disasters of Jena and Auerstadt she allied herself with France, and for some years furnished a contingent to the armies of Napoleon, who in return recognised her elector as king, and largely increased his territories. The newly-made king remained faithful to Napoleon even in his reverses; but the army was too German in feeling to fight willingly under the French flag. In 1809 they did not distinguish themselves at Wagram, and their defection at Leipsic contributed not a little to the results of that bloody day. After the peace the king retained his title, though shorn of a great part of his dominions, and the army was reconstituted on a smaller scale. In 1866 Saxony sided with Austria, and her army shared in the disasters of that brief campaign and the crowning defeat at Koniggratz. At the close of the war she was compelled to ally herself with Prussia, and, as part of the North German Confederation, to place her military forces at the disposal of the Prussian monarch. In 1870 and 1871 her troops, under the command of the crown prince (now king) of Saxony, formed the 12th corps of the great German army, and bore their share in the battles of Gravelotte and Sedan and in the siege of Paris. Her army is organised in every respect as a Prussian army corps, and is under the command in chief of the German emperor, who, in concert with the king of Saxony, names the officers for the higher commands. She retains, however, her separate War Ministry, budget, &c.; and appointments and promotion to all but the highest commands are made by the king of Saxony. The Saxon troops fought well in the late war between Germany and France. In appearance they are smarter than most of the German troops, and have a certain resemblance to the English; but their uniform and equipment are assimilated in all respects to the Prussians.

[1] See the opinion of Mr Brassey, the eminent contractor, quoted in his *Life*.

Bavarian Army.

The kingdom of Bavaria, with a population of a little under five millions, furnishes two army corps to the German army. Like Saxony, Bavaria, originally an electorate, was enlarged and made into a kingdom by Napoleon. Under the command of Marshal Wrede, a distinguished Bavarian, her troops fought side by side with the French through the campaigns of 1805 to 1812, but in 1813 she seceded and joined the Alliance, and attempted to intercept the French on their retreat from Leipsic. Napoleon, however, inflicted a severe defeat on his old general at Hanau, and opened his road to France. In 1866 the Bavarians took part against Prussia, but owing to their dilatoriness in taking the field, the Prussians were able to beat them in detail, nor did their generals or troops shine in this war. In 1870, however, they joined their former enemy in the war against France, and bore their full share in the glories and losses of the campaign, the second Bavarian corps having suffered more heavily than any but the third Prussian corps. Her army has now been assimilated to that of Prussia in most respects, but still retains certain distinctive peculiarities of dress and equipment, such as her old light blue uniform, and helmet with black plume.

Würtemberg Army.

Lastly, Würtemberg, with a population of a little under two millions, furnishes one army corps, organised, clothed, and equipped in all respects like the Prussian army. Like the Bavarians, the Würtembergers fought against the Prussians in 1866, but in 1870 made common cause with them against the French, and by the convention entered into the following year, placed their army permanently under the command of the Prussian king as emperor. The emperor nominates to the highest commands, but the king of Würtemberg retains the nomination and appointment of officers in the lower grades.

The total military forces of the German empire (war strength) are shown in the following table :—

Field Troops.	Officers and Men.	Horses.	Guns.
Infantry—148 Regiments	453,731	15,540	...
,, — 26 Rifle Battalions	26,756	754	...
Cavalry—93 Regiments	62,234	63,932	..
Artillery—18½ Brigades	68,321	64,350	1800
Engineers—18 Battalions	15,457	3,221	...
Train—18 Battalions	36,315	43,386	...
Staff and Administration	14,029	13,404	...
Total Field Troops	676,843	204,587	1800
Depôt Troops	242,979	18,989	342
Garrison Troops[1]	431,869	34,522	318
Grand Total	1,251,691	258,098	2,460

But even this does not represent the entire force at the disposal of the empire in war. More than 100,000 trained soldiers still remain available; while the *Ersatz* reserve of men untrained, but registered, and ready to be drafted into the depôts, raises her total to over two millions of men.

French Army.

From the earliest times the inhabitants of Gaul were distinguished for bravery and enterprise. First as enemies and afterwards as subjects and auxiliaries, they played an important part in the great wars of Rome; and though they yielded to the irruption of the Franks, the admixture of races seemed only to heighten the warlike spirit of the nation. Under Charlemagne, and, later, in the Crusades, and under Philip Augustus and St Louis, the chivalry of France especially distinguished itself. The excessive power and independence of the great vassals, however, long prevented the formation of any permanent national force, and made France a prey to intestine wars and foreign invasions. Charles VII. availed himself of the lull which followed the final expulsion of the English in the middle of the 15th century to organise his *compagnies d'ordonnance*, and thus laid the foundation of a national standing army. But the armies that followed the kings in their wars still consisted mainly of foreign mercenaries, hired for the occasion; and the creations of Charles and his successors fell to pieces during the religious wars. Louvois, War Minister of Louis XIV., was the true creator of the French royal army. On his accession to power, the king's guards, some squadrons of *gendarmerie*, and a few infantry regiments (afterwards distinguished as the "old"), constituted the whole of the standing army. All other forces had to be created at the outbreak of a war, being usually raised under contracts allotted to generals and others. Louvois first transferred the army from the hands of contractors and speculators to those of the king. He abolished the *arrière-ban*, and substituted a money tax for the liability to service, thereby obtaining funds for the maintenance of a regular army. In 1672, after ten years of his administration, Louis XIV. was able to take the field with a force of 91,000 infantry, 28,000 cavalry, and 97 guns, all permanently organised troops, the largest national army that had yet been seen; and six years later the military forces of France had been raised to nearly 280,000 men. The last half of the 17th century is a brilliant period in the annals of the French armies. Organised by Louvois, animated by the presence of the great king, and led by Condé, Turenne, Luxembourg, Catinat, and Vendome, they made head against coalitions which embraced nearly all the powers of Europe, and won a series of victories that extended the bounds of France, and made her for a time the first military nation of Europe. But after the death of Louis XIV. the French army gradually deteriorated. In the Seven Years' War it was disgracefully defeated. Under the reign of Louis XV. confusion and maladministration prevailed everywhere, and the highest idea of military art was to copy servilely every minute detail of the Prussian army. The higher officers, usually nobles about the court, seldom went near their regiments; and Madame de Genlis relates how, when young courtiers departed to join their regiments for a few weeks' duty, the ladies of the court decked them with scarfs and favours, as if proceeding on a distant and perilous expedition.

Under Louis XVI. the army improved somewhat; the American war and the successes of Lafayette and Rochambeau revived a more warlike spirit; instruction was more carefully attended to, a good system of drill and tactics was elaborated at the camp of St Omer, and attempts made to reform the administration. But the Revolution broke over France in the midst of these attempts at reorganisation; the old royalist army disappeared with the monarchy, and was merged in that revolutionary army which under a new flag was destined to raise the military fame of France to its greatest height.

If Louvois was the creator of the royal army, Carnot was so of the revolutionary army. At the outbreak of the Revolution the royal army consisted of 105 infantry regiments of 2 battalions each, 14 rifle battalions, 7 regiments of artillery, and 62 regiments of cavalry, numbering about 173,000 in all, but capable of augmentation on war strength to 210,000. To this might be added a provincial or militia force of about 60,000, but nominal rather than

[1] Of these garrison troops, about 165,000 infantry, 10,000 cavalry, and 156 guns are available as reinforcements to the field troops.

real. At the very outset it was deemed necessary to reorganise and augment this army. Voluntary enlistment under the system of *racoleurs* or "bringers," by which the army had hitherto been fed, was found insufficient. "Compulsory service" was proposed in 1789, but rejected as "contrary to the liberty of the citizen." An appeal was then made to the patriotism of the nation, and 200 battalions of volunteers were enrolled; but though many presented themselves, and these volunteers contained much of the best blood and highest intelligence of France, the numbers fell far short of the expectations, and the proportion that reached the frontier was small. In the winter of 1792–3 the French armies, notwithstanding the unexpected successes of the preceding campaign, seemed on the point of dissolving altogether, and the Convention was driven to order a compulsory levy of 300,000 men.

To eradicate the royalist element from the army, the old regiments were broken up and amalgamated by battalions with the volunteers; and the name even of "regiment" was abolished. Promotions were made, not by seniority of rank, but length of service; thus an old sergeant succeeded to the command of a regiment over the heads of all the captains. In August 1793 the affairs of France were at their lowest ebb. Its armies had been driven from the Rhine and out of Belgium, and a dangerous insurrection had broken out in La Vendée. The compulsory levy, slowly and imperfectly carried out, had not yielded the full number; and those that were obtained deserted by hundreds. The nominal strength amounted in all to 480,000 men, but one army with a paper strength of 90,000 had really only 33,000 in the ranks, and the others were little better. Under the new system of promotion commands changed almost daily, and fell into the hands of men who had never before been entrusted with more than a section; and confusion reigned everywhere.

Such was the position when Carnot, then a captain of engineers, was called to the Ministry of War. A few days later a levy *en masse* of all the male population between the ages of 18 and 25 was ordered, and was carried out with more method and success than former levies. The muster-rolls of the armies filled rapidly, and by the end of the year the effective force had risen to 770,000. The amalgamation of the old army and the volunteers, which had been commenced, but imperfectly carried out, was effected on a different and more thorough principle; the white uniform distinctive of the old days of royalty was abolished, the infantry organised in demi-brigades of three battalions (usually one of the old army to two of volunteers), and the men and cadres intermixed within the demi-brigade. A permanent organisation in divisions, composed of all arms, was introduced, and able officers selected for the commands. Jourdan, Hoche, Pichegru, Kleber, Moreau, were at the head of the armies of the republic. Arsenals and manufactories of warlike stores were created, schools of instruction were established; the republican forces were transformed from hordes to armies, well disciplined, organised, and equipped. The enemies of France were defeated at all points; and in tracing the plan for the campaign of 1794 Carnot showed that his genius shone in strategy as much as in administration. "Twenty-seven victories, of which 8 in pitched battles, 120 combats; 80,000 enemies *hors de combat*; 91,000 taken prisoners; 116 fortresses or important towns taken, 36 of them after siege or blockade; 230 forts or redoubts carried; 3800 guns, 70,000 muskets, 1900 millions of powder, and 90 colours captured;"—such was the account Carnot was able to give of eighteen months of office; and at the close he returned to his duty as a simple major of engineers. And even this did not do justice to all he had effected. Himself of an almost Roman type of character,—severe, but a true patriot and republican,—he had succeeded in infusing much of his own spirit into the army; he had given it not merely discipline and organisation, but honour and soldierly feeling. When Moreau promulgated to his army the decree of the Convention, which forbade them to give quarter to any Englishman or Hanoverian, he added, in general orders, "I have too high an opinion of French honour to believe that such an instruction will be obeyed;"—and he was right.

In the year 1796 Napoleon appeared on the scene, and by a series of brilliant victories enlarged the frontiers of France and secured a glorious peace. But the exhaustion of years of continuous warfare had made itself felt: the armies were reduced to mere skeletons, and no sufficient means existed of replenishing them, till in 1798 the *conscription* was introduced. From that time there was never a dearth of men: the whole male population of France was practically at her ruler's disposal; and Napoleon had full scope for his genius in organising these masses. His principal improvements were effected in the interval between the peace of Amiens and the war with the third coalition, while threatening the invasion of England. His armies were collected in large camps on the coasts of the Channel, and there received that organisation which, with minor variations, they retained during all his campaigns, and which has since been copied by all European nations. The *divisions*, as organised by Carnot, consisted usually of two brigades (twelve battalions) of infantry, two regiments of cavalry, and two or three batteries of artillery. This was a great improvement on former organisation, and worked well in the comparatively small armies which then took the field. But in large armies of 150,000 men and upwards the number of isolated commands was too great. Further, it had been found by experience that the very completeness of the divisional organisation—each division forming a miniature army complete in all branches—tended to excessive independence of action on the part of the divisional commanders. Napoleon therefore grouped two or three divisions into *corps d'armée*, commanded by marshals. He withdrew the whole of the cavalry and a portion of the artillery from the divisions, and with the light cavalry and batteries so obtained formed a reserve corps under the immediate orders of the corps commander; while he kept the whole of the heavy cavalry, amassed in cavalry divisions, his guards, and a certain proportion of artillery, in his own hands, as a reserve to the whole army. Thus was organised that "grande armée" which immortalised itself at Ulm, Austerlitz, Jena, Friedland, Wagram, and Borodino; and after planting the tricolor on every capital of Europe, perished at last in the snows of Russia.

The frightful expenditure of life during Napoleon's wars almost drained France of her manhood, and his frequent calls on the country made the name of the conscription detested. One of the first acts of the Restoration was to abolish it, and return to voluntary enlistment; but it was soon evident that this means of recruiting no longer sufficed, and within three years compulsory service had to be again resorted to. In 1818 the annual contingent was fixed at 40,000, and the period of service at six years; in 1824 the contingent was increased to 60,000, and in 1832 to 80,000. Of this, however, a part only, according to the requirements of the service, were enrolled; the remainder were sent home on leave or furlough. Up to 1855 certain exemptions were authorised, and substitution or exchange of lots amongst young men who had drawn was permitted, but the individual drawn was obliged either to serve personally or find a substitute. In 1855 the law of "dotation" or exemption by payment was passed, and put an end to personal substitution. The state now undertook to provide substitutes for all who paid a fixed sum, and did so by high bounties to volunteers or to soldiers for re-engaging. Although the price of exemption was fixed as high as £92, on an average 23,000 were claimed annually, and in 1859 as many as 42,000 were granted. Thus gradually the conscription became rather subsidiary to voluntary enlistment, and in 1866, out of a total establishment of 400,000, only 120,000 were conscripts. Changes had also taken place in the constitution of the army. On the Restoration its numbers were reduced to 150,000, the old regiments broken up and recast, and a royal guard created in place of the old imperial one. When the revolution of July 1830 had driven Charles X. from his throne, the royal guard, which had made itself peculiarly obnoxious, was dissolved; and under Louis Philippe's reign the army was augmented to about 240,000 with the colours. Under the Provisional Government of 1848 it was further increased, and in 1854, when France allied herself with England against Russia, the army was raised to 500,000 men. The imperial guard was re-created, and every effort made to revive the old Napoleonic traditions in the army. In 1859 Napoleon III. took the field as the champion and ally of Italy, and the victories of Montebello, Magenta, and Solferino raised the reputation of the army to the highest pitch, and for a time made France the arbiter of Europe. But the campaign of 1866 suddenly made the world aware that a rival military power had arisen, which was prepared to dispute that supremacy. From this time a trial of strength between France and Prussia was looked forward to as inevitable, and both sides prepared for the coming struggle. Niel, the then War Minister of France, saw clearly that the organisation which had with difficulty maintained 150,000 men in Italy, was no match for that which had within a month thrown 250,000 into the very heart of Austria, while waging a successful war on the Maine against Bavaria and her allies. In 1867, therefore, he brought forward a measure for the reorganisation of the army, by which he calculated to raise the military force to 800,000 men—half of them with the colours and half in reserve—besides forming a separate army for home defence in case of need. It is not necessary to dwell on the law of 1868, for it remained but two years in real operation. To complete Niel's scheme many years were required; but Niel himself died within a year, and the next year saw the French army annihilated, or existing only as prisoners of war in Prussia.

At the outbreak of the great Franco-German war the French field troops consisted of 368 battalions, 252 squadrons, and 984 guns. The strength of the entire army on peace footing was 393,000 men; on war footing, 567,000. The forces immediately available for the war on the Rhine were estimated at 350,000, but they actually fell short of 300,000. They formed 8 *corps d'armée*, each composed of from two to four infantry divisions and one cavalry division,—making a total of 26 infantry divisions of 13 battalions each, 11 cavalry divisions of from 4 to 7 regiments each, and 756 guns. Within seven weeks the whole of this army, with trifling exceptions, was either captive in Germany or hopelessly shut up in Metz. But the spirit of the nation rose to the occasion, and though, as the result proved, extemporised armies can do little against veteran ones, the efforts of the people and the creative energy of her rulers will always command admiration. The next year's contingent of recruits was called out and hastily trained. Fourth battalions were formed from the depôt *cadres*, and organised into *régiments de marche*. The *gardes mobiles* were mobilised, and by successive decrees and under various names nearly all the manhood of the country called to arms.

The regular troops raised as *régiments de marche*, &c., amounted to 213,000 infantry, 12,000 cavalry, and 10,000 artillery. The *garde mobile* exceeded 300,000, and the mobilised National Guard exceeded 1,100,000—of whom about 180,000 were actually in the field and 250,000 in Paris; the remainder in camps or depôts. Altogether the new formations amounted to nearly 1,700,000, and if to that be added the army existing at the beginning of the war, the total forces developed by France during the struggle reach the enormous amount of 2¼ millions.

The reorganisation of the army took precedence of all other questions when the conclusion of peace with Germany and the suppression of the communist revolt gave rest once more to the country. By the law of recruiting of 1872 compulsory personal service was introduced, and substitution or purchase of exemption was abolished. The period of liability was fixed at twenty years—five years of the time to be passed in the regular army, four years in the reserve of the regular army, five years in the territorial army, and six in the reserve of the territorial army. The annual contingent is not a fixed one, or determined by the actual requirements of the army, but includes all capable of bearing arms; certain exemptions in favour of only sons of widows, sole supports of families, teachers, and theological students excepted. But as the peace establishment, governed by financial considerations, would not admit of retaining the whole of five years' contingents with the colours, it was provided that the contingent should be divided by lot into two classes, the first to serve the full five years, the second to be sent home after six months' or a year's training. One-year volunteers are admitted on conditions similar to those existing in Prussia. In the calculations on which the law was based it was estimated that about 300,000 annually came of age, of whom about one-half would be rejected as unfit, or exempted on personal or family grounds. Of the remaining 150,000, one-half would serve for the full five years, the remainder for six months or a year only; and the peace army would thus comprise four yearly contingents of 75,000 and one of 150,000. Deducting the one-year volunteers, a percentage for casualties, and the men of the fifth year who would usually be sent home on furlough, the remaining four classes give about 350,000; and adding 120,000 to this for the permanent part of the army, the total of 470,000, being the proposed peace establishment, is obtained.

The organisation of the army was made the subject of a separate law passed in 1873. The land forces are divided into the *active army* and the *territorial army* or landwehr. The active army consists of 18 *corps d'armée*, besides a special corps for service in Algeria; each corps is composed of two divisions of infantry, a brigade of cavalry, a brigade of artillery, a battalion of engineers, and a squadron of the military train, and retains its organisation permanently in peace and war. The total strength of an army corps is about 40,000 of all ranks, or about 30,000 combatants, with 108 guns. The country is divided into 18 "regions," and each region has always a corps stationed within it, and is provided with magazines and stores of all sorts required to equip the corps for the field, and to furnish out the depôt and territorial army as well. The army corps are not permanently localised, but are moved from district to district; and on mobilisation they draw their reserves and stores from the districts in which they happen to be stationed. Recruiting is partly general and partly regional; those recruits who are drawn for five years being distributed throughout the army, while those who have to serve one year only are attached to the corps stationed in their district. For recruiting and for purposes of mobilisation the "regions" are subdivided, each subdivision comprising one or more recruiting offices, in which the recruiting lists, as well as the registers of all furlough or reserve men, and men belonging to the territorial army, are kept. As a rule, each such office corresponds to a battalion of the line, and has from 2000 to 3000 names on its books. The general commanding an army corps has under his orders all military forces (territorial or reserve troops as well as active) and establishments within the district. He is assisted by a staff divided into two sections, of which the first or active part accompanies the active army on mobilisation, while the second or territorial part is permanently attached to the district, and is specially charged with recruiting, remounts, and all local affairs, and remains stationary on mobilisation. No general can hold the command of an army corps for more than four years. At the head of each subdivisional recruiting office is placed an officer of rank corresponding closely to the landwehr battalion district commander in Prussia. All soldiers of the active army, reserves, or territorial forces who are living at their homes, under whatever conditions, and are domiciled within his subdivision, are under his orders. The *territorial army* exists in cadre only in peace time; but its cadres are always formed and its organisation established. It is officered by retired or half-pay officers and one-year volunteers, or old non-commissioned officers who, on completing their army service, have qualified as officers of the territorial army. The reserve of the territorial army is not called out except in case of absolute necessity, and then by classes beginning with the youngest.

The military forces of France under the new laws are estimated as follows, allowance being made for casualties:—

Active army (5 classes),	705,000
Reserve of active army (4 classes),	510,000
Temporary exemptions,	141,000
Permanent part of army,	120,000
Total of active forces,	1,476,000
Territorial army—	
5 classes, organised,	582,000
6 classes (reserve), not organised,	626,000
Total,	1,208,000

In estimating the numbers available for the active army, however, deductions must be made for the last class of recruits (150,000) and the temporary exempts (141,000), who are untrained, and for a number of non-effectives, estimated at from 150,000 to 200,000, which would reduce the total to about 1,000,000. And further, in comparing these numbers with those of the German army, it must be borne in mind that, whereas almost every man on the German lists has received his three years' training, nearly one-half of the French army is composed of men who have served a year or less with the colours. The peace establishment of the French army is fixed at 450,000; the war establishment of the field army, exclusive of depôts and garrison troops, at 780,000.

The French field army now (1874) numbers 496 battalions of infantry, 380 squadrons of cavalry, and 380 batteries; being 126 battalions, 56 squadrons, and 158 batteries in excess of its strength at the outbreak of the war of 1870. The imperial guard has been broken up, and its soldiers distributed throughout the army. Of the creations of the war, the mobilised national guard has been disarmed and dissolved; the *gardes-mobiles* sent home, but inscribed as reserve of the army; and the *régiments de marche* have been partly disbanded, partly amalgamated with the regiments from whose depôts they had been formed. The *infantry* consists of 144 line regiments, each of 3 active and 1 depôt battalion; 4 regiments of Zouaves and 3 of Turcos, each of 4 field battalions and a weak depôt; 36 rifle battalions (*chasseurs*) of 6 field and 2 depôt companies each; a foreign regiment; and 3 battalions of Algerian light infantry ("Zephyrs"). The peace establishment of a regiment of the line is about 2000; the total strength of the infantry, 298,000.

The *cavalry* consists of 12 regiments of cuirassiers, 26 of dragoons, 12 of hussars, 20 of *chasseurs-à-cheval*, 4 of *chasseurs d'Afrique*, and 3 of Spahis. Notwithstanding the reputation which the Prussian uhlans had acquired in the war, one of the first acts of the French Government was to abolish the lance, and transform the old lancer regiments into dragoons. Each regiment consists of 5 squadrons, 4 of them field and 1 depôt, and numbers about 900 men and 800 horses; the total strength of the cavalry is 58,000 men and 50,000 horses.

The *artillery* consists of 38 regiments, of which 19 have each 10 field batteries, and 19 have 6 field and 4 horse-artillery batteries. The battery has six guns. The artillery further comprises 30 garrison batteries, a regiment of pontoniers, 15 companies of artificers, and 2 regiments of artillery train. The total peace strength of the artillery is 45,000 men and 24,000 horses.

The *engineers* consist of a staff of 462 officers and 570 men, and 3 regiments, forming 48 companies of sappers, 6 of miners, and 3 of engineer train. These are ultimately to be formed into 19 independent batteries.

The key to the French military character, its strength and its weakness, is well given by one of their own writers, Blondel:—"We love the roll of the drum, the coquetry of uniform, the roar and tumult of battle; but *obedience* is burdensome to us,—it is strange to our character and to our time. The ruling spirit of criticism is injurious to discipline, and too often the study of duties is overlooked in the study of rights. The *warlike* spirit of the ancient Gauls has remained as an inheritance to their descendants; but notwithstanding the fame which our arms have achieved in all epochs of our history, the true *military* spirit is rare in France." This warlike spirit, which the French possess perhaps beyond any other nation, is a matter of race and temperament; the military spirit is the result of a nation's training, and in that the French have been singularly unfortunate. From the time that the Franks, fourteen centuries ago, subdued the original Gallic or Celtic population of France, the nation was divided into two sharply-defined classes, the conquerors and conquered. The former alone were warriors and free; the latter were mere serfs condemned to till the ground and labour. The Frank chivalry was renowned through Europe; but the peasant was perhaps the most abject of his class. This it is that explains the difference between the helpless crowds of footmen that followed the French nobility to battle, and seemed only brought there to be slaughtered, and the sturdy British archers who formed so important an element of strength in the English armies. Hence also the difficulty found in raising an efficient national infantry; as their own king, Francis I., says in his manifesto to the German princes—"We have in our land no foot soldiers, because our ancestors trained our peasantry to agriculture rather than war." Even in the days of Louis XIV. and Louis XV. the foreign troops amounted to one-third or one-fourth of the army, and formed distinct corps, usually receiving higher pay. The brilliant feats of arms that gave such *préstige* to the French name were mostly performed by he gay and gallant aristocracy. It was the "Maison du Roi who seized Valenciennes in broad day by a *coup de main*, who decided the battle at Steinkirk, who broke the column of Fontenoy. The common soldiers were *canaille*, separated by an infinite gulf from their officers. All this was changed by the great Revolution. The former slaves became masters, but they had had no training to qualify them for freedom, and that "law-abiding" spirit that marks the German and Anglo-Saxon races was wanting in them. The old warlike spirit was revived and stimulated by the enthusiasm of newly-acquired liberty; and Napoleon knew how to turn to account the admirable material he found to hand. But while he knew better than any one how to stimulate this martial ardour, he did nothing to raise the tone of the army or inculcate a sense of duty. Glory and rewards were the two levers of action he trusted to; and the extravagant "dotations" bestowed on all occasions on his followers did much to create that mercenary spirit that has ever since tainted the army. To the French soldier war means glory, promotion, plunder: if these are not immediately attainable, he becomes impatient, and blames his leaders. Physically the Frenchman is smaller than the German or Englishman, but is usually better formed about the hips and lower limbs, more active, and more enduring. Mr Brassey, the great contractor, ranks him next after the Englishman and before the German for power of work. Of a gay, volatile, excitable temperament, he has always distinguished himself by impetuosity in attack, but has not shown equal constancy and perseverance in maintaining the contest. A brilliant offensive brings out all his best qualities; he has a natural aptitude for war, a quick eye to seize the situation, and the *furia Francese* has become proverbial; but on the defensive he becomes impatient and discouraged, and he is soon demoralised by defeat and disaster. It is then, when discipline and duty alone hold men together, that the want of the true *military* spirit makes itself felt, and till this is created in France, even her most brilliant successes must be uncertain and transitory.

Austrian Army.

The imperial army of Austria may be said to date from the Thirty Years' War. Long before that, Maximilian I. had established a corps of "kyrisser" (original of the modern cuirassiers), and taken into his pay a considerable force of "landsknechts," the early German infantry. But the latter were companies engaged for the war only, and disbanded at its termination; and it was not till the reign of Rudolph II. (about 1600) that any permanent regiments were formed. Even these can hardly be counted as belonging to the imperial army, for the men composing them were only indirectly subject to the sovereign, and really obeyed their own chiefs, who could transfer their services to other powers. It was Wallenstein who first raised a distinctly imperial army of soldiers owing no duty but to the sovereign; and it was the suspicion that he intended to use this army, which was actually raised largely at his own expense, to further his own ends, that led to his assassination. From that time the regiments belonged no longer to their colonels, but to the emperor; and the oldest regiments in the present Austrian army date from the Thirty Years' War. At the close of the war Austria had 19 infantry and 7 cavalry (6 cuirassier, 1 dragoon) regiments. Half a century later her forces had increased to 40 regiments of infantry and the same of cavalry; and in 1809, when she put forth her whole strength for the great struggle with Napoleon, she had 61 infantry regiments (46 German and 15 Hungarian) and 45 of cavalry. Up to the beginning of this century, her armies were recruited almost entirely by voluntary enlistment; but, like all the other powers, she was compelled to follow the example of France, and have recourse to the conscription during the great Revolutionary wars. During the half-century which intervened between the final overthrow of Napoleon and her struggle with Prussia for supremacy in Germany, various minor alterations were introduced, but in the main her military system remained as it was at the close of the great war. The conscription continued in force, the period of service being fixed at ten years, eight of them in the ranks and two in the reserve; unlimited furloughs, however, were largely granted, and the actual service in the ranks seldom exceeded six years, and was often reduced to two or three in the infantry. The disastrous war with Prussia in 1866, and the new constitution finally granted in 1867, led to an entire revision of her military institutions in the following year, and her present organisation is based on the law of 1868.

The armed forces of Austria consist of the *standing army*, which in peace time, on a reduced footing, serves as a school for training the nation to arms, and in war time, completed by its reserves, forms the field army; the *landwehr*, which in war time acts as a support to the field army and provides for home defence; the *Ersatz reserve*, from which casualties in the field army are replaced; and the *landsturm*, a national levy only called out to resist invasion. The war establishment of the standing army is fixed at 800,000; the peace establishment varies, being governed by financial considerations, but is usually about 250,000.

Every male citizen capable of bearing arms becomes liable to military service on completing his twentieth year. Exemption by payment, or by providing a substitute, is not allowed; and those who are exempted on physical grounds are required to pay a sum of money, proportioned to their means, into the military pension fund. Temporary exemptions are, however, granted, as in other armies, to only sons of widows and others who are the sole supports of families. The period of service, or liability to service, lasts for twelve years. The annual contingent of young men passed as fit for service is divided, by lot into three classes. The first form the standing army, and serve for three years in the ranks, seven in the reserve of the army, and two in the landwehr. The strength of this first class is determined by the annual requirements of the army, and was fixed at 95,000. The second class forms the "Ersatz" reserve, or reserve for recruits of the standing army. They are not trained at all, but for ten years remain liable to be called in in case of war to fill the depôts and replace the casualties of the field army. The total strength of the "Ersatz" reserve may not exceed that of one year's contingent for the active army; the annual "Ersatz" reserve contingent is therefore fixed at $\frac{1}{10}$th of this. The third class, including all who are not drawn for the two preceding ones, are passed at once into the landwehr, in which they serve their twelve years. The organisation of the landwehr varies in the different provinces. Austria, as far as its military institutions are concerned, is divided into four distinct provinces, viz., Austria proper, Hungary, Tyrol and Vorarlberg, and the military frontier. The landwehr of these provinces are distinct, and cannot be moved out of their own provinces except by authority of the Reichsrath or central parliament. Most of the landwehr are trained for eight weeks on first joining, and fourteen days annually afterwards. The Hungarian militia, or "honveds," as they are called, are better trained than the others. Apparently with the object of providing a more distinctly national force, the Hungarian diet has made arrangements by which one company of each regiment is kept permanently embodied for instruction purposes, so that every man shall have a full year's training. The landwehr also includes the men who have completed their ten years in the army and reserve, and have to serve for two years in the landwehr. These are intended to provide a steadying element of old soldiers; but as many of them have only actually served two years in the ranks, and been away from their colours for eight, their value is doubtful. The number of young men coming of age and fit for service amounts to 140,000 to 150,000 annually. Of these, 95,000 are passed into the army, and about 10,000 into the "Ersatz" reserve; and the balance, averaging about 40,000, into the landwehr. The landwehr thus comprises two years' contingents of old soldiers (which, after deductions, may be estimated at about 150,000), and twelve years' contingents of about 40,000; or a total, after allowing for casualties, of between 500,000 and 600,000. The actual organisation, however, only provides for incorporating about one-third of this number. Service in the landsturm is voluntary, except in Tyrol, where all the male population capable of bearing arms are enrolled, and divided into two classes; the first including all between 18 and 39 who are not actually serving in the army or landwehr, the second those between 30 and 45. All liability ceases at the age of 45.

The standing army consists of—

	Peace Establishment.	War Establishment.
80 Regiments of Infantry,	149,720	485,440
40 Battalions of Rifles,	19,860	58,430
Total Infantry,	169,580	543,870
41 Regiments of Cavalry,	44,000	58,670
13 Regiments Field Artillery,	19,210	41,870
12 Battalions Garrison,	7,790	18,910
Total Artillery,	27,000	60,780
2 Regiments of Engineers,	5,710	16,350
1 Regiment of Pioneers,	2,800	7,750
12 Squadrons of Train,	2,600	30,900
Engineers and Train,	11,110	55,000
Miscellaneous Establishments,	23,860	33,760
Grand Total,	275,550	752,080

with 644 guns on peace establishment, and 1600 on war establishment. There is no special corps of guards, as in the Prussian and Russian armies; the "imperial and royal guards," which include the archers of the body-guard, the palace guard, the Hungarian crown guard, &c., only number 600 in all; and their duties are ceremonial and police rather than combatant.

Infantry.—An Austrian infantry regiment consists of 5 field battalions of 4 companies each, and 1 depôt battalion of 5 companies. In peace time the first three battalions are maintained on a peace-establishment of 386 of all ranks, the fourth and fifth on a reduced or *cadre* establishment of 300, and the depôt battalion in *cadre* only (21 officers and non-commissioned officers). The first three battalions are mobile, their stations being determined by the *ordre de bataille;* and they are always under the immediate command of the colonel of the regiment. The fourth and fifth and depôt battalions remain permanently at the headquarter station of the regimental recruiting district, and are under the command of a colonel or lieutenant-colonel (regimental second in command), called the reserve commander, who is also head of the recruiting district, and charged with all duties connected with the annual conscription, calling out of reserves, &c. The captain commanding the depôt battalion acts as his assistant in these duties. The staff of the depôt battalion conduct all business relating to the muster-rolls and registers of reserve and furlough men, and have custody of the augmentation stores of clothing, arms, ammunition, &c. Its own muster-roll is composed mainly of men who, after an eight weeks' training, have been sent on furlough, but held ready to fill vacancies occurring in the field battalions. The annual contingent of recruits is distributed among the five field battalions, and trained at their headquarters. In war time the five field battalions are raised to a war strength of 952 of all ranks, and the depôt battalion to 1155, by calling in the reserve and furlough men.

If the field force is still found insufficient, a sixth field battalion may be formed from the first four companies of the depôt battalion; and the fifth depôt company, under the command of the deputy of the district commander, then takes over all the depôt duties, being augmented for the purpose. The regiment forms two distinct bodies, the first three battalions, under the regimental commander, taking their place in the active army according to the *ordre de bataille;* the remaining two (or three) forming a "reserve regiment," bearing the same number, which may or may not be brigaded with its own regiment.

A *rifle battalion* consists of four field companies, a reserve company, and a depôt company: the four field companies forming a field battalion, which is stationed according to the *ordre de bataille,* while the reserve and depôt companies remain at the recruiting headquarters. In peace time the field battalion has a strength of 460 of all ranks, the reserve company 72, and the depôt company a *cadre* only. In war the field battalion is augmented to 989, the reserve company to 240, and the depôt company to 232. The 40 reserve companies are formed into 10 reserve battalions of 4 companies each; and, if necessary, 10 additional reserve battalions can be formed from the depôt companies, leaving only a sufficient staff to train the "Ersatz" reserve and perform the other depôt duties. Seven of the existing rifle battalions form together the "Imperial Tyrol Rifle Regiment;" the remainder are single battalions, numbered from 1 to 33.

The Austrian infantry stand two deep, but in somewhat looser order than is usual in other armies; their usual formation is in line of company columns, with intervals of three paces if in "mass," or deploying intervals if extended, the companies being formed in columns of sections. Their movements are rather loose but quick; and their new drill gives great independence of action to captains and subordinate commanders. They are armed with breech-loading rifles, partly on the "Wänzl" pattern, and partly on the "Werndl." The troops armed with the former carry 60 rounds, those armed with the latter 72 rounds of ammunition; and the regimental ammunition waggons carry in addition 30 rounds for the former and 36 for the latter. The old white tunic, long distinctive of the Austrian army, has been abolished, and replaced by a serviceable blue-grey uniform. The Hungarian regiments are distinguished by wearing pantaloons, fitting close to the leg and going inside the boot, instead of the trousers worn by the rest of the infantry.

Cavalry.—The cavalry consists of 14 regiments of dragoons, 16 of hussars, and 11 of lancers. The cuirassiers were converted into dragoons after the war of 1866 (only 2 dragoon regiments existed at the outbreak of that war), and the distinction between the heavy and light cavalry was abolished at the same time. The dragoon regiments are mostly raised in the German provinces of Austria, the hussars in Hungary, and the lancers in the Polish provinces.

A cavalry regiment consists of 6 field squadrons, a depôt, and a reserve squadron. The 6 field squadrons are kept permanently on a war footing, and form the field regiment which in peace time is stationed according to the *ordre de bataille,* and in war joins the active army: its establishment is 30 officers, 996 non-commissioned officers and men, and 900 horses. The reserve squadron does not exist in peace time, but is formed on mobilisation from the depôt, and has the same establishment as a field squadron (171 men and 150 horses); it is chiefly employed as "staff" cavalry,—to furnish orderlies, escort convoys, watch lines of communication, &c. The depôt squadron is maintained as a *cadre* only (19 of all ranks) in peace time, but in war time, besides forming the reserve squadron, is itself raised to a strength of a field squadron. The depôt *cadre* is permanently stationed in the recruiting district (a cavalry regiment recruits from one or more adjoining infantry recruiting districts), and has charge of the clothing, arms, and equipment of all kinds of the furlough and reserve men, and the registers and muster-rolls, but has nothing to do with the training of either recruits or young horses, who are sent direct to the field squadrons. In recruiting for the cavalry, young men of strong frame, accustomed to horses, and of a minimum height of 5 feet $3\frac{1}{2}$ inches, are selected. The remounts of horses are bought by commissions, and are trained and broken at the headquarters of the field squadrons; 12 per cent. of its establishment being the maximum number of remounts allowed yearly to a regiment. The Austrian cavalry has always borne a very high reputation, and its drill is considered by competent judges to be the best in Europe. Much of the old pedantry of drill has recently been swept away, and replaced by a more serviceable system. The soldiers now rise in their stirrups, ride with both hands, and only draw swords when necessary. The instruction of recruits and training of the horses falls almost entirely on the subaltern officers of the field squadrons—commencing on the 1st October, when the annual contingent of recruits is called in, and lasting till the end of June, when the tactical instruction of the squadron is supposed to be complete; from July to September is devoted to drilling in regiments and larger bodies. The hussars and dragoons are armed with breech-loading carbines and swords; of the lancers, 32 men per squadron carry carbines, the rest lances, pistol, and sword.

Artillery.—The artillery consists of 13 regiments of field artillery and 12 battalions of garrison artillery. A regiment of field artillery on peace establishment consists of 12 batteries, viz., four 4-pounder field batteries, three 4-pounder horse batteries, and five 8-pounder field batteries; and the *cadres* for two more 8-pounder batteries, a depôt battery, and five ammunition columns. The batteries have only 4 guns horsed in peace. The *cadres* of the depôt and two 8-pounder batteries remain at the headquarter station of the recruiting district; the other batteries are stationed and detached according to circumstances. In war the batteries are raised to a strength of 170 or 200 men, with 8 guns, 8 ammunition and 6 other waggons, and 109 to 147 horses. Two additional 8-pounder field batteries and a depôt battery are formed by each regiment from its *cadres*, and 5 (in some regiments 6) ammunition columns. A field artillery regiment on war establishment thus numbers 14 batteries or 112 guns; and as a rule a regiment is attached to each army corps of 3 infantry divisions Of the ammunition columns, 3 carry artillery and infantry ammunition in about equal proportions (12 infantry ammunition waggons and 14 artillery waggons), and are attached, one to each infantry division; the others carry principally artillery ammunition, and small-arm ammunition for the cavalry, &c., and are attached to the army corps headquarters or the army ammunition park. The Austrian field guns are rifled muzzle-loaders, of bronze. The 4-pounders and their ammunition waggons have four horses in the field batteries, and six in the horse batteries; the 8-pounders and their ammunition waggons are six-horsed. A 4-pounder battery carries 156 rounds per gun an 8-pounder 128 rounds. The remounts of horses are obtained by purchase as in the cavalry, but a larger and heavier class of horse is selected for the artillery.

A battalion of garrison artillery consists of 6 companies, of which in peace time 5 are maintained on a peace establishment of 113 of all ranks, and 1 on a *cadre* establishment. In war they are all augmented to a strength of 234. The companies of garrison artillery are employed in the defence or attack of fortresses. A small number of mountain batteries, armed with 3-pounder rifled bronze mountain guns, are attached to the garrison battalions.

The artillery further includes a certain number of "artillery reserve establishments" (siege parks, reserve ammunition parks, &c.), which are only organised in war, and the "artillery material department," which is charged with the construction and supply of all warlike stores in peace, and in war has further to furnish companies of field artificers to the siege parks and artillery reserve establishments. The great factory and depôt for all artillery *matériel* is the artillery arsenal at Vienna, an establishment of great antiquity and celebrity. The principal powder factory is at Stein, near Laibach. Laboratories are established at Wiener-Neustadt, at Vienna, in immediate connection with the arsenal, and at most of the principal artillery stations.

Engineers.—The engineers include two regiments of engineers and one of pioneers. A regiment of *engineers* consists of 5 field battalions of 4 companies, 8 reserve companies, and a depôt battalion. In peace time the reserve companies and depôt battalions are maintained in *cadre* only. In war time all the companies are raised to a strength of about 230 of all ranks; the field battalions accompany the active army, a company being usually attached to each infantry division, and a battalion to the army reserve; the reserve companies are employed on the lines of communication. The general duties of the engineers consist in carrying out all works connected with the investment, attack, and defence of fortresses, strengthening positions, opening communications, &c. The *pioneers* form 1 regiment of 5 battalions; each battalion composed of 4 field companies, 1 reserve company (in *cadre* only in peace time), and a *matériel* reserve. In time of war each battalion forms a depôt company as well. The pioneers are charged with the pontoon equipment; the construction of all bridges; and the construction, repair, and working or destruction of railways and telegraphs. They form 15 "field railway divisions" in war, 5 of which are kept mobilised in time of peace, to afford instruction in this most important branch of modern military engineering. The officers of the pioneer corps are trained at the cadet school at Hainburg. Special care is taken in the selection of recruits for the engineer and pioneer regiments. As a rule, they must be of a minimum height of 5 feet 6 inches, of considerable physical strength, and of some education; and most of them must be mechanics. The standard of height is, however, relaxed in the case of skilled workmen.

Military Train.—The transport of the Austrian army is provided for partly by the military train, partly by the regimental transport attached to the several arms. The military train consists of 36 field squadrons, 36 reserve squadrons (in *cadre* only in peace time), 6 depôt squadrons, and 6 *matériel* depôts. In peace time the train forms a mere nucleus, capable of expansion in war, and supplies the transport required by the military authorities in some of the chief garrison towns; its whole strength is only 2500 men, with 500 waggons and 1250 horses. In war time it is raised to a total of nearly 31,000 men, with 12,000 waggons and 36,000 horses. The 36 field squadrons are raised to a strength which varies from 173 men and 197 horses, to 547 men and 718 horses, according to the special duties they have to perform. The 36 reserve squadrons are raised to the same strength, and a similar number of "Ersatz" divisions are formed to carry out the duties which in peace time were performed by the field squadrons. On mobilisation the field squadrons, as a rule, transfer the horses actually in their possession to the field artillery; and are themselves completed in horses partly by purchase and partly by requisition, and in men from the reserve, who have been trained in their ranks, and from the cavalry reserve men who are not required to complete the cavalry regiments. When an army takes the field, one squadron of military train is allotted to each infantry or cavalry division, one to each army and army corps headquarters, one to each pioneer battalion for the transport of its bridge equipment, and one to the artillery reserve and ammunition park. A squadron attached to an infantry or cavalry division is formed into five sections, of which the first provides the necessary transport for the divisional and brigade staffs and the field hospital; the second, third, and fourth for the provision column; while the fifth or reserve section supplies all necessary reliefs and minor miscellaneous requirements. Regimental transport is provided for by the regimental train, each infantry regiment having permanently attached to it 8 baggage waggons, 6 commissariat store waggons, and 3 ammunition waggons; and each cavalry regiment, 4 baggage and 13 supply waggons.

General Organisation and Administration of the Army.—Since 1867 the Austrian empire has consisted of two distinct states, a German or Cis-Leithan empire, commonly known as Austria proper, and a Magyar, or Trans-Leithan, kingdom, known as Hungary. Each of these countries has its own parliament, ministers, and government. The connecting ties between them are a common hereditary sovereign, a governing body known as the Delegations, and a common army and navy. The war strength of 800,000, at which the naval and military forces of the empire are fixed, is distributed between Austria and Hungary in proportion to their populations; Austria contributing 470,368, and Hungary 329,632. The annual contingents are divided in similar proportions. The cost of the maintenance of the army, which in 1871 was estimated at £10,500,000, is charged in the budget for the "common affairs of the empire," laid before the Delegations. A portion of this is met by the proceeds of the customs, and other sources of revenue set apart to meet the common expenditure; the rest is defrayed by the two states in the proportion of $\frac{7}{10}$ths from Austria, and $\frac{3}{10}$ths from Hungary. The emperor is commander-in-chief of the army; the military and administrative business is centred in the War Department, which is presided over by the War Minister and his deputy. The empire is divided into 16 military territorial districts. Of these, 7 are called "general commands," and have general officers of high rank specially appointed to them; the remainder are termed "military commands," and are commanded by the senior divisional commander stationed in the district. Each commander of a district is assisted by a general officer of lower rank, who has special duties to perform, and takes the place of the commander in the event of the latter being called away on mobilisation. The military districts again are subdivided into 80 regimental recruiting districts, corresponding to the 80 infantry regiments, each under the superintendence of the reserve commander or second colonel of the regiment, whose duties correspond closely to the landwehr battalion commanders in the Prussian organisation.

The Austrians have no permanent corps organisation; their standing army is formed into independent divisions, which have no fixed stations, but are distributed about the empire according to circumstances, and occasionally relieve one another. There are 32 such divisions, of 2 infantry brigades each, 18 of these have cavalry brigades attached to them. In war time 3 infantry divisions, with a regiment of artillery and proportion of cavalry, would usually be united to form an army corps; but the division remains the principal unit of organisation. The following gives the strength and details of an Austrian infantry division in the field:—

	Officers and Men.	Horses.	Guns.	Waggons.
Divisional Staff,	379	114	...	14
2 Brigades Infantry (4 regiments = 12 battalions, ...	11,882	280	...	74
2 Battalions Rifles,	1,978	8	...	8
Cavalry (3 squadrons),	531	476	...	8
Artillery (3 batteries),	552	370	24	43
1 Company Engineers,	234	15	...	6
Ammunition column,	170	166	...	32
Field Hospital,	133	54	...	21
Provision column,	242	288	...	158
Total,	16,101	1771	24	364

This includes all, non-combatants as well as combatants, or the "rationing strength" as it is termed. The combatant strength of a division is 12,884 infantry, 472 cavalry, and 24 guns.

The Austrian army, though long the most perfectly equipped in Europe, and always distinguished for its appearance, its discipline, the strong *esprit de corps* of its officers, and the scientific training of its staff, has yet the most unfortunate history of all the great European armies. Defeated repeatedly by Frederick in the Seven Years' War, by Napoleon in the Revolutionary wars, and later by the French in 1859 and the Prussians in 1866, the Italians are the only nation over whom it can claim to have been generally victorious. Yet its spirit has always remained unbroken; and however severe the defeat, however disastrous the campaign, no reverse ever brought Austria to the condition of Prussia after Jena, or of France after Sedan. There are several causes to which this almost uniform ill-success may be attributed. Trusting to diplomacy rather than force of arms, her strategy has always been cautious and vacillating. The hands of her generals have repeatedly been held when in the act of striking. But the same caution which often prevented her reaping the successes actually within her reach, or retrieving disasters which were not yet irremediable, also left her always with a reserve and a show of power still formidable. Austria has also suffered from the heterogeneous composition of her army. Germans, Hungarians, Czechs, Poles, Croats, Italians, served together under officers who frequently could not communicate with their men. The Germans, or Austrians proper, are loyal and faithful to the house of Hapsburg; but the other nationalities were not only indifferent, but frequently hostile, and instances of whole regiments surrendering to the enemy rather than fight for a cause they detested, are common in the history of her wars. The only ties by which this heterogeneous mass was bound together, was a strict and somewhat harsh discipline, and the strong loyalty and *esprit de corps* of its body of officers. The Austrian officers have always been distinguished by a *cameraderie* peculiar to themselves. Officers of various nations and of very different social standing meet on terms of perfect equality, and intimacy as the "emperor's servants," and no distinctions are acknowledged within the army save those of military rank. The general physique and intelligence of the rank and file of the army is rather below than above the average. Some of the Hungarian regiments are fine bodies of men, but the standard in other parts of the empire is very low, and education has made but little progress in the outlying provinces. The men are generally docile and somewhat phlegmatic, but have neither the *élan* of the French nor the stubbornness of the northern nations.

Since 1866 a great change has taken place in the character of the Austrian forces. The disastrous campaigns of 1859 and 1866 shook the confidence of the nation in that fine imperial army that ever showed so gallantly on parade, and yet seemed ever to suffer defeat in the field.

The army was reorganised on something of the Prussian model, universal personal service introducing a more intelligent and more highly educated element into the ranks. The cession of her last possessions in Italy, and the independent constitution granted to Hungary, removed the principal causes of disaffection. Her regimental officers, who formerly, though gallant and loyal gentlemen, were not distinguished for study of their profession, are now subjected to tests more severe than in any other country; while the constant renewal of the rank and file, and even of the non-commissioned officers, under the three years' system, throws on them almost the whole of the arduous and ever-recurring labour of training the annual contingents of recruits. Her rigid drill has given place to one of exceptional freedom. Even the outward appearance of the army is changed; and the gay uniforms for which Austria was once celebrated have given place to more sober and serviceable ones. Whatever may be the result of the next struggle she finds herself engaged in, none who have watched her military development will deny that she deserves success, so far as success can be earned by a frank acceptance of the lessons taught in her disasters, by honest and persevering efforts to remedy the defects laid bare, and by the loyal devotion with which the officers and the country have accepted the new and arduous duties thrown on them.

Russian Army.

Of all European powers, Russia maintains by far the largest army. In 1870 its peace establishment amounted to three-quarters of a million, and its war establishment to a million and a quarter; and when the changes which were commenced in that year have taken full effect, her available war strength will be increased to nearly two millions. But even this enormous force is not excessive when measured by the vast extent of her possessions (7,500,000 square miles), or her population (82 millions); it is calculated that a levy of 25 per cent. of the young men coming annually of age will suffice for the requirements of the army, and that military service will thus fall more lightly in Russia than in any other great nation of the Continent.

Before the recent changes the Russian army was a reflex of the social condition of the country. As in civil life there was practically no middle class, so in the army there was a wide gulf between the officer and the soldier. The officers were mainly drawn from the nobility, every young man of rank being practically compelled to serve; the soldiers were entirely drawn from the serfs. Although every one was nominally liable to serve, numerous exemptions were made in favour of merchants, skilled mechanics, and others whose services were accounted more valuable to the nation in their civil capacities, and the purchase of substitutes was allowed; so that actually the recruits were drawn almost entirely from the lowest class of agricultural labourers. Service was nominally for life, though after a certain number of years the soldier was allowed his discharge on pension. The army was recruited by an annual levy of so many per thousand of the male population (usually from 4 to 6); the number of men required from each village or district being notified, and the headmen and elders charged with furnishing them. The power thus placed in the hands of the small local authorities was most despotically used, and a youth who had incurred the displeasure of his superiors was surely drafted off to the army. Although the army carried with it the advantages of ultimate freedom and a pension, the time in the ranks was so long, its hardships so great, and the pay so miserably small, that the service was very unpopular, and severe measures were necessary to prevent the recruits deserting on their way to the depôts. Subsequent to the Crimean war, however, various steps were taken to improve the condition of the soldier; the term of service in the ranks, first fixed at twenty years, was reduced to fifteen, and a system of unlimited furloughs introduced, under which the soldier was sent to his home after seven or eight years' service, though liable to recall if needed. The liberation of the serfs in 1861 paved the way for still further reforms, and by an imperial ukase of the 4th (16th) November 1870, the principle of universal personal liability to service was established. By the new army organisation law, every Russian is liable to service on attaining his twenty-first year. The purchase of exemption or of substitutes is prohibited; but it seems doubtful whether this clause will be fully enforced, and hitherto the purchase of exemption at a fixed rate of 800 roubles (about £120) has been permitted. The conscription takes place annually between the 1st November and 15th December, when the number required to complete the active army (estimated at about 25 per cent. of those liable to service) are chosen by lot. The period of service is fifteen years,—of which four are spent in the ranks; two years on furlough, liable to recall at any moment; and nine years in the reserves, which can only be called out in case of war or national danger. In the cavalry and horse artillery, the time with the colours is extended to five years, and that in the reserve is shortened. Those who are not drawn for the active army are put through a short course of training, and then sent to their homes; but for six years they remain liable to be called in to replace casualties in the active army in case of war. After this they pass into the national legions, which include all able-bodied men between the ages of 20 and 38 not actually serving in the army or navy. As in Prussia, certain advantages are given to young men of means and good education, who are allowed to shorten their period of service in the ranks. Special regulations apply to the Ukraine and provinces which furnish the Cossacks and other irregular troops.

The military resources of Russia thus consist of the *active army*, or men serving with the colours; the *reserves*, who have completed their period in the ranks, but rejoin the army in case of war; the *irregular troops*, or Cossacks; and the *national legions*, or armed levies, only called out in exceptional cases, such as invasion. The regular army is formed by the active army, completed in time of war from the reserves, and is divided into *field troops* and *local troops*,—the former furnishing the armies for the field, the latter the garrisons, and the depôts at which the recruits are assembled and trained, and whence the field troops are fed. The local troops, as their name implies, are permanently localised; the field troops are not, as in Prussia, connected with certain districts, but draw their recruits indiscriminately from the whole empire, and are moved from one part to another as occasion demands.

The field troops of the regular army consist of 612 battalions of infantry, 236 squadrons of cavalry, 16 battalions of sappers and engineers, and 306 batteries of guns and mitrailleuses. They are divided into guards and line, each having its due proportion of all arms, and are organised in detail as follows:—

Infantry.—The infantry consists of—

12	Regiments of Guards (including 2 Grenadiers) of 3 battalions each.	
12	,,	Grenadiers of 3 battalions each.
4	,,	Caucasus Grenadiers of 4 battalions each.
148	,,	the Line of 3 battalions each.
12	,,	Infantry of the Caucasus of 4 battalions each.
4	Battalions of Rifles of the Guard.	
20	,, ,,	Line.
8	,, ,,	Caucasus and Turkestan.

A battalion of the guards or line consists of 4 line companies and 1 of rifles; it has four different establishments, viz., "*cadre*" strength of 320 rank and file, "peace" strength of 500, "increased peace" strength of 680, and "war" strength of 900 rank and file. This is exclusive of musicians, officers' servants, &c. A regiment on war establishment numbers 81 officers, 270 non-commissioned officers, 2700 rank and file, 96 drummers and buglers, and 259 artificers, officers' servants, and other non-combatants; and is accompanied by 12 officers' horses, 173 draught horses, and 41 ammunition, ambulance, and baggage waggons. Rifle battalions consist of 4 companies only, and have three establishments,—"war," of 720 rank and file; "increased peace," of 544; and "peace," of 400 rank and file.

The Russian infantry is formed in two ranks. On parade the four line companies of a battalion stand in order from right to left, while the rifle company stands at fifty paces in rear of the centre; but for manœuvring purposes the three rifle companies of the regiment are often united to form a separate battalion. The guards still maintain on parade much of the stiffness and precision for which the Russian army was once famous; but generally the movements of the infantry are loose and rapid. In the main their drill resembles that of the German army; the commonest formation for march and manœuvring is the company column of sections. The men are armed with the "Berdan" breech-loading rifle, a bayonet (which is always carried fixed), and a short two-edged sword. They carry 60 rounds of ammunition in two pouches, and 40 rounds are carried in the regimental ammunition carts, so that there is always present with the regiment 100 rounds per man; and the divisional reserves carry 60 rounds per man besides. A certain number of entrenching tools are issued to each company, and on service are carried by the men in turns. The *clothing* is of somewhat coarse texture, but very serviceable; that of the guards is of slightly finer material than is supplied to the rest of the army. All infantry alike wear tunic and trousers of dark green cloth (or white linen trousers in summer time), long boots into which the trousers are tucked in the field or for marching, cap or "kepi" of black cloth with straight peak, metal badge, and horse-hair plume, and cloak of reddish-grey cloth with a dark-coloured hood. The tunics of the guard are turned back in front, and faced with red or yellow. Regiments are distinguished by the colour of the "paroli" (a strip of cloth worn on the collar) and of the shoulder straps. The belts of the first three regiments of the guard and grenadier divisions (with the exception of the rifle companies) are white; those of all others black. The knapsack is rather large, and made of black calf-skin. A white smock frock, intended as a fatigue dress, is worn in summer at drill.

A Russian regiment is very completely equipped with transport. Every company has two waggons attached to it, one carrying ammunition (40 rounds per man), the other six days' rations of biscuit, salt, and other provisions and stores. In addition to these the regiment has an orderly-room waggon, a paymaster's waggon, a store and implement waggon, four ambulance waggons, and two hospital and medicine carts. All these are kept in store in peace time with the headquarters of the regiment; but only one waggon per company is horsed. In war time most of the waggons are four-horsed; but some still have shafts, and are drawn by three horses abreast.

The regimental staff comprises 1 colonel, 3 lieutenant-colonels, 1 supernumerary field officer, a regimental adjutant, paymaster, quartermaster, and instructor in arms, 3 battalion adjutants, a chaplain, and 4 surgeons. In the field each company is attended by an apothecary, provided with the necessary appliances; and the officers' servants and other unarmed men are taught the elementary principles of military surgery, and trained to the duties of stretcher-bearers.

Cavalry.—The regular cavalry consists of 10 regiments of the guard, 18 regiments of dragoons, 14 regiments of lancers, and 14 regiments of hussars.

The cavalry of the guard comprise 4 regiments of cuirassiers, 2 of lancers, 2 of hussars, 1 of dragoons, and 1 of horse grenadiers. There are also 2 regiments of Cossacks of the guard, who in peace time furnish 2 squadrons each for duty, and in war take the field with 6 squadrons, and may fairly be included among the regular troops.

All regiments of cavalry are organised in the same manner, and consist of 4 field squadrons and 1 reserve squadron, the latter belonging to the "local troops." They have two establishments, viz., "war," of 128 men per squadron (mounted); and "peace," of 112 men per squadron. The war establishment of a cavalry regiment is 32 officers, 73 non-commissioned officers, 512 rank and file, 16 trumpeters, and 305 non-combatants, including dismounted men in reserve, officers' servants, artificers, &c.; or a total of 938 officers and men, with 693 horses and 11 carriages. The formation and manœuvres of the Russian cavalry do not differ materially from those of other armies of Europe, except in the case of dragoons, who are armed with a rifle and bayonet, and specially trained to act as infantry. In all other cavalry the front rank is armed with a lance in addition to sword and revolver. The rear rank is armed with sword and carbine in lancer and hussar regiments, and sword and revolver in cuirassier regiments. The cuirassiers wear white tunics with shoulder scales, cuirass, and helmet; the dragoons a dark green tunic, with scales and cloth cap; the lancers, a blue tunic with metal epaulettes, and the czapka, or lancer cap; and the hussars, a blue tunic and cloth cap. Only the hussars of the guard wear bearskin caps and pelisses. The guards have parade trousers of black or dark blue with stripes; but in the field, trousers or pantaloons of a greyish blue cloth are worn by all cavalry alike. The saddlery is simple in construction, though somewhat heavy and cumbrous. Four separate folds of felt, each $\frac{1}{4}$ inch thick, support a wooden frame previously fitted to the horse's bare back; on the wooden frame is strapped the horse rug, and the saddle is complete. When one fold of felt is wet or hardened by dried perspiration, it is replaced by another, and sore backs are almost unknown. The men as a rule ride fairly well, though not so well as the Austrian or English cavalry; and the peculiar seat, and height of the saddle above the horse's back, strike the eye as ungainly. The horses, though often small, are hardy and enduring; they are provided partly from the Government breeding establishments and partly by purchase, and come mostly from the south-eastern provinces of the empire. They are not taken on the strength of the regiment until rising six years old, and are cast on completing their twelfth year, this securing that they shall always be in their prime, and fit for the severe work of active service.

The staff of a cavalry regiment consists of a lieutenant-colonel commanding, two field-officers commanding divisions (of two squadrons each), and regimental adjutant, paymaster, quartermaster, and instructor in arms. Each regiment has also a chaplain, two surgeons, and a veterinary surgeon. Each squadron has its provision waggon, and each regiment has an ambulance waggon, and three store and office waggons. Dragoon regiments have two ammunition waggons carrying 30 rounds per man; other regiments have only one.

Artillery.—The field artillery consists of 3 brigades of field and 1 of horse artillery of the guard; 44 brigades of field and 7 of horse artillery of the line; and 3 Turkestan brigades.

A brigade of field artillery consists of six batteries, viz., three heavy, two light, and one of mitrailleuses. The horse artillery brigade of the guard comprises five light batteries (including one of the Don Cossacks of the guard); the remaining horse brigades have only two batteries each. The Turkestan brigades vary slightly in composition. The Russian artillery thus numbers—143 heavy field batteries; 100 light field batteries; 19 batteries of horse artillery; 4 mountain batteries; and 50 batteries of mitrailleuses; or a total of 2128 guns and 400 mitrailleuses.

A battery has three establishments—"peace," with only 4 guns and 2 waggons horsed; "increased peace," with 8 guns and 8 waggons; and "war," with 8 guns and 16 (or 24) waggons. On war establishment a heavy field battery numbers 6 officers, 316 non-commissioned officers and men (including artificers, &c.), and 214 horses; with 8 guns, 24 ammunition waggons, and 9 provision and store carriages. A light battery has 261 officers and men, 160 horses, 8 guns, 16 ammunition and 8 other waggons and carriages. The guns are of bronze or cast steel, breech-loading and rifled on the Prussian system. The mitrailleuse batteries are armed with a 10-barrelled gun on the Gatling system, slightly modified by the Russian general Gorloff. A heavy battery carries 120 rounds per gun, a light battery 130, and a mitrailleuse battery a total of 6290 rounds. The harness is rough and clumsy with long rope traces. The dress of the men of the field batteries is similar to that of the infantry, and that of the horse artillery to that of the dragoons.

Engineers.—The corps is divided into sappers and pontoniers. The sappers form 11 field battalions, 1 field company (Turkestan), and four reserve battalions (local troops); also 2 engineer field parks, 2 siege parks, and 6 field telegraph parks. The pontoniers form 6 half-battalions. A field battalion of sappers consists of 4 companies, and has a war establishment of 900 rank and file, and a peace establishment of 600. The half-battalions of pontoniers consist of two companies, and have a war establishment of 13 officers, 469 non-commissioned officers and men, with 392 horses, 52 pontoon and 10 other waggons and carriages; and carry 26 iron pontoons and 12 trestles, sufficient to form 700 feet of bridge.

Organisation of the Field Army.—The organisation of the Russian army is entirely divisional; two or more divisions may be brought together to form an army corps, but no such organisation exists permanently. The infantry is formed in 47 divisions, viz., 3 of guards, 3 of grenadiers, 1 of Caucasus grenadiers, and 40 of the line. Each division consists of 4 regiments or 12 battalions (with the exception of the divisions of the Caucasus, which have 16 battalions), and has attached to it a brigade of field artillery, but no cavalry or rifles. The rifles are organised in separate brigades of 4 battalions each, and form 8 brigades (1 guard, 1 of the Caucasus, 1 of Turkestan, and 5 of the line); and the cavalry in cavalry divisions of six regiments, to each of which is attached a brigade of horse artillery. With the exception of the guards (of whom two divisions are always stationed in St Petersburg) and some of the troops of the Caucasus and Turkestan, these divisions have no permanent stations, but relieve one another from time to time. Five infantry and two cavalry divisions are usually stationed in the St Petersburg district; 15 infantry and 2 cavalry divisions in the Warsaw and Vilna districts (Poland and Polish frontier) 8 infantry and 2 cavalry in Kiev and Odessa (south-eastern provinces); 7 infantry and 1 cavalry in Moscow; and 6 infantry and 1 cavalry in the Caucasus. Of the cavalry, the guard divisions and three line divisions are usually maintained on war footing, the remainder on the peace establishment; the artillery all on peace establishment. Of the infantry, a few battalions in Turkestan are alone maintained on war footing; the divisions in the Caucasus are mostly on the "increased peace" establishment; the guards and grenadier divisions, and those occupying Warsaw and the great fortresses, on "peace" footing; and those distributed about the interior on *cadre* establishment.

The following was the peace and war strength of the field army in 1873:—

	Peace.	War.
Infantry (612 battalions),	364,422	694,511
Cavalry (236 squadrons),	38,306	49,183
Artillery,	41,731	48,773
Engineers,	13,413	16,203
Total,	457,872	808,670

Local Troops.—That portion of the Russian army which is stationary in peace is distinguished by the name of "local troops;" and these again are divided into "reserve and depôt troops" and "troops for service in the interior." The reorganisation of these forces was commenced in 1873, but will take some years to complete.

According to the new organisation, the reserve and depôt troops will consist of 120 local battalions of infantry, each forming on mobilisation a three-battalion reserve regiment and a depôt battalion; 56 reserve squadrons of cavalry; 24 local batteries of artillery, forming in war 24 reserve artillery brigades (96 batteries) and 24 depôt batteries; and 5 reserve companies of sappers. In peace time they are little more than *cadres*, distributed according to population, and are charged with the training of recruits and reserve and furlough men. In war they form a reserve army of 30 infantry divisions and 24 artillery brigades, or about 420,000 men and 768 guns, available to reinforce the field army; and depôts numbering about 85,000 men.

The "troops for duty in the interior" consist—First, of 48 "frontier battalions," of which 24 are stationed in the Caucasus, 12 in Turkestan, and the remainder in the military districts of Orenburg and Eastern and Western Siberia. They are organised in all respects like the rest of the infantry, and have a war establishment of 1074, and a peace establishment of 615 of all ranks. Secondly, of "garrison infantry and artillery," intended for the defence of fortresses, and numbering 98 battalions and 59 (in war time 91) artillery companies. Thirdly, of "government battalions" and "local detachments," who do garrison duty in the capitals and towns, and act as police, guards, &c.; of these there are 70 battalions and 400 separate detachments, distributed throughout the empire, maintained on a reduced establishment in peace, but raised to a total war strength of 120,000 men when the field army is mobilised. Lastly, of "etappen detachments," stationed on the military roads, and charged with furnishing escorts to recruits and prisoners, and providing them with lodging and subsistence; and local artillery detachments, charged with the care of artillery material stored in large towns.

The total strength of the "local troops," when the new organisation has been completed, will amount to about 784,000 men and 816 guns.

Irregular Troops.—The irregular troops or Cossacks have always borne a most important share in the wars of Russia. In 1812 more than 100,000 were raised, and the services they rendered in that and the following campaigns made their name famous and a terror throughout Europe. In 1856 they raised 184,000 men, of whom about three-fourths were cavalry; but the Crimean war did not give the opportunity of utilising this class of troops.

The Cossacks have always been a race of free men; neither serfage nor any dependence upon the land has existed among them. It has been the policy of the Russian Government to foster their martial spirit, and various privileges have been granted to them with this object. They pay no taxes; but in lieu of this render military service, from the age of 19 to 40. Only a portion of this time is actually spent in the ranks; but in war time, by order of the emperor, the whole male population between the ages of 15 and 60 may be called to arms. The Cossacks are organised in "polks" or regiments of light cavalry, about 900 strong, and formed usually of six "sotnias" or squadrons; in battalions of infantry, about 1100 strong; and horse artillery batteries of 8 guns. In peace time a few squadrons are stationed at St Petersburg and Warsaw, furnishing escorts to the emperor and viceroy. The rest are distributed about the Cossack provinces and on the frontiers, maintaining the lines of communication in the wild Asiatic provinces. The force under arms in 1871 amounted to 66,000, forming 323 sotnias or squadrons, 35 companies of infantry, and 12 batteries. In war time this can be raised to—

Cavalry, 155 "polks" or regiments,	142,000
Infantry, 37 battalions,	41,000
Horse Artillery, 27 batteries,	6,000
	189,000

with 232 guns. In war time the divisional cavalry of the regular army is furnished by the Cossacks, one polk being attached to each infantry division for purposes of outpost duty, escorts, and orderlies.

Militia.—The militia or national legions include all men within the ages liable to service who have not served actively in the army. There is as yet no regular organisation for the militia, nor have the men been drilled; notwithstanding this, on the three occasions on which they have been called out (viz., 1807, 1812, and 1855), they have always been rapidly formed, and have done good service to the country. In 1855 the number actually raised was 366,000. The number liable to service in 1871 was over 500,000; and as the new law comes fully into action that number will be enormously increased.

Organisation and Administration.—The emperor is the Commander-in-Chief of the army, and exercises his authority through the War Minister. The War Ministry is divided into twelve sections or departments, including the imperial headquarters or military cabinet of the emperor; the council of war, which is the highest legislative and administrative authority in the empire; the headquarter staff; and the artillery, engineer, intendance, medical, &c., departments. For purposes of military administration the empire is divided into 14 military districts, corresponding to the civil "general governments," and 51 governments or military sub-districts. At the head of each military district is a general, who is also viceroy or governor-general, and has the supreme control of all affairs, civil as well as military. The local forces belonging to each military district are commanded by a local divisional commander, and the forces of each government by a local brigadier. In addition to the command of the local troops, these officers are charged with the keeping of the muster-rolls of men on furlough, &c., and generally with the arrangements for mobilisation. The field troops stationed in the district are under the command of their own divisional generals, subordinate to the district general. The guards and some of the regiments stationed in the fortresses and great towns are lodged in fairly comfortable barracks; but the accommodation generally is quite insufficient. The erection of barracks for the whole army is projected, and the necessary buildings have been commenced in many places; but it must be long before the plan can be fully carried out. Meanwhile a large part of the troops are billeted in the towns, and in some country districts are distributed among the villages, living with the peasants, and for months without seeing their officers or any opportunities for drill. During the summer months, May to October, the regiments and divisions are brought together in large standing camps for training, commencing with battalion and regimental drill, rifle practice, instruction in field fortification, &c., and concluding with brigade and divisional field-days and great manœuvres. In 1873, 445 infantry battalions, 238 squadrons, 93 sotnias of Cossacks, and 828 guns were thus assembled at the various camps of instruction, the largest of which were at Warsaw, where nearly 50,000 men were collected; and at Krasnoe Selo, near St Petersburg, where about 30,000 men, principally of the guard, were encamped.

The Russian guards, selected as they are with care from the vast military population of the empire, are perhaps the finest body of men in Europe; and with their brilliant and various uniforms, relieved by the Oriental picturesqueness of the Cossack squadrons, certainly present the most gorgeous and imposing military display to be seen anywhere. They have many special privileges, and all officers of the guards rank two grades higher than the corresponding ones of the line. The ordinary line soldier is rather below the average of European armies both in physique and intelligence; but he is generally a good marcher, capable of enduring great hardship and fatigue, and is good-natured, cheerful, obedient by instinct and habit, and imbued with a certain religious and superstitious loyalty, which is always a powerful motor, and at times can be excited to fanaticism. Of all their commanders, Suwaroff knew best how to appeal to this semi-barbarous and superstitious instinct, and to this he owed much of his extraordinary influence and brilliant successes. Generally, however, the Russian's strength lies rather in endurance than action; no army, the British perhaps excepted, fights so stubbornly and will endure such heavy losses without flinching. Hence the most bloody battles in modern history have been those fought against Russian troops,—Zorndorf and Kunnersdorf in Frederick's wars, Eylau and Borodino in Napoleon's time. Outwardly the discipline is good, though the intercourse between men and officers retains somewhat of that mixture of familiarity and servileness characteristic of a stage not far removed from slavery; but it may be questioned whether it is of the kind that will withstand the strain of war, or gives the officers that moral influence which alone tells in moments of danger or discouragement. The non-existence of a class corresponding to the lesser nobility of Germany or the gentry of England has always made the officering of the Russian army a matter of peculiar difficulty. The staff and scientific corps are largely officered by foreigners, mostly Germans; in the infantry the want is supplied to a certain extent by promotion from the ranks. The Russian army, like the nation, is in a transitional state. The liberation of the serfs was a vast constitutional change which could not make itself fully felt in less than a generation, and which affects the army as well as the nation. The introduction of personal service, applied to all classes, must materially alter its character. The Russian Government, fully alive to the present defects of the army, and also to its importance as a means of raising, educating, and disciplining the nation, is using every endeavour to instruct and improve the soldier. Regimental schools have been established throughout the army, at which the soldier is taught, either by or under the immediate supervision of his officers, for many hours a day during the long winter months. Higher class schools are also formed for the instruction of non-commissioned officers, where they receive not only a military education, embracing tactics, military history, field fortification, &c., but also a general education which qualifies them, on leaving the army, to become, as many do, teachers in the national schools, or to fill civil appointments. The physical training of the soldier is also attended to; gymnastics of all kinds are constantly plantised, and with such effect that the Russian soldier contrasts very markedly with the awkward, ungainly peasant.

The military power of Russia has been vastly increased of late years by the construction of the great strategic lines of railway which now traverse the empire in all directions, and enable her to concentrate her vast resources with ease and quickness. The immense extent of the empire has hitherto been an insuperable obstacle to the full development of her power. In 1854-56 the efforts made to hold the Crimea exhausted Russia more completely than a series of defeats in the heart of the empire could have done. For every man who actually reached the Crimea four were expended on the road from sickness and fatigue, and the total losses suffered in this war were estimated at the enormous amount of 450,000 men. Now reinforcements can be brought with ease by rail from the most distant provinces, and for a concentration on her south-western frontiers she has four distinct main lines of railway, connected by branch ones with every important military station. It is not to be wondered at that Prussia and Austria watch with uneasiness the development of the military resources of their powerful neighbour.

Italian Army.

The old Piedmontese law of conscription is the basis of the present military organisation of Italy, as its constitution is of the constitution of the new kingdom. The Piedmontese have long borne a high reputation among southern nations for their military qualities. The dukes of Savoy have played a not unimportant part in history, and showed special ability in preserving the independence of their small kingdom between two such powerful neighbours as France and Austria. During the wars of the French-Revolution Piedmont was temporarily absorbed into the French republic; but the kingdom of Sardinia was restored in 1815. Various causes combined to place Piedmont at the head of the national and liberal movement which agitated Italy during the ensuing thirty years, and bring her in direct antagonism to Austria. Charles Albert, her then ruler, had paid great attention to the army, and when Italy rose against Austria in 1848 he took the field with an excellent force of nearly 70,000 men. At the outset fortune favoured the arms of Italy; but the genius and energy of Radetsky, the veteran Austrian commander, soon turned the tide, and in the summer of 1849 the Piedmontese army was decisively defeated at Novarra, and her king compelled to sue for peace. Charles Albert abdicated in favour of his son Victor Emanuel, a prince who had already distinguished himself by his personal gallantry in the field. Under his care the army soon recovered its efficiency, and the force which joined the allied armies in the Crimea attracted general admiration from the excellence of its organisation, equipment, and discipline. In 1859 Piedmont again took up arms against Austria for the liberation of Italy; but this time she had the powerful assistance of France, and played but a subordinate part herself. In this campaign the Sardinian army was composed of one cavalry and five infantry divisions, and numbered about 60,000 combatants. By the peace of Villa Franca, Italy, with the exception of Venetia, was freed from the Austrians, and Lombardy was added to Piedmont. The revolutionary campaign of Garibaldi in the following year united the whole peninsula under the rule of Victor Emanuel, and in 1866, when Italy for the third time took up arms against Austria—this time as the ally of Prussia—her forces had risen to nearly 450,000, of whom about 270,000 actually took the field. But in quality these were far from being equal to the old Piedmontese army; and the northern army, under the personal command of the king, was defeated at Custozza by a much smaller force under the Archduke Albrecht of Austria. Since 1866 the army has been somewhat reduced, but increased care given to its organisation and training, and in manœuvring power it now stands high among the armies of Europe.

The existing organisation of the Italian army is determined by the laws of 1873. Every Italian is liable to personal service from the age of 18 to 40. Substitution (except in the case of brothers) and exemption by payment are abolished. Absolute exemption is only allowed to such as are physically unfit for service. Partial exemptions are allowed to only sons of widows, supports of families, &c., who are passed at once into the local militia without serving in the army. Temporary exemptions or "adjournments" may be granted for three successive years on urgent personal or family reasons. The remainder of the annual contingent is divided by lot into two classes. The first class serve eight years in the army, four in the active militia, and the rest of their time in the local militia. Of the eight years in the army, three in the infantry and five in the cavalry are usually spent with the colours; the remainder on furlough. Further, the Minister of War has the power to send home on furlough, after a year's service only, young men of exceptional character or intelligence, school teachers, artists, &c. The second class are liable to service in the several forces for the same periods, but are considered as on unlimited furlough, and only subjected to six months' training. One-year volunteers are received on the same conditions as in other armies. The numbers of the first class contingent are determined annually by law, and are distributed among the districts and cantons according to the number of men found fit for service. This is estimated at from 90,000 to 95,000; and the contingent of the first class was fixed in 1872 and 1873 at 65,000. The war strength of the army, exclusive of local or "sedentary" militia, is estimated at 750,000, of whom 375,000 are in the active army, or first line; 250,000 in the active militia, or second line; and 125,000 in the depôts. The peace establishment is fixed at 200,000.

The Italian army consists of 80 regiments of the line, 10 of *bersaglieri* (riflemen), 20 regiments of cavalry, 10 of artillery, and 2 of engineers. A regiment of the line consists of 3 battalions of 4 companies each, and numbers about 1500 men on peace and 3000 men on war footing. Eight of the existing regiments are grenadiers. The *bersaglieri* are formed in regiments of four battalions each, and are picked troops, armed with a shorter rifle, and especially trained to traverse long distances at a run. They are frequently used in conjunction with cavalry, and it is proposed to relieve them of their knapsacks, to increase their mobility still further. The cavalry consists of 5 regiments of the line, 7 of lancers, 7 of light horse, and 1 of guides. Each regiment has six squadrons, with a war strength of 150 horses per squadron. Of those squadrons, two are intended to be detached to the infantry divisions in war time, while the remaining four form the corps cavalry. The artillery comprises 10 regiments of field artillery, and 4 of garrison artillery, besides a certain number of coast and artificer companies. A regiment of field artillery consists of 10 batteries of 8 guns each, and 3 companies of artillery train. A regiment of garrison artillery consists of 15 companies. The engineers consist of a separate staff of officers, and 2 regiments, each divided into 4 companies of pontoniers, 16 of sappers, and 3 of engineer train. In addition to the above field organisation, every regiment of cavalry, infantry, artillery, or engineers has a depôt, which in peace time is maintained on *cadre* establishment only, but in war is completed from the surplus furlough men, and replaces casualties in the field army.

The total strength of the Italian active army on peace and war footing is approximately as follows:—

	Peace.	War.
Infantry, 80 Regiments, ...	128,000	245,000
Bersaglieri, 10 ,, ...	18,000	36,000
Cavalry, 20 ,, ...	18,000	21,000
Artillery, 10 Field Regiments, ...	11,000	21,000
,, 4 Garrison ,, ...	6,000	13,000
Engineers, 2 Regiments, ...	4,000	7,000
Train, 3 ,, ...	2,500	10,000
Staff Administration, &c., ...	3,500	8,000
	191,000	361,000

In war time this force is organised in 20 divisions, forming 10 army corps,—each corps comprised of 24 infantry battalions, 4 *bersaglieri* battalions, 2 cavalry regiments, and 10 field batteries, giving a fighting strength of 28,000 infantry, 2000 cavalry, and 80 guns. The corps and divisional organisation is not permanent in peace time; but the divisional staffs are kept up in those of 16 territorial and 4 active divisions maintained in peace.

The depôts and active militia, or second line of troops, are maintained in *cadre* only in peace time; the depôts on mobilisation are raised to a strength of 125,000, or a third of the active army. For the militia the *cadres* of 960 companies of infantry, 60 companies of *bersaglieri*, 10 of engineers, and 60 of artillery, are formed in peace time. On mobilisation these will give a force of about 250,000 men, of whom 200,000, with 40 batteries or 320 guns, could take the field if necessary. The local or "sedentary" militia is not organised in peace time, and is only called out in the last extremity, corresponding generally to the landsturm of Germany.

The kingdom of Italy is divided into 16 "territorial divisions," and these again are subdivided into "districts," of which there are 62, each comprising one or more of the 80 provinces of the kingdom. These districts are under the supervision of a colonel or lieutenant-colonel, whose duties correspond generally to those of the commander of the landwehr battalion districts in Prussia. He has under him a staff, and the *cadres* of from 1 to 6 companies, forming the depôts of the active army in peace time, and in war furnishing each the *cadres* for one militia battalion. He superintends the first instruction and forwarding of the annual contingent of recruits for the army, and the periodical training of the men belonging to the second class, who are on permanent furlough.

The Italian army is composed of very various materials, and in its reorganisation it has been the object of the Government to blend these together as much as possible. Going exactly contrary to the Prussian principle of localisation, the kingdom is divided into five "zones," and special arrangements are made to provide that each regiment shall receive recruits in due proportion from all five of these. The Piedmontese are a hardy, athletic race, superior, perhaps, to any in Europe in power of work and endurance of fatigue, privations, and hardships. They are temperate, intelligent, and combine a certain natural independence with a traditional respect for their princes and aristocracy, which makes them docile and amenable to discipline. The aristocracy of North Italy, like that of England, has always associated itself with the welfare and progress of the country, and deservedly kept the respect of all classes, and furnishes an excellent class of officers to the army. The southern Italian, on the other hand, is generally indolent, and incapable of much exertion, physical or mental; occasionally roused to enthusiasm, but wanting in steadiness of character; usually either bigoted and a slave to his priest, or a free-thinker, with little respect for any authority human or divine. Since enervated and luxurious Rome fell before the more vigorous northerner, the southern Italian has shown but little military spirit. Whether the amalgamation of the various races will raise the whole army to the level of the Piedmontese, or lower the old Piedmontese army to the level of the others, is a problem which can only be solved practically; but one may fairly hope that the new national life which is dawning on Italy will restore to its inhabitants something of the qualities which once made Rome mistress of the world.

Spanish Army.

Spain, once the proudest of nations, has been brought so low by years of misrule and anarchy that she can scarcely now be classed among the powers of Europe; and the army which under Charles V., the Duke of Alba, and the Constable of Bourbon had proved itself so formidable, has been reduced to a state of disorganisation that makes any detailed notice of it impossible. The martial spirit of old Spain, roused by the protracted struggle with the Moors, and fanned by the exploits of the Cid and the successes of Ferdinand of Castile, culminated in the reigns of Ferdinand and Isabella, and of their successor, Charles V. At the end of the 15th and beginning of the 16th century the Spanish army was renowned throughout Europe; while the discoveries of Columbus and the conquests of Cortes and Pizarro had extended her power and the fame of her arms to the New World. Gonsalvo de Cordova, Ferdinand's "great captain," was the creator of the Spanish infantry, which, modelled originally on that of the Swiss, soon eclipsed the latter, and became in its turn the model for other nations. More heavily armed than the Swiss, it trusted, like them, to massive formations and the irresistible weight of its attack. During the 16th century the Spanish infantry maintained its reputation, and it was not till the close of the century that its renown began to fade before the new school of Maurice of Nassau, and that the deep masses of the "Spanish brigade" gave way to the smaller and more mobile formations of the Netherland *ordonnance.* Under the disastrous reigns of the last princes of the house of Austria the army rapidly degenerated, and when Philip V. ascended the throne in 1700 it scarcely amounted to 15,000 men. During the 18th century it was largely augmented, and at the outbreak of the French revolution numbered about 120,000 of all arms. But though formidable in numbers, it was no longer so in quality; and throughout the long war with Napoleon it distinguished itself principally by its uniform ill success, and the haste with which it abandoned even the strongest positions. After the peace the army was reorganised, and efforts were made to improve its general condition. But the series of civil wars, or of risings in which the army was a principal actor, thwarted all such attempts. When Isabella was driven from the throne in 1868 the army espoused different sides, the bulk of the infantry joining Prim and the revolutionists, while the artillery and some of the *corps d'élite* remained faithful to the queen. In 1867 the total armed forces of the kingdom (including navy and colonial troops) were fixed at 200,000. The land forces in Spain itself amounted to 150,000, of whom 80,000 belonged to the regular army, and the remaining 70,000 were made up of *carabineros* or gendarmerie, *guardia civil,* and provincial militia. The law of recruiting passed in 1870 made all Spaniards liable to service on reaching the age of 20, and fixed the terms of service at four years in the ranks and two in the reserve. Substitution by exchange of numbers or by *remplaçants,* and exoneration by payment, were sanctioned—the price of the latter being fixed at £60. In 1872 the draft of a new military law was laid before the Cortes, by which substitution and exoneration were abolished, and the annual contingent required to complete the army was to be taken by position (according to age) on the lists, instead of by ballot. The term of service was fixed at seven years,—three to be passed in the army, two in the first reserve, and two in the second reserve; the first reserve being liable to be called out at any time to complete the active army, but the second reserve only in case of war, and by a vote of the Cortes. The abdication of King Amadeus, however, prevented tho carrying out of the contemplated reorganisation of the army.

The contrast between the conduct of the Spanish soldiers and of the Spanish people during the Peninsular war presents a curious problem. At the very time that the armies of Spain were dispersed on every occasion, often almost without firing a shot, the people were signalising themselves by the heroic defence of their towns, and by carrying on a desperate guerilla warfare that nothing could subdue. The Spaniard possesses many of the highest qualities of a soldier: he is hardy, temperate, individually brave, high-spirited, and independent; and though naturally indolent and idle, is easily roused, and capable of great heroism, as well as of sustained exertion. Yet this people, when brought together, form without exception the worst soldiers of Europe. They are impatient of discipline and restraint, and as easily discouraged as they are excited; and that mutual confidence in one another and in their leaders, which alone gives moral strength to a mass of men, is altogether wanting. How much of this may be due to the want of good leaders may be a question; but discipline must always be the basis of all military efficiency, and of discipline in the true sense of the word neither the soldiers nor the people of Spain have any idea

Portuguese Army.

The existing army dates from the Peninsular war, when a considerable force of Portuguese, at one time exceeding 60,000 men, was organised under Marshal Beresford. Trained and partly officered by English officers, it proved itself not unworthy of its allies, and bore its full share in the series of campaigns and battles by which the French were ultimately expelled from Spain. At the peace the army numbered about 50,000 infantry and 5000 cavalry, formed on the English model, and all in the highest state of efficiency. This force was reduced in 1821, under the new constitutional government, to about one-half. By the present law of military organisation, passed in 1864, the strength of the army is fixed at 30,000 men on peace footing, and 68,000 on war footing. The number under arms, however, has never approached this; and in 1869 the actual strength and composition of the army was as follows:—

	Officers.	Men.
18 Regiments (of 9 companies each) Infantry of the Line,	683	9218
9 Battalions of Rifles,	314	3468
8 Regiments of Lancers and Dragoons,	244	2253
3 ,, Artillery,	107	1278
1 Battalion of Engineers,	3	317
Staff and Administrative Troops,	194	106

The number of troops in the Portuguese colonies amounted to 8500 infantry and artillery, besides a reserve of 9500 men.

The army is raised partly by conscription and partly by voluntary enlistment, more than one-half being obtained by the latter method. Exemption may be purchased by the payment of a fixed sum, amounting to about £80. The time of service is eight years, of which five are spent in the regular army and three in the militia. The Portuguese have distinguished themselves rather by naval enterprise than as soldiers. Physically they are inferior to the Spaniards; but they are more amenable to discipline, and proved themselves far more valuable and trustworthy auxiliaries in the long Peninsular struggle

Dutch Army.

The military power of the "United Provinces" dates its rise from the middle of the 15th century, when, after a long and sanguinary struggle, they succeeded in emancipating themselves from the yoke of Spain; and in the following century it received considerable development in consequence of the wars they had to maintain against Louis XIV. In 1702 they had in their pay upwards of 100,000 men, exclusive of 30,000 in the service of the Dutch East India Company. At the beginning of the wars of the French Revolution the army had fallen to 36,000 men. In 1795 Holland was conquered by the French under Pichegru, and in the course of the changes which ensued the army was entirely reorganised, and under French direction bore its share in the great wars of the empire. In 1814 Holland was relieved of the yoke of France, and in the following year, her armies, under the gallant Prince of Orange, fought side by side with the British at Waterloo. At the peace of 1815 the Belgian provinces, subject before the war to Austria, were annexed to Holland, and the whole formed into a constitutional kingdom; but the union between the northern and southern provinces of the Netherlands was dissolved by the Belgian revolution of 1830, and in 1839 Belgium was finally acknowledged as an independent kingdom.

The military forces of the Netherlands consist of a home or regular army, a colonial army, and a militia. The regular army is in theory raised by conscription, five years being the term of service, but substitutes are allowed, and a great part of the force under arms are volunteers, the conscripts being drilled for ten months only, and then sent home on furlough, subject to six weeks' annual training. The colonial army is raised entirely by voluntary enlistment. The infantry of the regular army consists of 8 regiments of the line, each of 4 active and 1 depôt battalion, a regiment of guards, composed of 2 battalions of chasseurs and 2 of grenadiers, and a battalion of instruction. A battalion consists of 5 companies, of a peace strength of about 100 men, and a war strength of 200. The cavalry consists of 4 regiments of hussars, each regiment having 6 squadrons, viz., 4 field, 1 reserve, and 1 depôt. The strength of a squadron in time of peace is about 100 men, in time of war about 200. The artillery consists of 5 regiments, viz., 1 field, 3 garrison, and 1 of horse artillery. The field artillery regiment has 14 active batteries of 6 guns each, and 1 depôt company; the horse artillery has 4 active batteries and 1 depôt; the garrison regiments have each 14 companies, of which 1 is for torpedoes and 1 instructional. The engineers consist of a scientific staff, and 1 battalion of sappers and miners. The war strength of the Dutch army in 1872 was as follows:—

Staff and Administration,	175
Infantry,	43,010
Cavalry,	4,259
Artillery,	11,166
Engineers,	1,115
Total,	59,725

with 108 guns. The colonial army numbered about 28,000 men,—13,000 Europeans, and 15,000 natives.

The militia, or *garde civique*, is divided into two classes. the first, or active militia, numbering about 26,000, the second, or resting militia, about 61,000. The whole are organised in battalions according to locality. They are generally well clothed and armed, and of fair physique, but are very badly drilled. The men of the regular army are well drilled, and sturdy and robust, though rather small They have had the advantage of the services of many

Prussian officers as instructors, and a large camp of instruction is formed annually. The officers are mainly supplied from the military academy at Breda, and are of the upper classes; promotions from the ranks are very rare.

Belgian Army.

By a law passed in 1868 the strength of the Belgian army was fixed at 100,000 men on war footing, and 40,000 in time of peace. It is formed by conscription, to which every able-bodied male is liable on completing his 19th year. Substitution, however, is permitted, and substitutes or volunteers actually form a large part of the army. The annual contingent is 12,000 men. The period of service is eight years, of which two-thirds are passed on furlough; the actual time in the ranks has recently been increased from twenty-six to thirty months for the infantry; in the other services it is three years. The *infantry* consists of 1 regiment of carabineers, 3 of chasseurs, 1 of grenadiers, and 14 of the line. Each regiment has 3 field and 1 reserve battalion of four companies each, the latter in *cadre* only in peace time. The *cavalry* consists of 4 regiments of chasseurs and 4 of lancers, each of four field and one depôt squadron. The chasseurs form on mobilisation the divisional cavalry, the lancers the reserve cavalry. The *artillery* is formed in 4 regiments, and numbers 34 field and 6 reserve batteries of 6 guns each. The *engineers* are organised in 1 regiment of 3 battalions (four companies each), and 5 special companies, viz., two telegraph, one railway and one pontoon, and one of artificers. On mobilisation the army forms two army corps, each of two infantry divisions and a reserve of cavalry and artillery, and numbering 26 battalions, 16 squadrons, and 96 guns.

Besides the standing army there is a civic militia (*garde nationale*), available for the defence of the country in time of war. This force, which numbers 125,000 men without, and 400,000 men with the reserve, is formed of all citizens between 21 and 40 able to bear arms, but is only organised in the large towns and fortresses. In time of peace it is under the Ministry of the Interior, but in time of war under the Ministry of War.

The organisation of the Belgian army was subjected to a practical test in 1870, when it was suddenly mobilised and placed in observation on the frontier. The results were not satisfactory. The actual numbers fell considerably short of the estimated ones, and of the men present a large number were quite unfit for service. The number of officers was altogether insufficient, and the army was in many respects incompletely equipped. A bill for the reorganisation of the army, based on compulsory personal service, was introduced in 1871, and adopted in principle by an overwhelming majority of the commission appointed to examine it. But public opinion pronounced so decidedly against the abolition of substitution that Government gave way, and the bill was withdrawn. Ultimately, General Thiebault accepted the Ministry of War, and introduced a modified measure, which yielded the disputed point of substitution, and contented itself with additional guarantees for the character and quality of the substitutes, and reform in various branches of army administration. In a rich and enterprising commercial country like Belgium personal service would naturally fall peculiarly heavily; but, further than that, a not inconsiderable portion of the inhabitants are opposed to the maintenance of any standing army. The Belgians are not a military nation; the martial spirit which once made them a match for the trained soldiers of the most powerful and warlike kingdom of Europe, seems to have given place to mercantile instincts and industrial pursuits. The troops that fought at Waterloo alongside the British did little to raise Belgium's military reputation, some having deserted the battle-field in the midst of the conflict. The modern Belgian soldier is active, fairly intelligent, and a good marcher, but undersized, of inferior physique, and in most respects a bad copy of the French soldier.

Danish Army.

The Danish army, though small in numbers, has always been of excellent material, and the gallant stand made in 1864 against the overpowering forces of Austria and Prussia deservedly won the admiration of Europe. Since then she has reorganised her army on the principle of universal service; but has applied that principle in a manner peculiar to herself, and intermediate between the militia system of Switzerland and the three-years' system of Germany. By the law of 1867 every Danish citizen is liable to serve in the army or navy. Those who have been brought up as sailors, and have served at least eighteen months as such, are inscribed on the reserve lists of the navy; the rest serve in the army. Service commences at 22, except in the case of volunteers, who are allowed to join at 18. The period of service is fixed at eight years in the army, and eight years in the reserve or "reinforcement" (*forstaerkning*). The actual service with the colours is very short, and is divided into two periods. The first or recruit's course of instruction, which all must go through, lasts for six months in the infantry, five in the guard, field artillery, and engineers, and nine and a half in the cavalry. The second course lasts for nine months in the infantry, eleven in the cavalry, and one year in the artillery and engineers, and is confined to those who are considered insufficiently trained, to non-commissioned officers selected for promotion, and to a certain number, selected by lot, who are retained to complete the *cadres* and carry on garrison duties. In the infantry the bulk of the recruits are sent home after the first six months, about one-third to one-fourth remaining for the second term. On the other hand, the great majority of the cavalry, and almost the whole of the field artillery, are retained for the second period, and thus receive respectively twenty and seventeen months' training. For every three months of service in excess of the six months' course, one year is deducted from the period of service in the reserve. Those who were sent home after six months are called out again for a supplementary course of six weeks during their second year, which is passed at the camp of instruction at Hald, near Viborg, where from 8000 to 10,000 men are annually assembled for large manœuvres.

The Danish army is organised territorially, the kingdom being divided into five brigade districts, each of which is again subdivided into two regimental districts. A brigade consists of two infantry regiments, each of two line and one reserve battalion, and a cavalry regiment. The infantry regiments draw their contingent of recruits from the corresponding regimental districts, the two line battalions taking it by turns annually to receive and train the whole of the recruits for the regiment. The cavalry are recruited from the brigade districts, and the guard, artillery, and engineers from the kingdom generally. After remaining for four years on the lists of the line regiments, the conscripts are transferred for the remaining four years to the reserve battalions, in which they have to perform one course of training, the reserve battalions being mobilised during four weeks annually for the purpose. The Danish army thus consists of 1 regiment of infantry of the guard and 10 of the line, each of three battalions—two active and one reserve; 5 regiments of cavalry, each of three active and two reserve squadrons; 1 regiment of field artillery of twelve batteries, and 1 regiment of garrison artillery of two battalions; 1 regiment of engineers, of six active and three reserve companies, and 2 companies of military train. The total strength of the army, exclusive of reserves, is about 38,000 men; the number serving with the colours varies according to the time of year.

The Danish soldiers are, generally speaking, a fine body of men, of considerable physical power, and inured to hardship and rough living. They combine a good deal of northern stubbornness with the romance and martial feeling of the old Scandinavian. Nursed in old traditions and chivalrous legends, the quiet, hard-working Danish peasant has within him a vein of poetry and a sympathy for heroic deeds strongly contrasting with his outward demeanour. He still retains much of the character of the feudal ages —instinctive respect and attachment to his leaders, and implicit confidence in them; and in the army this feeling has been strengthened by the local character which the regiments have always had, officers and soldiers serving together for generations. The officers are all drawn from the upper class, and are as a rule highly-educated gentlemen; they are trained from an early age at the Academy at Copenhagen, where the languages and literature of all countries are taught, as well as purely scientific subjects, and undergo strict examinations before they pass as cadets.

Swedish and Norwegian Army.

Although the crowns of Sweden and Norway are now permanently united, each country retains its own government, constitution, and laws; and the military forces of the two countries are separate and differently organised. The Swedish army is composed of three distinct classes,—the "värfrade," or enlisted troops, to which belong the royal guards, one regiment of hussars, the artillery, and the engineers; the "indelta," or national army, paid and kept by the landowners, each of whom furnishes a certain number of men, to whom, besides a small annual pay, a cottage and a piece of land are allotted during the period of service; and thirdly, the "beräring," or conscription troops, drawn by annual levy from the male population between the ages of 20 and 25 years. The "indelta" are called out for a month's training annually in time of peace. Besides the above, there is a Gothland militia force of 30 companies of infantry and 3 batteries of artillery, numbering about 8000 men; these, however, are not compelled to serve beyond the confines of the isle of Gothland, and have a separate command. The royal guards number 2240, the line (under which is included the "indelta") about 25,000 infantry, 5000 cavalry, 5000 artillery with 234 guns, and 1000 engineers. The "beräring" amount to about 95,000 of all arms. The Swedish troops are physically the finest in Europe,—powerful, hardy, and brave, and retaining much of the old Scandinavian heroic spirit; and, though strictly a militia only, their peculiar aptitude for all warlike exercises would make them formidable antagonists, even to the best trained armies. Few nations have so brilliant a military history. Under Gustavus Adolphus in the Thirty Years' War, and later under the heroic but insatiate Charles XII., they achieved a reputation almost unrivalled in Europe; and their armies and tactics served for many years as models to the great military powers.

The military forces of Norway are differently organised, and though divided into line and militia, are in fact purely a militia force. By the law of 1867 all young men past the age of 21 are liable to the conscription, with exception of the inhabitants of the three northern provinces, who are free from all military service. Actually the troops are raised partly by voluntary enlistment and partly by conscription. The term of service is for ten years, divided into three in the line, four in the reserve, and three in the militia or "landvaern." The *cadres* of the army are formed entirely of volunteers. The young men raised by conscription are required to go through a recruit's course of forty-two days, and subsequently an annual training of twenty-four days. On the 1st January 1872 the troops of the line numbered 13,000 men, the reserves 19,000, and the landvaern 11,000. The landvaern are only liable to service within the frontiers of the kingdom.

Swiss Army.

The inhabitants of Switzerland were always a hardy and independent race, but their high military reputation dates from the middle of the 15th century, when the comparatively ill-armed and untrained mountaineers signally defeated Charles the Bold of Burgundy and the flower of the chivalry of Europe in the battles of Granson, Morat, and Nancy. The Suabian war, towards the end of that century, and the Milanese war, at the beginning of the following one, added to the fame of the Swiss infantry, and made it the model on which that arm was formed all over Europe. The wealthier countries vied with each other in hiring them as mercenaries, and the poor but warlike Swiss found the profession of arms a lucrative one. Whatever discredit may attach to the soldier who sells his services to any country or cause, and fights for money alone, the Swiss at least have done much to redeem the position by their unswerving loyalty to their employers. The devoted faithfulness of Louis XVI.'s Swiss guard is proverbial, and has been commemorated with just pride by their countrymen. The French Revolutionary armies overran Switzerland, as they did all the small neighbouring states, and during Napoleon's career she had to submit to his rule, and furnish her contingent to his armies. On the fall of Napoleon she regained her independence, and returned to her old trade of furnishing soldiers to the sovereigns and powers of Europe. Charles X. of France had at one time as many as 17,000 Swiss in his pay; Naples and Rome had each four regiments. The recruiting for these foreign services was openly acknowledged and encouraged by the Government. The young Swiss engaged usually for a period of four or six years; they were formed in separate regiments, officered by countrymen of their own, and received a higher rate of pay than the national regiments; and at the close of their engagement returned with their earnings to settle down on their paternal holdings. A series of revolutions, however, expelled them from France and Italy, and recently the advance of liberal ideas, and the creation of great national armies based on the principle of personal service, has destroyed their occupation. Switzerland is now remarkable in a military sense as being the only country that maintains no standing army; and the fact that, with an annual expenditure of only £200,000, she shows a force of 200,000 men, has made her military institutions the study of economists and the model for many would-be military reformers.

The 13th article of the constitution of 1848 forbids the maintenance of a standing army within the limits of the confederation; but every citizen is required to bear arms for the defence of the country, and for this purpose a certain military training is given at all schools. The actual forces of the republic consist of a militia divided into three classes,—the "auszug" or *élite*, the reserve, and the landwehr. The strength of the *élite* is fixed at 3 per cent. of the population, and that of the reserve at 1½ per cent.; the landwehr includes all who have passed the *élite* and reserve up to the age of 44. The total service is limited to twenty-five years. Within these conditions the cantons are allowed to raise their contingents and distribute the service as they please; and it thus happens that service in the *élite* lasts for five years in some cantons, and for fourteen years in others. Exemption from service is granted to certain Government and public officials, to the clergy, surgeons, &c.; all other citizens become liable on attaining the age of 20. No substitutes are allowed, and any one rejected for bodily infirmity, or exempted from any cause, is required to pay a small tax.

The strength of the armed forces of Switzerland was given as follows in 1872:—

	Auszug.	Reserve.	Landwehr.	Total
Staff	...	...	...	841
Infantry	66,649	39,078	54,334	160,061
Rifles (Scharfschützen)	6,001	3,364	4,616	13,981
Cavalry	1,913	1,086	1,571	4,570
Artillery	8,262	5,350	4,643	18,255
Engineers	1,245	1,059	743	3,047
Administration	299	129	74	502
	84,369	50,066	65,981	201,257

Of these, however, the landwehr exist on paper only, and may be left out of consideration; and the available force is estimated at about 105,000, of whom 70,000 belong to the "auszug," and 35,000 to the reserve.

The infantry are armed and equipped by their cantons, the recruit himself having to bear a portion of the expense. Before being placed on the rolls of the "auszug" he has to undergo a training of four weeks for the line, or five weeks for the rifles; and subsequently an annual training of eight days while in the *élite*, and six days in the reserve. Practically, however, the *élite* are commonly called out every second year only, and the training of the reserve is often omitted altogether The cavalry, artillery, and engineers have a recruit's course of six weeks, and an annual training of (nominally) a fortnight; but in practice the latter has been reduced to eight days every second year. The cavalry resemble our yeomanry, consisting of a wealthier class of men, who find their own horses; the engineers are selected from men following suitable trades. The whole army is formed in six divisions, and annually one or two of these are assembled for divisional manœuvres. A handsome federal barrack for infantry and cavalry and a permanent instructional establishment exist at Thun. Officers are required to go through a six weeks' course at this federal school, and to attend one course of recruit training on appointment. The nomination of officers, and promotions up to the rank of captain, are made by the cantonal governments; promotion to the higher grades and appointments to the staff by the federal authorities, though usually on the recommendation of the cantons. Candidates for the staff are required to go through a two months' course at a staff school which is annually opened for the purpose.

A study of the military system of Switzerland will at once explain its apparent cheapness. The expenditure shown in the federal budget is only a portion of the real cost of the army; to it must be added the expenses borne by the cantons and by the men themselves. The actual cost is estimated by the best authorities at £533,000 per annum, or about £5 per head for an effective strength of 105,000 men. In England the annual cost of the militia is about £8 per head, of the volunteers £3. The Swiss so-called army may take its place between our militia and volunteers. The men are less trained than our militiamen, but are generally better educated and of a more intelligent class. They show at least as much independence as our volunteers, and many things of acknowledged necessity are left undone, simply because the men will not do them. The officers are in all respects inferior, and that class who have previously seen service in the army is wanting. In equipment the army is far behind our auxiliary forces, and an attempt made in 1872 to improve its organisation generally, and give the federal authorities more power, was successfully resisted by the cantons. During the war of 1870–71 five divisions of the Swiss army, amounting in all to about 37,000 men, were mobilised and assembled on the frontier; and superficial observers were enthusiastic in their praises of the organisation and efficiency of this citizen army. But their own commander reported that there was "incredible friction in the mechanism of the whole force;" that many of the battalions were in the lowest condition of discipline and efficiency; and that "to march against an enemy with such troops as these would indeed be a bold enterprise;" and urged that "it would be far preferable to have an army weaker in point of numbers, but of better quality." What becomes of such forces when opposed to a real army has been abundantly illustrated by the history of the French *gardes mobiles* in the war of 1870. Switzerland exists by the sufferance of her powerful neighbours, and her military institutions are suited to such conditions, but not to a power that relies on itself for its independence.

Turkish Army.

The Ottoman empire, whose power at one time seemed to threaten the very existence of the Christian states, has long lost her terrors, and her military institutions are now studied rather to see what elements of resistance to foreign aggression she still possesses, than for the part she may play in European politics. Her armies have lost their peculiar character and constitution, and with it much of the spirit which once made them formidable. In the early days of her rising power every Osmanli was a soldier; and the whole nation was animated with that martial fanaticism that was the secret of her strength. As her conquests extended, her warriors were rewarded with grants of land, and a system of military tenure arose resembling the feudal system of Western Europe. And though the Osmanli retained his simple habits and warlike spirit, the unfitness of such a militia for prolonged operations soon led, as in the Christian states, to the establishment of a more permanent force. Sultan Amurath I. in 1360 first formed a bodyguard of Christian captives; and this force, highly privileged and rewarded, soon swelled to large dimensions. Such was the origin of the janissaries, the earliest standing army in Europe, and for long the scourge and terror of the neighbouring Christian states. Like most proselytes, they were more fanatical even than the genuine Osmanli; and this, added to a permanent organisation, made them for a time almost invincible. But success and indulgence produced their usual results, they became overbearing, corrupt, and formidable only to their own country. From being the sultan's slaves they became his masters, and the history of Turkey shows a long list of rulers appointed, deposed, or murdered by the janissaries. Two attempts to break their power failed disastrously. But Sultan Mahmoud II. was not daunted by a first failure, and when in 1826 he commenced his reorganisation of the army, and the janissaries again rose against him, they found him prepared. The new troops remained faithful, and in a terrible three days' struggle, in which 20,000 of their number were killed, the janissaries as a body were annihilated. Mahmoud now hastened to reconstitute his army on European models; but while his measures were still in embryo he found himself involved in a war with Russia, and though the newly-raised troops behaved with gallantry, the war soon took an unfavourable turn, and ended disastrously for Turkey with the humiliating peace of Adrianople. The reforms instituted by Mahmoud were, however, carried on vigorously by his successor, Abdul Medjid, and form the basis of the present military institutions of Turkey.

As now constituted, the Turkish forces consist of the "nizam," or standing army; "ichtjat," or first reserve;

"redif," or second reserve; "hijade," or landsturm; and a certain number of irregular levies.

Although in principle every one is liable to service, the army is recruited entirely from the Mussulman population, Christians and others being exempted on payment of a tax called the "bédel." The capital, the island of Crete, and certain frontier districts, are by ancient privilege exempt both from service and from the tax. The burden of the conscription therefore fails on a comparatively small proportion, considerably less than one-half of the population. The actual conscripts, however, are not numerous. A considerable proportion of the army is raised by voluntary enlistment, the pay being sufficiently high to attract poor Mussulmans; and as personal substitutes, or exemption on payment of a fixed sum (in which case Government finds the substitute), are both allowed, all possessed of any means can and usually do escape service. The period of service is fixed at twenty years,—four in the ranks, two in the "ichtjat," six in the "redif," and eight in the "hijade." The strength of the standing army remaining at 150,000 men, the annual levy is fixed at one quarter of this, or 37,500; and it is estimated that this will give 70,000 (two years' contingents, deducting casualties) in the "ichtjat," about 200,000 in the "redif," and 250,000 in the "hijade," or a total of 670,000 men. Practically, however, these numbers would never be attained, and a great part of the necessary organisation exists only on paper.

The standing army is divided into six army corps, corresponding to the six military districts or "ordus" into which the empire is divided; each army corps consists of 6 to 7 infantry regiments, 6 or 7 rifle battalions, 2 to 7 cavalry regiments, and 1 artillery regiment. There is no divisional or brigade organisation in peace time, the regimental commanders communicating direct with the corps commanders; but in war time brigades of two regiments and divisions of two brigades are formed. The *infantry* of the standing army consists of 41 line regiments of 3 battalions each, and 38 rifle battalions, or a total of 161 battalions. A line or rifle battalion has 8 companies, and a normal or war strength of 33 officers and 800 men; the peace strength is variable, being reduced by furloughs granted at the discretion of the corps or regimental commander, and seldom exceeds 400. Their regimental organisation, parade formations, and drill, are copied from the French. The infantry uniform, which until recently was also on the European pattern, is now more national, and consists of an open blue jacket, an ornamental waistcoat, leather sash, wide Turkish trousers, yellow lace boots, and fez cap. The *cavalry* numbers 25 regiments, all light cavalry, each of 6 squadrons, and numbering on war establishment 42 officers, 914 men, and 856 horses. The four centre squadrons are armed with lances, the two flank ones with breech-loading carbines; all carry sword and revolver besides. The uniform is an open jacket and waistcoat like that of the infantry, but differently laced; the saddle is that known in Austria as the "Hungarian" saddle.

The *artillery* consists of 6 regiments of field artillery, attached to the several army corps, a reserve artillery regiment, and 7 regiments of garrison artillery. A field artillery regiment consists of 15 batteries of 6 guns each; the reserve artillery regiment is similarly organised, and acts as a depôt to the others. The garrison regiments are distributed to the different fortresses; they are formed of 4 battalions of 3 companies, and have a war strength of 2040 men, but in peace scarcely number a third of that. The fortification corps, or corps of engineers, belongs to the artillery, and consists of 2 battalions of 4 companies each. The artillery has always been the best organised and most highly trained branch of the Ottoman army. Mahmoud paid special attention to it, and it was the fidelity of that branch that gave him the victory in the struggle with the janissaries. Foreign officers, Germans especially, have always been largely employed in it, and by their exertions have brought it to a state of efficiency contrasting most favourably with the rest of the army.

The following gives the actual strength of the "nizam" or standing army in 1870, and its estimated strength on war establishment (combatants only):—

	Actual strength.	Estimated war strength.
Infantry	71,000	128,000
Cavalry	16,000	20,000
Artillery (guns)	396	552

After completing four years' service in the ranks, the Turkish soldier is passed into the "ichtjat," or first reserve, for two years, during which he is liable at any time to be recalled, and cannot leave his district without permission. The men of this first reserve, estimated at 70,000, are intended to form separate battalions, but are in all respects available for service like the standing army. Actually a large number would be required to complete the "nizam," and the *cadres* and officers for these reserve battalions only partially exist. A few such battalions were, however, formed at the time of the Yemen expedition in 1870. After two years in this first reserve, the soldier is passed on to the "redif," or second reserve. The "redif" can only be called out in war time, and is not liable for service except within the country. It is divided into two levies, each of three years' contingents, and forms separate regiments and batteries; and it is proposed to form these into army corps corresponding to the existing corps of the standing army, and consisting each of 6 infantry regiments, 6 rifle battalions, 3 cavalry regiments, and 1 artillery regiment of 6 batteries. But this organisation exists on paper only, and it is very doubtful if the necessary *cadres* and officers would be forthcoming. Lastly, after six years in the "redif," the man is passed on to the "hijade," or landsturm, for eight years; but this force, though liable to be called out in war, is not organised even on paper.

The *irregular troops*, which are raised in war, and at one time formed a principal element of strength, are of two kinds,—paid troops (Bashi-Bazouks) and volunteers (Spahis, Bedouins, &c.) The former are usually raised by contract, the governor of a province receiving orders to raise a certain number, and being supplied with the necessary funds, and thereupon contracting with such chiefs or adventurers as undertake to furnish the men at the lowest cost. Most of the money finds its way into the pockets of the governor or contractor, and but little goes to the Bashi-Bazouks. In the last war between Russia and Turkey (1853–55) 20,000 to 30,000 of these were raised, for the most part ill-armed and worse disciplined infantry; but most of them were disbanded before the close of the war. The volunteers, on the other hand, though deficient in organisation, are zealous Mussulmans and brave soldiers. They come mostly from the wild border tribes, in small bodies, under their own chiefs and beys, and furnish a very valuable irregular cavalry.

The Turkish soldier of the present day is generally docile, faithful, temperate, and capable of undergoing great hardships or fatigue. The familiar terms on which the subordinate officers mix with the men would be considered subversive of discipline in any other army, but do not appear to be so in the Ottoman army, and serious military offences are rare. When well commanded, he has shown himself capable of great personal devotion and even heroism, but of a passive rather than an active character. Naturally calm and rather apathetic, he seems to have retained that fatalism which is a special characteristic of his religion, but to have lost the fiery zeal that distinguished his ancestors, and made them, whether individually or as a nation, such formidable assailants. It may be questioned whether, in a purely military aspect, Mahmoud did not lose more than he gained by the destruction of the janissaries and reorganisation of his army on modern models, and whether any amount of drill and science will compensate for the old fanatical spirit. But some such reforms were necessary; Turkey could not continue to hold a place in Europe, yet live the life of an Eastern nation and of an age long past. Her new armies have showed themselves formidable on many occasions; her artillery promises to rival that of most Western nations; and if the Osmanli character is in some respects ill-suited to the scientific and far-seeing character of modern warfare, it still retains enough of its old religious fanaticism to make her more than ordinarily dangerous in a defensive and, as it would seem to her, a holy war.

In a notice of the military forces of Turkey mention must be made of her vassal states, Egypt and Tunis, each of which is bound to furnish an auxiliary contingent in war. The military forces of Tunis and Tripoli are too insignificant to require special notice: her contingent is from 2000 to 4000 infantry, 1000 cavalry, and 8 guns, and during the Crimean war she did actually send about 4000 men to the seat of war in Asia Minor. Egypt is now pledged to furnish an army corps of 30,000 men complete with cavalry and guns. In the Crimean war she furnished first one and afterwards two divisions, amounting to about 21,000 men; and during the insurrection in Crete she furnished a contingent of 10,000 men. The Egyptian army is almost the creation of its present ruler, Ismail Pacha, who on his accession found only two infantry regiments and a few detachments of irregulars. It now consists of 15 infantry regiments of 3 battalions each, 3 rifle battalions, 4 cavalry regiments, 2 regiments of field artillery, and 3 of garrison artillery, and 1 battalion of sappers; and numbers on war strength about 52,000 infantry, 2500 cavalry, and 144 guns. The peace strength is little more than half this. These troops are all organised and drilled on European principles, mainly after French models. Many of the highest officials are actually old French officers. In addition to these, Egypt maintains a force of about 8000 *sandschaks* or irregular troops, who receive a higher rate of pay, but are required to arm, clothe, and feed themselves, and are permanently stationed on her frontiers. In case of war Egypt can raise about 10,000 irregular cavalry among the tribes that are subject to her.

American Army.

The army of the United States of America is the last that calls for notice. Threatened by no powerful or warlike neighbours, the United States are saved from that ruinous competition in armaments which presses on the industry of European countries. The American army is little more than a police force, of which a few regiments serve as a reserve to the civil power in the great towns, while the rest are dispersed in small posts along the frontiers or among the Indian districts. By an Act of 1870 its strength was limited to 30,000 men. It consists of 10 regiments of cavalry, each of 12 companies or troops; 25 regiments of infantry, of 10 companies each; 5 regiments of artillery, and one engineer battalion. The cavalry, broken up in small detachments, partake more of the character of mounted police than of that of European cavalry. They are armed with swords and breech-loading or repeating rifles, and trained to act on foot as well as on horseback; and the whole cavalry drill is assimilated as closely as possible to that of the infantry. The infantry are organised after the old English fashion in single battalion regiments of 10 companies. The army is raised entirely by voluntary enlistment; the term of service is three years, but it is now proposed to extend it to five, and re-engagements are encouraged. Two regiments of cavalry and three of infantry are composed of negro soldiers, but commanded by white officers. The officers of the army are furnished by West Point Academy, a military school equal to any in Europe. The course of instruction lasts four years, and includes all subjects of general education besides purely professional ones. West Point is sought by young men of the best families in America, and the number educated there considerably exceeds the requirements of the army. It is thus the means of spreading a certain military education throughout the country, and it was to this West Point training that the Southerners owed the large number of excellent officers that were found in their ranks in the war.

For military purposes the territory of the United States is divided into ten departments, and those grouped into four military divisions: the South, comprising the departments of the South and of Texas; the division of the Missouri, comprising the departments of Dakota, the Platte, and Missouri; the division of the Pacific, comprising the departments of Columbia, California, and Arizona; and the division of the East, comprising the departments of the East and the Lakes.

By the constitution of September 1787 the President is Commander-in-Chief of the army and militia of the Union, and Congress has power to raise and support armies, to make rules for their government and regulation, and to provide for calling forth the militia to execute the laws of the Union, suppress insurrections, and repel invasions. The Articles of War, by which all troops when mustered into service are governed, were enacted in 1806, and are a close but somewhat improved copy of those in force in the English army, and much of their army regulations is identical with the old general regulations and orders of the royal army.

The military history of the United States is as strange as the rise and rapid growth of the nation. In 1790 the rank and file of the army, as fixed by Act of Congress, amounted to 1216 men; and in 1814 an English expedition of only 3500 men was able to seize and burn Washington, the capital of a country which even then numbered eight millions of inhabitants. In 1861, at the commencement of the war of the secession, the whole regular force amounted to only 14,000 men. In April of that year the President called out 75,000 volunteers for three months to defend the capital, which was threatened; and in May a further call for 42,000 was made. In July two calls for 500,000 each were authorised by Congress, and as even this vast force proved insufficient for the gigantic struggle which America had now embarked in, it was found necessary to introduce the conscription. In October 1863 a levy of 300,000 men was ordered, and in February 1864 a further call of 500,000 was made. Finally, in the beginning of 1865 two further levies, amounting in all to 500,000 men, were ordered, but were only partially carried out in consequence of the cessation of hostilities. The total number of men called under arms by the Government of the United States, between April 1861 and April 1865, amounted to 2,759,049, of whom 2,656,053 were actually embodied in the armies. If to these be added the 1,100,000 men embodied by the Southern States during the same time, the total armed forces reach the enormous amount of nearly four millions, drawn from a population of only 32 millions,—figures before which the celebrated uprising of the French nation in 1793, or the recent efforts of France and Germany in the war of 1870-71, sink into insignificance. And within three years the whole of those vast forces were peaceably disbanded, and the army had shrunk to a normal strength of only 30,000 men. (G. P. C.)

ARNAUD, Henri, the celebrated pastor, military leader, and historian of the Vaudois, was born, in 1641, at La Tour, or La Torre, in Piedmont. He is said to have served under William of Orange, and it is probable that he received pecuniary assistance from that prince in his efforts to restore the exiled Vaudois to their native valleys. Owing to the cruelties of Victor Amadeus of Savoy, from two to three thousand of these Vaudois had been forced to take refuge in Switzerland and the states along the banks of the Rhine; and twice they ineffectually attempted to return to their home. But the English Revolution of 1688, and the accession of William of Orange to the throne, encouraged Arnaud to make a grand effort. Concentrating about 900 followers in the great forest of the Pays de Vaud, he remained in concealment for some time; and at last embarked with them on the Lake of Geneva on the night of 16th August 1689. By September 16 they had entered the valley of San Martino, after hard fighting with the French and Savoyard troops that harassed and opposed them. Being now, however, in danger of attack from about 20,000 French and Piedmontese troops, they were obliged to repair to the lofty table-land of the Balsille, which they fortified with such skill as to be able to withstand the fiercest attacks of the enemy, repeatedly renewed through the whole winter. A general assault on the Balsille (2d May 1690) by about 22,000 French was an utter failure, resulting in the decimation of the enemy, without the loss of a single man to Arnaud. Not caring to hazard a renewal of the assault the garrison withdrew from this stronghold to Angrona, where, just when all chance of further escape seemed impossible, they learned that hostilities had broken out between France and Piedmont, and that their king, who had persecuted and expelled them, was now ready to receive them with open arms. Thus ended the "glorieuse rentrée des Vaudois dans leurs vallées," effected, according to their own account, with a loss of only 30 men, while they made out that the joint losses of the French and Savoyards fell little short of 10,000 men. For a while the Vaudois were allowed to remain in peaceful possession of their ancient homes; but when the war of the Spanish Succession broke out, Arnaud and his followers took part in the combination against France, and rendered the allies effectual service. When the war came to a close, the ungrateful king of Piedmont once more joined the French monarch against his own subjects, and complied with the demands of that prince, that the Vaudois should be expelled from some of their valleys. The exiles, amounting in all to about 3000, found an asylum in Würtemberg. Arnaud, who had invitations from William III., and might have spent the remainder of his days in ease and honour in England, chose rather to continue the pastor of the exiles in the village of Schönberg, and wrote, in his retirement, the *Histoire de la glorieuse Rentrée des Vaudois dans leurs Vallées.* It was printed in 1710, and dedicated to Queen Anne, and has been twice translated into English. Arnaud died at Schönberg in 1721, and every memorial that he left behind him was long cherished by his followers and their posterity.

ARNAUD, or ARNOLDUS, DE VILLA NOVA, a physician, alchemist, and astrologer, who lived at Paris about the end of the 13th and beginning of the 14th centuries. The discovery of the three principal acids,—sulphuric, nitric, and hydrochloric,—has been attributed to him, but Hoefer (*Hist. de la Chimie.*, t. i. p. 385) has shown that these had all been discovered long before his time. His works, with a life prefixed, were printed at Lyons, first in 1504, folio, and again with the notes of Nicholas Tolerus, in 1520, folio; also at Basel in 1515 and 1585.

ARNAULD, Angélique (called Angélique de Saint-Jean), niece of the first or great Angélique, was born in 1624. She was educated at Port-Royal, and took the veil in her twentieth year. In 1653 she was made sub-prioress. During the persecution of the Jansenists, from 1661 to 1664, she was the chief support of the nuns in their resolute refusal to sign the Formulary of Alexander VII. Along with some others she was put into confinement, and, even after permission had been given to return to Port-Royal, they continued to be under the close surveillance of soldiers, who were not withdrawn till 1669, after the "peace" edict of Clement IX. In 1678 Angélique was elected abbess, which office she continued to hold till her death in 1684. She has left several works, in particular the *Mémoires pour servir à l'histoire de Port-Royal, &c.*, 3 vols., 1742, which throw much light on the life of her great aunt. See Arnauld, Jacqueline Marie.

ARNAULD, Antoine, one of the greatest French theologians and philosophers, was born at Paris, Feb. 8, 1612. His father was the most famous advocate of the time, and had gained special distinction by his defence of the university against the Jesuits in 1594. Of his large family, Antoine was the twentieth and youngest child. As he was at first destined to follow his father's profession, he turned his attention to legal studies as soon as he had completed the usual course of education at the colleges of Calvi and Lisieux. But the earnest advice of his mother, a deeply religious woman, who afterwards became an inmate of Port-Royal, induced him to give up the profession of a lawyer and to engage in the service of the church. He received his first instructions in theology from Lescot, confessor of Richelieu, but his teacher's influence over his mind was greatly weakened by the study of some works of Augustine, which, at the request of his mother, had been recommended to him by St Cyran. The thesis which he presented for the degree of bachelor in 1635 showed manifest traces of Augustine's influence, and gave great offence to Lescot. Arnauld now entered the Sorbonne, and from 1638 to 1640 professed the courses of theology and philosophy requisite for a licence. In 1641 he was ordained priest, and took his degree of doctor. After being twice rejected on formal grounds, or, perhaps, from the hostile influence of Lescot, he was, in 1634, admitted a member of the Society of the Sorbonne. In 1641 his mother died. Her last words, in which she implored him to hold stedfastly by the truth, made a deep impression on his mind. He gave up several benefices which he had obtained, and resolved to devote himself with all his soul to the defence and propagation of what he believed to be the truth. Between 1641 and 1643 he composed a treatise in two vols, *De la Necessité de la Foi* (not published till 1700), and another, *Théologie Morale des Jésuites.* In August 1643 he published his famous work, *De la Fréquente Communion*, expressly directed against the Jesuits, who held that the mere mechanical reception of the sacraments was sufficient, and that previous preparation and actual repentance were of secondary importance. They had even gone the length of saying, that the more a man sinned the more frequently and boldly should he approach the table of communion. Arnauld's book was sanctioned by many doctors of the Sorbonne, and by several bishops and archbishops. It was denounced by the Jesuits, one of whom, by name Nouet, preached against its heretical tenets, and called Arnauld an heresiarch worse than Calvin or Luther. This, however, carried matters too far, the Sorbonne and the bishops, who had given their sanction, were implicated in such a condemnation, and, by their influence, Nouet was compelled to retract. But the Jesuits insisted that the work must be judged at Rome, and laid special stress on a sentence in the preface, due not to Arnauld, but to De Barcos. This sentence they held to be adverse to the Papal supremacy, and they so wrought upon Mazarin as to obtain from him a decree commanding Arnauld and De Barcos to repair to Rome. Such intense excitement and indignation were roused by this decree, which struck a blow at the freedom of the French Church, that Mazarin apologised and withdrew it. De Barcos, who had made preparations for his journey to Rome, now learned that the Jesuits were forming bolder and more dangerous designs against Arnauld and himself. He withdrew into concealment and warned Arnauld, who followed his example. The book was examined at Rome and defended by Bourgeois, a doctor of the Sorbonne, and only the one sentence in the preface fell under Papal censure.

Scarcely was this controversy over, when a fresh cause of trouble arose. In 1640 appeared the *Augustinus* of Jansen, bishop of Ypres, the great object of which was to show that the doctrines of Augustine on grace, freewill, and redemption, were opposed to those of the Jesuits, which were really semi-Pelagian. This work fell under Papal censure in 1642, in the bull *In eminenti*, which condemned it as a revival of the errors of Bajus. Arnauld, in 1643, wrote some observations and considerations on the bull, and in 1644–45 a first and second apology for Jansenius. For a time there was little opposition made by the Jesuits, and Arnauld, besides superintending at Port-Royal, occupied himself in translating into French some of Augustine's works, and into Latin his own treatise *De la Fréquente Communion.* At last, in 1649, one Cornet proposed to the Sorbonne seven propositions which he maintained to be heretical. Of these, five were drawn from the *Augustinus* of Jansen. The other two propositions were allowed to drop, and after much controversy the five were condemned by a Papal bull in 1653. Two years later the duc de Liancourt, whose chaplain was a Jansenist, and whose grand-daughter was an inmate of Port-Royal, was refused absolution by a Jesuit confessor unless he dismissed his chaplain and withdrew his grand-daughter from the heretical community. Arnauld wrote two letters upon this affair—the first anonymously, the second signed with his name, and addressed to the duc de Luines. In this second letter it was stated,—1st, that the fathers of the church exhibit to us, in St Peter, a saint who was deficient in saving grace; 2d, that the five heretical propositions were not contained in the *Augustinus.* This second statement contains the celebrated distinction of the questions "de jure" and "de facto." As a matter of right,—of faith,—the propositions were heretical, wherever they occurred; but as a matter of fact, they were not to be found in Jansen's book in the sense ascribed to them by his opponents. The Jesuits held that this was really a rejection and defiance of the Papal bull; and, in 1656 they prevailed on the Sorbonne to expel Arnauld, deprive him of his doctorate, and pass a decree to the effect that all future members of their body must sign the censure. Arnauld's defence against this decree was undertaken by Pascal, who, in his brilliant *Provincial Letters*, brought down the dispute to the level of public comprehension. Arnauld continued to live in retirement, and, in company with Nicole, composed the valuable Port-Royal treatises on grammar, logic, and geometry. In 1668 the peace of the church allowed him to emerge from his retirement. He was received with great honour, and devoted himself to defending Jansenism from the imputation of leading to Calvinistic heresy. To refute this calumny he had already published (in 1664) the work known as the *Petite perpetuité de la Foi;* and in 1669 appeared the first volume of the *Grande perpetuité de la Foi de l'Eglise sur l'Eucharistie,* which was continued in 1671 and 1674. This great defence of transubstantiation, though appearing under Arnauld's name, was mainly the work of Nicole. Arnauld followed it up with several polemical writings against the impious and immoral tendencies of Calvinism. During this time also he was engaged in his elaborate assault on the moral doctrines of the Jesuits, the first volume of the *Morale Pratique des Jésuites* appeared in 1669, and seven other volumes followed at intervals up to 1694.

In 1679 Arnauld was again compelled to conceal himself. He fled from France, and, pursued by the enmity of the Jesuits, went from Mons to Tournai, thence to Ghent, from Ghent to Brussels, and, after having been driven into Holland, settled at Brussels from 1682 to 1690. In 1690 he was again compelled to leave his refuge, but, after wandering about for four years, returned to Brussels, where he died on the 8th August 1694. He was buried in secret, and his heart was sent to be interred at Port-Royal. During the last years of his life his activity never slackened. While continuing the large works already begun, he entered on a long philosophical discussion with Malebranche, in the course of which he published his treatise *Des Vraies et des Fausses Idées*, 1683, the *Réflexions Philosophiques et Théologiques*, 1685, and a number of letters to Malebranche. He was also engaged in keen controversy with his old friends Nicole and Domat. Of his unwearied activity a characteristic illustration is his reply to Nicole, who urged him to rest from his labours. "Rest!" replied he, "shall we not have the whole of eternity to rest in?"

As a theologian Arnauld stands high among French writers, not only from the matter of his works, but from their style. He was the first to introduce a pure and grammatical mode of composition, and to lay aside the infinitely numerous subtleties of the preceding centuries. His writing is singularly vigorous and clear. His philosophic reputation rests on his doctrine of external perception and his work on logic. He was perhaps the first to oppose the theory of representative ideas, or of perception through the ideas of objects, which ideas exist apart from the perceived thing and the perceiving mind. According to him, we perceive things in ideas, but the idea is the same as the perception; we have, in short, only a modification of the mind, conditioned by, or containing objectively, the thing itself. This mental state is subjective, but with an objective reference; to mark the first characteristic, it may be called perception, to mark the second, idea. In many points Arnauld anticipates Reid's objections to representative ideas, but their theories of perception can scarcely be regarded as identical. The *Art de Penser*, familiarly known as the Port-Royal Logic, is the best specimen of the logic of the Cartesian school. It is fresh, clear, and instructive, not overburdened with the useless paraphernalia of scholastic forms, but rich in practical precepts and examples. It is, however, in the main popular, and falls far short of a scientific presentation of the theory of thought. It has been frequently republished in France, and has been much used both in England and in Germany. The complete edition of Arnauld's works, with life by Larrière, is in 45 volumes, 4to, Paris and Lausanne, 1775-1783.

ARNAULD, Jacqueline Marie (better known by her religious name, Marie Angélique de Ste Magdeleine), born 8th September 1591, was the second daughter of Antoine Arnauld, the celebrated advocate. She was early destined for the church, and assumed the dress of a novice in 1599. By concealing her age from the Pope, her father obtained a bull nominating her abbess of Port-Royal when she was little more than eleven years old. For some time after entering on office she spent a purely secular life, performing the needful religious exercises, but taking little or no interest in them, and gradually acquiring an intense dislike to the profession she had adopted. At last, in 1608, a sermon preached in the convent chapel produced a great change in her mind. She now saw that her true duty and happiness lay in the work of the convent; she inflicted on herself severe penances, persuaded the nuns to adhere rigorously to their vow of poverty, and excluded even her own relatives from the cloister precincts. The fame of the reformation wrought by her earnestness spread abroad, and when Mme. d'Estrées, abbess of Maubuisson, was, on account of her gross misconduct, removed and sent into confinement among the *Filles Penitentes* at Paris, Angélique was appointed to take charge of the convent. From this she was forcibly ejected by Mme. d'Estrées, and had to be reinstated by a body of the royal archers. For five years she laboured in Maubuisson, and wrought a considerable change in the state of the convent. In 1623 she returned to Port-Royal, and three years later, as their accommodation became too limited for their numbers, the community removed to the house known as Port-Royal de Paris. Here Angélique accomplished what she had long desired; she was allowed to resign her dignity as abbess, the office was made triennial, and the occupants of it were elected by the nuns. From 1633 to 1636 she acted as superior of a religious community newly instituted in Paris, and then returned, as prioress, to Port-Royal, where her sister Agnes had been elected abbess. In 1648 she, with a few companions, went back to Port Royal des Champs, and there had opportunities for showing much kindness to the poor, who were oppressed by the disastrous civil wars. Angélique died in 1661, just before the great storm of persecution broke over Port-Royal. Materials for her life are to be found in the general histories of Port-Royal, and in the works of the younger Angélique. A very full memoir of her is given in Miss Frances Martin's work, *Angélique Arnauld*, Macmillan, 1873.

ARNDT, Ernst Moritz, a distinguished German patriot, poet, and historical and miscellaneous writer, was a native of the island of Rügen in the Baltic, which at the time of his birth belonged to Sweden. He was born at Schoritz on the 26th December 1769. The second of a family of eight, he inherited from his father the sound mind in the sound body, good sense, practical sagacity, warm feeling, and a strong will; and from his mother the earnest, devout, and Christian spirit which animated all his words and deeds. After passing his boyhood in his father's house, familiar with the solitudes of sea and wood, trained in habits of accurate observation and cheerful activity, and stimulated by books to literary attempts of his own, he was sent, in 1787, to the gymnasium of Stralsund. There he studied for two years, and, after spending the next two years in the old home, he entered, in the spring of 1791, the university of Greifswald, whence he removed to Jena. There he fell under the influence of Fichte, whose teachings he received with eager love, and whose memory remained ever dear to him. Destined for the church, he applied himself at first to the study of theology, but after some years, conscious of no inward call, he renounced that pursuit. In 1796 he became a private tutor at Altenkirchen; visited afterwards Austria, Hungary, Italy, and France, giving to the world the fruits of his observation in a series of remarkable volumes published in the course of the following years; and in 1800 settled at Greifswald as "privat-docent" of history and philology. In 1806 he was named professor extraordinary. His special faculty and vocation distinctly revealed themselves in his bold *History of Serfdom in Pomerania and Rügen* (1803), for which he was denounced by the nobles to the king of Sweden. So convincing was the book that, in 1806, serfdom was abolished. In his next work, *Geist der Zeit* (1807), he aimed at a higher mark. He flung down the gauntlet to Napoleon I. who, in the campaigns of Austerlitz and Jena, had laid Germany prostrate before him, and in burning words he called on his countrymen to rise and shake off the hateful yoke. So great was the excitement produced by this appeal that Arndt, to escape the vengeance of Napoleon, took refuge in Sweden. The work passed through fifteen editions, and grew into four volumes, to which a fifth part, entitled *Pro Populo Germanico*, was added in 1854. Arndt having thus erected the banner of German freedom and unity, devoted himself thenceforth with unflagging courage to the great cause. In pamphlets, poems, and songs he communicated his own enthusiasm to his countrymen; and he zealously co-operated with Stein in the reorganisation of the army and preparation for the final struggle. The War of Liberation followed, and Germany was free. Long years were, however, to pass before unity was attained. One of the most famous of Arndt's songs was that commencing, "*Was ist der Deutschen Vaterland.*" After the peace he returned to Germany, edited at Cologne a political journal, entitled *Der Wächter* (1815–16), and in 1818 was appointed to the chair of history at Bonn. But his bold demands for constitutional reform offended the Diet, and being deprived in the following year, he passed twenty years in retirement and literary activity. In 1840 he was reinstated in his professorship, and in 1841 he was chosen rector of the university. The revolutionary outbreak of 1848 rekindled in the venerable patriot his old hopes and energies, and he took his seat as one of the deputies to the National Assembly at Frankfort. Seeing no prospect of a satisfactory issue he retired with the adherents of Von Gagern. With rare freshness and vigour he continued to lecture and to write, and on his 90th birthday received from all parts of Germany good wishes and love-tokens. About a month later, January 29, 1860, he made a peaceful departure out of the world. Arndt was twice married, first in 1800, but his wife died in the following year in giving birth to a son; he married a second time in 1817. Among his numerous works, in addition to those already named, are—*Nebenstunden, eine Beschreibung und Geschichte der Schottländischen Inseln und der Orkaden* (1820); *Die Frage über die Niederlande* (1831); *Erinnerungen aus dem äussern Leben* (1843); *Wanderungen und Wandlungen mit dem Reichsfreiherrn H. K. F. von Stein* (1858); and a complete edition of his *Gedichte* (1860). Lives of Arndt have been written by W. Neumann and Wilhelm Baur; and statues have been erected to his memory at Schoritz, his birth-place, and at Bonn, where he lies buried. (W. L. R. C.)

ARNDT, John, was a famous Protestant theologian of the 16th century, and may be regarded as the founder of the German Pietism of a later generation. He was born at Ballenstädt, in Anhalt, in 1555, and studied in a variety of universities—in Helmstädt in 1576; in Wittenberg in 1577, when the crypto-Calvinist controversy was at its height, and where he took the side of Melanchthon and the crypto-Calvinists; in Strasburg, under Pappus, who was a strict Lutheran and had a great influence over him; in Basel, where he studied theology under Sulcer, and also medicine. In 1581 he went back to Ballenstädt, but was soon recalled to active life by his appointment to the pastorate at Badeborn in 1583. After some time his Lutheran tendencies exposed him to the anger of the authorities, who were of the Reformed church. He found an asylum in Quedlinburg, and afterwards was transferred to St Martin's church in Brunswick. Arndt's fame rests on his writings, which were mainly of a mystical devotional kind, and were inspired by Bernard, Tauler, and Thomas à Kempis. His principal work is *The True Christianity*, which has been translated into most European languages, and has served as the foundation of many devotional works, both Roman Catholic and. Protestant. In this book Arndt dwells upon the mystical union between the believer and Christ, and his aim is to correct the purely forensic side of the Reformation theology, which paid almost exclusive attention to Christ's death *for* His people, by drawing attention to Christ's life *in* His people. Like Luther, Arndt was very fond of the little anonymous book, *Deutsche Theologie*, and published an edition with a preface recommending it. The first edition of his *True Christianity* appeared in 1605. His other works are *The Death of Adam and the Life of Christ*, *Thoughts on various Books of the Bible*, *The House and the Heart Church*, *Soul Medicine for the Pestilence*, and *De Unione Credentium cum Christo*. His *True Christianity* has been translated into English at least twice, and has gone through a great number of editions; the best known translation is that of A. W. Boehm, Lond. 1720. Several of his sermons are published in R. Nesselmann's *Buch der Predigten*, 1858. Arndt has always been held in very high repute by the German Pietists, and the founders of Pietism, Spener and Storr, repeatedly call attention to him and his writings; they have gone so far as to compare him to Plato, *cf.* C. Scheele, *Plato und Johan Arndt, Ein Vortrag, &c.*, 1857. A valuable account of Arndt is to be found in C. Aschmann's *Essai sur la Vie, etc., de J. Arndt.* (T. M. L.)

ARNE, Thomas Augustine, musical composer, was born in London on the 28th May 1710, his father being an upholsterer. Intended for the legal profession, he was educated at Eton, and afterwards apprenticed to an attorney. His natural inclination for music, however, proved irresistible, and his father, finding from his performance at an amateur musical party that he was already a skilful violinist, furnished him with the means of educating himself in his favourite art. In 1733 he produced his first work,—a setting of Addison's *Rosamond*, the heroine's part being intended for his sister, who afterwards became celebrated as Mrs Cibber. This proving a success was immediately followed by a burletta, entitled *The Opera of Operas*, based on Fielding's *Tom Thumb*. His individuality of style first distinctly asserted itself in the music to Milton's *Comus*, which was performed at Drury Lane in 1738, and speedily established his reputation. In 1740 he wrote the music for Thomson and Mallet's *Masque of Alfred*, which is noteworthy as containing the most popular of all his airs—*Rule Britannia*. In the same year he married Cecilia Young, who was considered the finest English singer of the day. Along with his wife he went, in 1742, to Ireland, where he remained two years. On his return to London he was engaged as leader of the band at Drury Lane Theatre (1744), and as composer at Vauxhall (1745). In 1759 he received the degree of Doctor of Music from Oxford. Three years later he produced, at Covent Garden, his opera of *Artaxerxes*, the popularity of which is attested by the fact that it continued to be performed at intervals for upwards of eighty years. The libretto was a translation by Arne himself, very poorly executed, of Metastasio's *Artaserse*. In addition to his numerous operas, Arne wrote several oratorios, which made little impression at the time, and are now almost entirely forgotten. His success in this department might have been greater but for the contemporary existence of the transcendent genius of Handel, though his deficiency in grandeur of conception and scientific resource is enough of itself to account for his failure. He is, however, undoubtedly entitled to a place in the first rank of native English composers. Though inferior to Purcell in intensity of feeling, he has not been surpassed by any of the school as a composer of graceful and attractive melody. There is something akin to genius in such airs as *Rule Britannia* and *Where the bee sucks*, which still retain their original freshness and popularity. As a writer of glees he does not take such high rank, though he deserves notice as the leader in the revival of that peculiarly English form of composition. Dr Arne died on the 5th March 1778.

ARNHEM, or Arnheim (according to some the *Arenacum* of the Romans, Arnoldi Villa in the Middle Ages), the chief town in the province of Guelderland, in the Netherlands, on the right bank of the Rhine along the slope of the Veluwe Hills. It is a clean and prosperous place, in a pleasant and beautiful district, and is much frequented by the wealthy merchants of the Low Countries, whose villas and gardens adorn its environs. The *Groote Kerk*, or principal church, formerly dedicated to St Martin, and now to St Eusebius, contains, besides other objects of interest, the marble monument of Charles of Egmont. The *Stadhuis*, or town-house, by Maarten van Rossum, is remarkable for the grotesque ornamentation which has earned it the name of the *Duivelshuis*. There are also a government-house, a court-house, a gymnasium, an orphanage, a hospital for invalided soldiers (Bronbeek's), a large assembly-hall (*Musis Sacrum*), a library, a theatre, barracks, and a good number of churches and schools. The town, formerly connected with the Hanseatic League, has still a considerable traffic by river and canal and rail, manufactures tobacco, which is largely cultivated in the neighbourhood, woollen and cotton goods, paper, earthenware, soap, &c., carries on wool-combing and dyeing, and has oil and bark mills. Arnhem was fortified in 1233 by Otho III., duke of Guelders. In 1505 it received the right of coining from Philip of Spain, duke of Burgundy. In 1514 Charles of Egmont took it from the Burgundians. In 1543 Charles V. made it the seat of the Council of Guelders. The States-General got possession of it in 1585, and it resisted all the attacks of the Spaniards. In 1586 Sir Philip Sydney died there from the effects of his wound. The French took the town in 1672, but left it dismantled in 1674. It was refortified by Coehoorn in the beginning of the 18th century. In 1795 it was again stormed by the French, and in 1813 it was taken from them by the Prussians under Bülow.

ARNICA. A genus of plants belonging to the natural order *Compositæ* (composite family). The flowers are clustered in heads (*capitula*), and are surrounded by an involucre composed of two rows of small leaflets called bracts. The outer flowers of the head are strap-shaped (ligulate), and contain pistils only, while the inner or central florets are tubular and have both stamens and pistils. The style is hairy, and the fruit is cylindrical, tapering at each end, and bears at its summit a pappus, consisting of rigid hairs in a single row. The most important species is *Arnica montana* (mountain tobacco), a perennial plant found in meadows throughout the northern and central regions of the northern hemisphere, but not extending to Britain. It grows on the mountains of Western and Central Europe. A variety of it, with very narrow leaves, is met with in Arctic Asia and America. The heads of flowers are large, orange yellow, and borne on the summit of the stem or branches. The outer ligulate flowers are an inch in length. The achenes (fruits) are brown and hairy. The root, or rather the root-stock, has been used in Pharmacy. It is contorted and of a dark brown colour, an inch or two in length. It gives off numerous simple roots from its under side, and shows on its upper side the remains of rosettes of leaves. It yields an essential oil in small quantity, and a resinous matter called arnicin. Arnica has been used as a stimulant in low fevers, and also in cases of palsy. It is said also to act in promoting perspiration. It is a popular remedy for chilblains, and it is said to prevent the blackness of bruises, The flowers have also been used in the form of tincture. They have an unpleasant odour. The plant is not much used at the present day. (J. H. B.)

ARNIM, BETTINA VON, famous for her acquaintance and correspondence with Goethe, was a member of the Brentano family, and born at Frankfort, April 4, 1785. Her acquaintance with Goethe continued from 1807 until 1811, when it was brought to a close by her offensive behaviour to his wife. Shortly after his death she published an extensive correspondence alleged to have passed between the parties. Its genuineness was immediately contested by Goethe's old friend Riemer, and the discussion leaves no doubt that it is everywhere interpolated, and to a great extent wholly fictitious. Bettina never could produce the originals of the letters; and it has been demonstrated that the sonnets which she claimed as addressed to herself, and as partly versifications of her own ideas, were in fact addressed to Minna Herzlieb before Goethe had even seen Bettina. This discovery effectually relieves the poet's memory from some very unpleasant imputations. The literary merits of the work are in some respects very considerable. Nothing can surpass Bettina's liveliness, freshness, originality, and graphic power when dealing with actual persons and things: she is, unfortunately, addicted to abstract speculation, and then becomes unintelligible. Though probably equally supposititious, her correspondence with the friend of her youth, the interesting and unfortunate Caroline von Günderode, is superior to her more celebrated work from its greater truth to nature; and her almost unknown volume of professed letters to and from her brother, Clemens Brentano, is the best of all. These later productions failed to attract a public sated with her peculiar mannerism, and Bettina had sunk into comparative obscurity before her death in 1859. Bettina was a true member of a family whose folly was in her time proverbially said to begin where the folly of others ceases. Her vanity, caprice, mendacity, and utter want of principle can only be excused on the supposition of her virtual irresponsibility for her actions. She possessed a brilliant fancy, and her remarks occasionally display great penetration; her conversational powers are described as marvellous. One of her freaks was to translate her correspondence with Goethe into English; the result is an unparalleled literary curiosity. The evidence respecting this correspondence is ably summed up in Mr Lewes's *Life of Goethe*. (R. G.)

ARNIM, or ARNHEIM, JOHAN GEORG BARON VON, one of the most distinguished men during the period of the Thirty Years' War, both as a general and as a diplomatist, was born in 1586, at Boitzenburg, in the province of Brandenburg. He entered the Swedish army, and served under Gustavus Adolphus. In 1626 he, though a Protestant, was induced by Wallenstein to join the imperial army. He gained great distinction by his military and diplomatic talents, and became the close friend and faithful ally of Wallenstein. After the dismissal of the latter from his command in 1630, Arnim went over to the elector of Saxony, and, at the battle of Leipsic, led the left wing of the united Saxon and Swedish armies. But he disliked the Swedes, who distrusted him; and it was mainly by his influence that the elector detached his forces from Gustavus Adolphus, and that at the peace of Prague the Saxons seceded from their alliance with Sweden. In 1632 Wallenstein, who had been restored to his command, took the field against his old comrade, but little was done by either, and more than a suspicion was roused that they were playing into each other's hands. In February 1634 Wallenstein was assassinated, and Arnim at once began more active operations. In May he gained a great victory over the imperialists at Liegnitz; but after the conclusion of peace, not thinking himself sufficiently honoured by the elector, he withdrew to his castle of Boitzenburg. Here he was seized by the Swedes, and imprisoned at Stockholm. He escaped, and was engaged in raising an army to revenge himself when he died suddenly in 1641.

ARNIM, KARL OTTO LUDWIG VON, a German writer of travels, was born at Berlin in 1779, travelled from 1835 to 1844 through Turkey and Greece, France, Spain, and Italy, and died in 1861. He was attached for some time to the German embassy at London, and wrote in English *Napoleon's Conduct towards Prussia* (1814), and *German National Melodies* (1816). He also translated some English plays and poems. His reputation rests mainly on his *Flüchtige Bemerkungen eines flüchtig Reisenden* (1838–1850), which are highly praised for their lively and graceful style.

ARNIM, LUDWIG ACHIM VON, a distinguished German poet and novelist, was born at Berlin in 1781. He studied at Vienna and Göttingen, and took the degree of M.D., though he never practised as a physician. His attention, however, in his early years seems to have been specially directed towards the natural sciences, and his first literary performance (*Theorie der Elektrischen Erscheinungen*) was in that department. But even in this essay he showed the fondness for the supernatural and the predilection for romance that appeared so strongly in his next work, *Ariel's Offenbarungen*, 1804. In the same year he published *Hallin's Liebesleben*, with an appendix containing a biography of Rousseau. He spent some years in travelling through parts of Germany and collecting old popular legends and songs. A selection of these he published at Heidelberg in conjunction with the poet Clemens Brentano, whose sister Bettina (noticed above) he afterwards married. The volumes, entitled *Des Knaben Wunderhorn*, were received with great favour. In 1809 he published the *Wintergarten*, a collection of tales; in 1810 an admirable novel, *Die Gräfin Dolores;* in 1811 a humorous dramatic romance, *Halle und Jerusalem*, and a novel, *Isabelle von Ægypten;* and two years later his *Schaubühne* or dramatic pieces. His literary activity was for some time interrupted by the war in Germany, but in 1817 he published his last great romance, *Die Kronenwächter*, the scene of which is laid in the time of the Emperor Maximilian. Arnim died in 1831. His works have been published in a collected form at Berlin, 1839–1846. They manifest great originality of invention, but are for the most part marred by the utter absence of literary form, being vague, incoherent, and whimsical to the last degree. Arnim is the subject of a brilliant but much too favourable criticism in Heine's *De l'Allemagne*.

ARNISÆUS, HENNINGUS, a German physician, was born at Halberstadt, probably about 1580. After completing his studies at the university of Helmstädt and taking his degree as doctor of medicine, he seems to have lectured for some time on moral philosophy at Frankfurt-on-the-Oder. In 1613 he was appointed one of the professors of medicine at Helmstädt, and he is said to have constructed there a chemical laboratory and a botanical garden. His anatomical plates were very celebrated, and some of them were extant in the time of Haller. In 1620 he was made court physician to Christian IV. of Denmark, and removed to Copenhagen, where he died in 1638. The greater number of his extant works are on the theory of politics, such as *Doctrina Politica*, published after his death, *De Republica*, *De jure Majestatis*, &c.; the following medical tracts are ascribed to him, *Disquisitiones de partus humani legitimis terminis* and *Disputatio de lue venerea*.

ARNO (the ancient ARNUS), a celebrated river of Italy. It rises in Monte Falterona, in the Apennines, descends into the valley of Casentino, in Upper Tuscany, passes the town of Bibbiena into the plain of Arezzo, where it receives the Chiana as a tributary, and enters the narrow valley of Laterina. Thence it issues through the rocky defile Dell' Inferno, pours into the lovely Val d'Arno, sweeps beneath the woods of Vallombrosa, and, after receiving the Sieve, enters the plain of Florence and flows through that city. Ten miles below Florence it is confined in an artificial channel, formed by the ancient Etruscans, for the purpose of draining the plain. It receives several tributaries, and enters the plain of Pisa, which it traverses; and after a further course of eight miles, falls into the Tuscan sea by an artificial embouchure excavated in 1603. Its whole winding course is about 140 miles. At Florence it is 400 feet wide, but is fordable in summer. It is liable to sudden floods, and then is impetuous, carrying down with it immense quantities of earth and stones, by which its bed is elevated; in many places it requires frequent embankment. The most remarkable inundations are those of 1537 and 1740, the water on the former occasion rising 8 feet in the city of Florence. On the banks of the upper Arno are vast accumulations of fossil bones of the elephant, rhinoceros, hippopotamus, and bear, especially between Arezzo and Florence.

ARNO, or AQUILA, tenth bishop and first archbishop of Salzburg, was one of those learned churchmen whom Charles the Great gathered round him, and who did so much to frame and strengthen that alliance between the Emperor and the Pope which lay at the basis of the Holy Roman empire of the West. The occasion of his introduction to the emperor was the defeat of Thassilo, duke of Bavaria, who had made war upon Charles, and was compelled to sue for peace. He sent at the head of the embassy Arno, who was then bishop of Salzburg, and in whose talents and fidelity he had the utmost confidence. The embassy did not succeed, mainly because Thassilo refused to make the required concessions, and Bavaria was annexed to the empire. When this took place Charles secured the services of Arno, and got for him from the Pope the archbishopric of Salzburg in 798 A.D. From this time forward Arno was frequently at the court of Charles, and became the intimate associate of Alcuin and other scholars whom the emperor delighted to gather around him. In 799 he presided at a synod of the church held at Reisbach, and in 807 at the more important synod of Salzburg. The zeal which he evinced for the conversion of the pagans of Hungary and Bohemia commended him to his ecclesiastical superiors. He established a library in Salzburg formed on the model of the emperor's palace library, and did all he could to further the interests of learning within his diocese. Assisted by a deacon named Benedict, he published a catalogue of the church lands, proprietary rights, and so on, belonging to the church in Bavaria. This is of great value to the historical student, and goes by the name of the *Congestum*, or *Indiculus Arnonis*; an edition with notes was published by Frederick Keinz, Munich, 1869. Arno also wrote *De Donis Ducum Bavariæ Salzbrugensi Ecclesiæ datis*, which is to be found in the *Thesaurus Monumentorum ecclesiasticorum et historicorum* (Antwerp, 1725). (T. M. L.)

ARNOBIUS, called Afer, and sometimes the Elder, was a native of Sicca Venerea in Numidia. The date of his birth is uncertain, but it must have been during the latter part of the 3d century of our era. He was a teacher of rhetoric, and at first an opponent of Christianity. His conversion is said by Jerome to have been occasioned by a dream; and the same writer adds that the bishop to whom Arnobius applied distrusted his professions, and asked some proof of them, and that the treatise *Adversus Gentes* was composed for this purpose. But this story seems rather improbable; for Arnobius speaks contemptuously of dreams, and besides, his work bears no traces of having been written in a short time, or of having been revised by a Christian bishop. From internal evidence the time of composition may be fixed at about 303 A.D. Nothing further is known of the life of Arnobius. He is said to have been the author of a work on rhetoric, which, however, has not come down to us. His great treatise, in seven books, *Adversus Gentes* (or *Nationes*), on account of which he takes rank as a Christian apologist, appears to have been occasioned by a desire to answer the complaint then brought against the Christians, that the prevalent calamities and disasters were due to their impiety, and had come upon men since the establishment of their religion. In the first book Arnobius carefully discusses this complaint; he shows that the allegation of greater calamities having come upon men since the Christian era is false; and that, even if it were true, it could by no means be attributed to the Christians. He skilfully contends that Christians who worship the self-existent God cannot justly be called less religious than those who worship subordinate deities, and concludes by vindicating the divinity of Christ. The second book is principally taken up with a discussion on the soul, which Arnobius does not think is of divine origin, and which he scarcely believes to be immortal. Curiously enough, he is of opinion that a belief in the soul's immortality would tend to remove moral restraint, and have a prejudicial effect on human life. In the concluding chapters he answers the objections drawn from the recent origin of Christianity. Books iii., iv., and v. contain an examination of the heathen mythology, in which he narrates, with powerful sarcasm, the scandalous chronicles of the gods, and contrasts with their grossness and immorality the pure and holy worship of the Christian. These books are valuable as a repertory of mythological stories. Books vi. and vii. discuss, in a very admirable manner, the questions of sacrifices and worship of images. He points out the absurdities of the heathen practices in these respects, and shows how unnecessary they are in a pure system of religion. The work of Arnobius appears to have been written when he was a recent convert, for he does not possess a very extensive knowledge of Scripture. He knows nothing of the Old Testament, and only the life of Christ in the New, while he does not quote directly from the Gospels. He is also at fault in regard to the Jewish sects. The best editions of his work are those of Orelli, 1816; Hildebrand, 1844; and Oehler, 1846. It has been translated into English as vol. xix. of the *Ante-Nicene Christian Library* (1871).

ARNOBIUS, the younger, a Christian priest or bishop in Gaul, flourished about 460 A.D. He is the author of a mystical and allegorical commentary on the Psalms, first published by Erasmus in 1522, and by him attributed to the elder Arnobius. It has been frequently reprinted, and in the edition of De la Barre, 1580, is accompanied by some notes on the Gospels by the same author. To him has sometimes been ascribed the anti-Augustinian treatise *Prædestinatus*, which is anonymous. His opinions, as appears from the commentary, are semi-Pelagian.

ARNOLD OF BRESCIA, remarkable as a forerunner of the Reformation and assailant of the Pope's temporal power, was born about the beginning of the 12th century, and became a priest in his native city. The fame of Abelard's eloquence induced him to repair to France for the sake of becoming his disciple. On his return he bitterly attacked the temporal dominion of the Pope and the wealth of the clergy, advocating the secularisation of all ecclesiastical property. He is said to have also impugned the current doctrine of the sacraments, but this appears to have been an invention of his adversaries. Persecuted in Italy, he returned (1140) to Abelard, and incurred the enmity of the latter's great antagonist, St Bernard, whose denunciations drove him to seek refuge at Zurich, where he acquired great influence. A popular insurrection at Rome (1146) encouraged him to proceed to that city, where he appeared as a political agitator, preaching the deposition of the Pope and the restoration of the ancient republic. He became exceedingly popular, and aided in expelling the Pope from the city, but no practical effect appears to have been given to his plans. The Romans obtained, however, a free constitution on a different model. Upon their demanding the confirmation of this at the accession of the new Pope, Adrian IV. (the Englishman, Nicholas Breakspear), it was refused unless upon condition of their delivering up Arnold. The demand being indignantly rejected, the city, for the first time in history, was laid under an interdict. The consequent suspension of all religious services so powerfully affected the people as to occasion a tumult, which compelled Arnold to take refuge in a castle in Campania (1155). A new emperor, Frederick Barbarossa, had meanwhile been elected, and was on the way to his coronation in Rome. By him Arnold was arrested and delivered up to the Pope, and the Roman constitution suppressed. Arnold was hanged, his body burned, and the ashes thrown into the Tiber. In history he ranks with Rienzi and Savonarola. His enemies have been his biographers, and they are unanimous in acknowledging his eloquence, his personal influence, and his perfect disinterestedness. Allowing for a romantic attachment to antiquated political forms, he was as a politician greatly in advance of his age. The best proof of his truly prophetic insight into the needs of his country is that, although he left no writings and no disciples, his name is to this day a popular cry in Italy. It is also the subject of, perhaps, the only truly national Italian drama, a tragedy by Niccolini. (Franke, *Arnold von Brescia*; Guibal, *Arnaud de Brescia et les Hohenstauffen;* Gregorovius, *Rom im Mittelalter*, vol. iv.) (R. G.)

ARNOLD, Samuel, a distinguished English composer, was born at London in 1740. He received a thorough musical education at the Chapel Royal under Dr Nares, and when little more than twenty years of age was appointed composer at Covent Garden Theatre. Here, in 1765, he produced his popular opera, *The Maid of the Mill.* In 1776 he transferred his services to the Haymarket Theatre. In 1783 he was made composer to George III., and, ten years later, organist in Westminster Abbey, where, on his death in 1802, he was interred. His operas were very numerous and popular, but they have not lived. The best of them were *The Maid of the Mill, Rosamond, Inkle and Yarico, The Battle of Hexham, The Mountaineers.* He also wrote several oratorios, which have shared the fate of his operas. The first of them was *The Cure of Saul*, in 1767, which was very successful. The others are *Abimelech, The Resurrection,* and *The Prodigal Son.* In 1786 he began an edition of Handel's works, which extended to 40 volumes, but was never completed. It is considered extremely inaccurate. He also published a continuation, in 4 volumes, of Dr Boyce's Cathedral Music.

ARNOLD, Thomas, a clergyman of the Church of England, was born at West Cowes, in the Isle of Wight, on the 13th of June 1795. He was the son of William and Martha Arnold, the former of whom occupied the situation of collector of customs at Cowes. Deprived at an early age of his father, who died suddenly of spasm in the heart in 1801, his initiatory education was confided by his mother to her sister, Miss Delafield, who, with affectionate fidelity, discharged the office with which she had been intrusted. From her tuition he passed to that of Dr Griffiths, at Warminster, in Wiltshire, in 1803; and in 1807 he was removed to Winchester, where he remained until 1811, having entered as a commoner, and afterwards become a scholar of the college. In after life he retained a lively feeling of interest in Winchester School, and remembered with admiration and profit the regulative tact of Dr Goddard, and the preceptorial ability of Dr Gabell, who were successively headmasters during his stay there.

From Winchester he removed to Oxford in 1811, where he became a scholar at Corpus Christi College; in 1815 he was elected Fellow of Oriel College; and there he continued to reside till 1819. This interval was diligently devoted to the pursuit of classical and historical studies, to preparing himself for ordination, and to searching investigations, under the stimulus of continual discussion with a band of talented and congenial associates, of some of the profoundest questions in theology, ecclesiastical polity, and social philosophy. The authors he most carefully studied at this period were Thucydides and Aristotle, and for their writings he formed an attachment which remained to the close of his life, and exerted a powerful influence upon his mode of thought and opinions, as well as upon his literary occupations in subsequent years. Herodotus also came in for a considerable share of his regard, but more, apparently, as a book of recreation than one for work. In theology, his mind, accustomed freely and fearlessly to investigate whatever came before it, and swayed by an almost scrupulous dread of aught that might appear to savour of insincerity, was doomed to long and anxious hesitation upon several points of fundamental importance before arriving at a serene and settled acceptance of the great verities of Christianity. Once satisfied, however, of these, his faith remained clear and firm; and having received his religion, not by tradition from men, but as the result of an earnest, penetrating, and honest examination of the evidence on which it rests, he not only held it with a steadfast grasp, but realised it, and felt it as a living and guiding power. From this time forward his life became supremely that of a *religious* man. To the name of Christ he was prepared to "surrender his whole soul," and to render before it "obedience, reverence without measure, intense humility, most unreserved adoration" (*Sermons*, vol. iv. p. 210). He did not often talk about religion; he had no inclination to gossip about his experience, or dwell upon the frames and feelings through which he passed; he had not much of the accredited phraseology of piety even when he discoursed on spiritual topics; but no man could observe him for any length of time without feeling persuaded that more than most men he was directed by religious principle and feeling in all his conduct. The fountain of his piety was in his heart's core; and its streams mingled easily with all the issues of his life. As his biographer has beautifully remarked, "his natural faculties were not unclothed, but clothed upon; they were at once coloured by, and gave a colour to, the belief which they received."

He left Oxford in 1819 and settled at Laleham, near Staines, where he was occupied chiefly in superintending the studies of seven or eight young men who were preparing for the university. His spare time was devoted to the prosecution of studies in philology and history, more particularly to the study of Thucydides, and of the new light which had been cast upon Roman history and upon historical method in general by the researches of Niebuhr. He was also occasionally engaged in preaching, and it was whilst here that he published the first volume of his sermons. Shortly after he settled at Laleham, he entered into the marriage relation with Mary, youngest daughter of the Rev. John Penrose, rector of Fledborough, Nottinghamshire.

After nine years spent at Laleham, he was induced to offer himself as a candidate for the head-mastership of Rugby, which had become vacant; and though he entered somewhat late upon the contest, and though none of the electors were personally known to him, he was nevertheless successful. He was elected in December 1827; in June 1828 he received priest's orders; in April and November of the same year he took his degrees of B.D. and D.D., and in August entered on his new office.

In one of the testimonials which accompanied his application to the trustees of Rugby, the writer stated it as his conviction, that "if Mr Arnold were elected, he would change the face of education all through the public schools of England." Nobly was the somewhat hazardous pledge redeemed by him in whose name it had been given. Under his superintendence the school became not merely a place where a certain amount of classical or general learning was to be obtained, but a sphere of intellectual, moral, and religious discipline, where healthy characters were formed, and men were trained for the duties, and struggles, and responsibilities of life.

Rugby was privileged to enjoy his superintendence for nearly fourteen years. During this period his energies were chiefly devoted to the business of the school; but he found time also for much literary work, as well as for an extensive correspondence. Five volumes of sermons, an edition of Thucydides, with English notes and dissertations, a History of Rome in three vols. 8vo, besides numerous articles in reviews, journals, newspapers, and encyclopædias, are extant to attest the untiring activity of his mind, and his patient diligence during this period. His interest also in public matters was incessant, especially ecclesiastical questions, and such as bore upon the social welfare and moral improvement of the masses.

In 1841 Dr Arnold received from Lord Melbourne, then prime minister, the offer of the chair of modern history at Oxford, an offer which he accepted with peculiar satisfaction. On the duties of this new office he entered on 2d December 1841, by delivering his inaugural lecture, amidst circumstances which he felt to be peculiarly gratifying and flattering. Seven other lectures were delivered during the first three weeks of the Lent term of 1842; the whole have been published since his death.

A few months after the delivery of his lectures, Arnold was suddenly removed from his earthly duties and anticipated enjoyments by an attack of angina pectoris. The midsummer vacation had arrived, and he was preparing to set out with his family to Fox How, a favourite retreat, where he had purchased some property and built a house, in Westmoreland. After a busy day spent in various duties, he retired to rest apparently in perfect health. Between five and six next morning he awoke in severe pain. All attempts to arrest the fatal malady proved fruitless. He bore with heroic fortitude and Christian resignation his sufferings, until eight o'clock, when he expired. The day on which he died was Sunday, the 12th of June 1842. His remains were interred on the following Friday in the chancel of Rugby chapel, immediately under the communion table.

We have no space left to attempt a delineation of the separate features of Arnold's character. We can only remark in general, that the great peculiarity and charm of his nature seemed to lie in the regal supremacy of the moral and the spiritual element over his whole being and powers. His intellectual faculties were not such as to surpass those of many who were his contemporaries; in scholarship he occupied a subordinate place to several who filled situations like his; and he had not much of what is usually called tact in his dealings either with the juvenile or the adult mind. What gave him his power, and secured for him so deeply the respect and veneration of his pupils and acquaintances, was the intensely religious character of his whole life. He seemed ever to act from a severe and lofty estimate of duty. To be just, honest, and truthful, he ever held to be the first aim of his being. With all this, there was intense sympathy with his fellows, the tenderest domestic affections, the most generous friendship, the most expansive benevolence. But to understand aright his claims upon our respect and homage, the history of his life must be read at large. As has been truly observed by one who seems to have known him well—"His Thucydides, his history, his sermons, his miscellaneous writings, are all proofs of his ability and goodness. Yet the story of his life is worth them all."—*Edin. Rev.*, vol. lxxxi. p. 234. His life has been most ably written by the Rev. A. P. Stanley, M.A., now D.D. and Dean of Westminster, in two volumes, 8vo. Lond. 1845. (W. L. A.)

ARNOTT, NEIL, M.D., F.R.S., a distinguished physician and physicist, was born at Arbroath, 15th May 1788. His parents, who were Roman Catholics, removed to Blairs, near Aberdeen, when Arnott was eight years old, and three years afterwards took up their abode in Aberdeen, which enabled him to attend the grammar school there. In 1801 he entered Marischal college, where he took special interest in the natural philosophy subjects, taught at that time by Professor Copland, a skilful experimenter. There his natural bent to physical science was greatly strengthened. He studied medicine first at Aberdeen, and subsequently under Sir Everard Home, through whom he obtained, while yet in his nineteenth year, the appointment of full surgeon to an East Indiaman. After making two voyages to China he settled in 1811 to practise in London, and speedily acquired high reputation in his profession. Within a few years he was made physician to the French and Spanish embassies. In 1836 he was appointed a member of the Senate of the new university of London, and became a fellow of the Royal and Geological Societies. In 1837 he was made a physician extraordinary to the Queen. From his earliest youth Arnott had an intense love of natural philosophy, constantly using illustrations and applications of its principles. To this liking was added an inventiveness which served him in good stead in his profession, and to which we owe the "Arnott water-bed," the "Arnott ventilator," the "Arnott stove," &c., all of which, with characteristic philanthropy, he refrained from patenting. He was the author of several works bearing on physical science or its applications. The most important of these is his *Elements of Physics*, published in 1827, the most successful attempt that had ever been made to popularise a scientific subject. It went through six editions in his lifetime. In 1838 he published a treatise on *Warming and Ventilating*, and, in 1855, one on the *Smokeless Fireplace*. He took a lead in sanitary improvements generally. The chief characteristic of his writings and inventions is their high practical utility. He was a strong advocate of scientific, as opposed to purely classical, education; and he manifested his interest in natural philosophy by the munificent gift of £2000 to each of the four universities of Scotland and to the university of London, to promote its study in the experimental and practical form. He died in London, 2d March 1874.

ARNOTTO, or ANNATTO, is a dyeing material produced from the seeds of *Bixa Orellana* (Nat. Ord. *Flacourtiaceæ*), a small tree which grows in Central and South America. The seeds are surrounded with a thin coating of a waxy pulp, which is separated from them by washing in water, passing the liquid through a sieve, and allowing the suspended pulp to deposit. The water is then drained away and the paste dried, till it is a thick, stiff, unctuous mass. In this state it has a dark orange-red colour, and is known as "roll" or "flag" arnotto, according to the form in which it is put up, but when further dried it is called "cake" arnotto. Arnotto is much used by South American Indians for painting their bodies; among civilised communities its principal use is for colouring butter, cheese, and varnishes. It yields a fugitive bright orange colour, and is to some extent used alone, or in conjunction with other dyes, in the dyeing of silks and in calico printing.

ARNSBERG, a city of Westphalia, in Prussia, the chief town of a government and circle of the same name, 51° 24′ N. lat., 8° 7′ E. long. It is situated on an eminence almost surrounded by the River Ruhr, 44 miles S.E. of Munster, and 58 miles E.N.E. of Dusseldorf. It is the seat of the provincial authorities, and has a court of appeal, a Catholic gymnasium, which was formerly the Benedictine abbey of Weddinghausen, a library, a normal seminary, and a society of agriculture. Weaving, brewing, and distilling are carried on, and there are manufactories of white lead, shot, and paper, as well as works for the production of railway plant. Arnsberg was the capital of the ancient duchy of Westphalia (incorporated with Hesse Darmstadt in 1803, and with Prussia in 1816), and was a member of the Hanseatic league. The new part of the town has been built since 1815. Population in 1873, 5123. Near the town are the ruins of an ancient castle once the residence of the earls of Arnsberg, the last of whom, Gottfried, sold his earldom in 1368 to the archbishop of Cologne.

ARNSTADT, an ancient town of Schwarzburg-Sondershausen, in Central Germany, about 11 miles south of Erfurt, with which it is connected by rail. The Liebfrauenkirche dates from the 12th century, and contains a number of interesting monuments. There is also a castle, a palace, a town-hall, a gymnasium, and a variety of charitable institutions. The so-called Günther's Mill is worthy of notice. Leather, cloth, tobacco, weighing-machines, paper, playing cards, chairs, &c., are among the objects of its industry, and a trade is carried on in grain and wood. There are copper-mines in the neighbourhood, as well as tepid saline springs, the waters of which are used for bathing. Population, 8693.

AROK-SZÁLLÁS, a privileged market-town in Hungary, on the Gyöngyös, 44 miles E.N.E. of Pesth, with a population of 10,400, largely engaged in the transit trade to Upper Hungary.

ARONA, a town in the province of Novara, near the southern extremity of Lago Maggiore. It is well built, and has a gymnasium, an hospital, a port, and dockyard on the lake, and several churches, of which the most important is that of S. Maria, with an altar-piece by Gaudenzio Vinci. There is considerable trade with Germany and Switzerland, and red marble is quarried in the neighbourhood. Count Carlo Borromeo, canonised for his piety and benevolence, was born, in 1538, in the now ruined castle; and on an eminence overlooking the district stands the colossal statue erected in 1697 to his memory by the gratitude of the people. It was executed by Zanello of Pavia and Falcano of Lugano, and is of bronze in the head and hands and feet, and of wrought copper in the remaining portions. It is 66 feet in height, and is raised 46 feet more by its pedestal. It is hollow, and can be ascended from within; the head affords room for three or four persons, and a beautiful view is obtained through the eyes. Population, 3443.

ARPINO, a town on the River Garigliano (*Liris*), in the province of Caserta, in Italy, with a population of 10,000, engaged in the manufacture of woollen cloth, parchment, paper, &c. The first of these industries seems to have existed from a very early date, to judge by inscriptions and the dedication to Mercurius Lanarius of the temple which is replaced by the church of S. Maria di Civita. Originally a Volscian town, *Arpinum* passed into the hands of the Samnites, and from them under the dominion of Rome. Its inhabitants became "Roman citizens" in 302 B.C., and received the right of voting in 188 B.C., being enrolled in the Cornelian tribe. The town is chiefly celebrated as the birth-place of Marius and Cicero. The hereditary *villa* of the orator is supposed to have been situated in the Isola S. Paola, at the mouth of the Fibrenus, where there now stands the monastery of S. Dominico Abbate, in which Hildebrand was once a monk.

ARQUA, a little Italian town, about 13 miles S.W. of Padua, with a population of 1100, chiefly known for that connection with Petrarch which has been so finely commemorated in Byron's lines—

> "They keep his dust in Arqua, where he died."
> *Childe Harold*, cant. iv. st. 31; also st. 59.

ARQUES, a French village in the department of Seine-Inférieure, noteworthy for its castle, founded by William, the uncle of the Conqueror, which was the scene of several remarkable sieges, and gave name to the battle of 1589 in which Henry IV. of France defeated the duke of Mayenne and the Leaguers. Of the extensive and massive building almost nothing remains. The village church, dating from the 16th century, is interesting for its sculptures and stained-glass windows. Population, 968.

ARRACK, a name derived from the Arabic *arak* (perspiration), and applied to a spirituous liquor distilled in India, Ceylon, and Java, and generally consumed in Eastern countries. In Ceylon arrack is distilled from the fermented juice called toddy, drawn from the unexpanded flower-spathes of various palms, chiefly the Palmyra palm (*Borassus flabelliformis*) and the cocoa palm (*Cocos nucifera*). On the Indian continent a kind of arrack is made from the flowers of the Muohwa tree (*Bassia latifolia*), besides that derived from palm toddy; and a large quantity of a nauseous and unpalatable spirit is distilled from rice, which goes by the name of rice arrack. This spirit is consumed by the lower orders and wild tribes of Bengal and Central India. In Java arrack is distilled from the impure molasses left in the manufacture of raw sugar, fermented with rice, to which a proportion of palm toddy is added. Large quantities of the deleterious spirit so prepared is shipped from Java to the countries of Northern Europe. The habitual use of these inferior liquors in the hot countries in which they are distilled is attended with most disastrous consequences.

ARRAIGNMENT (from *arraisonner*, *arraigner*, Old Fr., *ad rationem ponere*, to call to account), a law term, properly denoting the calling of a person to answer in form of law upon an indictment. After a true bill has been found against a prisoner by the grand jury, he is called by name to the bar, the indictment is read over to him, and he is asked whether he be guilty or not of the offence charged. This is the arraignment. His plea in answer to the charge is then entered, or a plea of not guilty is entered for him if he stands mute of malice and refuses to plead. If he pleads guilty sentence may be passed forthwith; if he pleads not guilty, he is then given in charge to a jury of twelve men to inquire into the truth of the indictment. He may also plead in abatement, or to the jurisdiction, or demur on a point of law. Several defendants, charged on the same indictment, are arraigned together.

ARRAN, an island on the west coast of Scotland, near the mouth of the river Clyde, which forms part of the county of Bute. It is about 20 miles in length, by from 8 to 11 in breadth, and contains a superficial area of 165 square miles, or 105,814 acres, of which about 14,431 are cultivated. This island is rugged and mountainous, particularly in the northern part, in which the valleys are deep and romantic. The principal mountain is Goatfell (in Gaelic, Goadh-Bhein, or Mountain of the Winds), 2865 feet above the level of the sea; and a few others, as Beinn Tarsuin and Ben Noosh, approach the same elevation. There are five small lakes and several streamlets in the island. There is little cultivation, the farms being principally pastoral. A good many Highland cattle and sheep are fed on the island. Game is abundant, consisting of blackcock and grouse. A few red deer and a number of wild goats still find shelter among the mountains.

The geology of the island is an epitome of that of Scotland. The mountains of the north, especially Goatfell, consist of granite, surrounded on the flanks by micaceous and argillaceous slates; lying on the edges of the slate are well seen red sandstone and conglomerate, especially on the eastern shores, but easily traceable across the island. On the eastern side limestone, containing Carboniferous fossils, is found at several points intercalated among the red sandstones chiefly at Corrie, where several strata divided by shale are quarried. In the southern part of the island the stratified formations are overlain by a great series of trap-rocks. Several beds of coal were formerly worked on the north-east coast. This coal lies low down in the Carboniferous series, at the base of the Carboniferous limestone, or in the "calciferous sandstones." Numerous veins of most beautiful pitchstone and pitchstone-porphyry traverse the red sandstone, especially at Drimadoon and between Brodick and Lamlash. On the mountains are found jasper, agates, cairngorms, and small clear specimens of rock-crystal, called the Arran diamond.

A considerable manufacture of sulphate of baryta as a pigment was at one time carried on in Glen Sannox. The herring fishery is prosecuted by the islanders. Arran possesses two remarkably fine natural harbours,—Lamlash Bay, on the south-east of the island, and Loch Ranza on the north-west side. The latter is an indentation of the sea on the north of the island, about a mile in length, and is a place of great resort for boats engaged in the herring fishing. The ruins of an old castle stand upon a small peninsula near the entrance. Almost the whole island belongs to the duke of Hamilton, whose seat is at Brodick Castle. The landing-pier for steamers and the principal hotel are at Brodick Bay, where there is a village with church and school. Six miles from Brodick lies the village of Lamlash. Its beautiful semicircular bay, sheltered by the Holy Island, forms an excellent harbour for ships of all sizes. The Holy Isle, an irregular cone 1020 feet high, was once the site of a cell inhabited by St Molios, a disciple of St Columba. Off the south-east point of Arran lies the low rocky islet of Pladda, with a lighthouse having two fixed lights 130 and 77 feet above high water, and visible 16 and 13 miles respectively, in clear weather. It has a telegraph station, from which the arrival of vessels in the Clyde is notified to Glasgow and Greenock. Many parts of the island are traditionally connected with Robert Bruce. Thus one of the largest of the water-worn recesses in the high sandstone cliffs of the west coast is called the king's cave, another is the king's kitchen, a third his cellar, and a fourth his table, while the hill above is the king's hill; the southern extremity of Lamlash Bay is the King's Cross Point; and an ancient fort in Glencloy is said to have sheltered his men.

The antiquities of the island, besides those already mentioned, are Druidical circles (of which the most complete are at Tormore, near Drimadoon, and are called Suidhe Choior Fhionn, or Fingal's cauldron seat), Danish forts, and sepulchral cairns, such as the immense mound, 200 feet in circumference, at the head of Glen Meneadmar or Moneymore.

ARRAS (the *Nemetacum* of the Romans), a fortified city of France, chief town of the department of Pas de Calais, and formerly capital of the province of Artois. Its name, otherwise Atrecht, is like Artois, a corruption of the name of the Atrebates. It is situated on both sides of the Scarpe, where that river receives the Crinchon, 32 miles N.E. of Amiens, and 100 miles N.N.E. of Paris. The town is well built and adorned with many handsome edifices, such as the town-house, a beautiful building, dating from 1510; the cathedral (1833), on the site of the older Gothic, which was destroyed in the Revolution; the citadel, erected by Vauban, who first employed his lunettes in the defences of the town; an arsenal, barracks, a theatre, &c. It is the seat of a bishop, and of a court of assize; and has a royal society, a college, a diocesan seminary, an institution for the deaf and dumb, and schools of design and belles lettres, as well as a public library of upwards of 40,000 volumes, a picture gallery, museum, and botanical garden. Its chief manufacturers are lace, woollens, hosiery, beet-root sugar, salt, soap, and earthenware; and there is a large general trade in wine, oil, grain, &c. It was at one time so celebrated for its tapestry that in English its name became identified with the manufacture. The River Scarpe is navigable up to the town. Population in 1872, 27,329. Lat. 50° 17′ 31″ N., long. 2° 46′ 49″ E.

Arras was the chief town of the *Atrebates* as early as the time of Cæsar, and some remains of the Roman town, such as a temple of Jupiter, have been found. In 407 it was destroyed by the Vandals, and by the Normans in 880. It gives name to a treaty concluded in 1414 between the Armagnacs and Burgundians, to another between Philip the Good of Burgundy and Charles VII. of France in 1435, and to a third, in 1482, between Maximilian of Austria and Louis XI. of France, by which Burgundy and Artois were given to the Dauphin as a marriage portion. In 1493 it came again into the possession of Maximilian; and in 1578 it was held by the prince of Orange. In 1640 troops of Louis XIII. took Arras; and by the peace of the Pyrenees, in 1659, France was confirmed in the possession of the town. It suffered severely during the Revolution, especially at the hands of the infamous Lebon, who, as well as the brothers Robespierre, was born in the town.

ARREST (from the French *arrester*, *arrêter*, to stop or stay) is the restraint of a man's person, for the purpose of compelling him to be obedient to the law, and is defined to be the execution of the command of some court of record or officer of justice.

Arrests are either in civil or in criminal cases.

I. *In Civil Cases.*—The arrest must be by virtue of a precept or order out of some court, and must be effected by corporal seizing or touching the defendant's body, or as directed by the writ, *capias et attachias*, take and catch hold of. And if the defendant make his escape it is a *rescous*, or rescue, and attachment may be had against him, and the bailiff may then justify the breaking open of the house in which he is, to carry him away.

Arrests on mesne process, before judgment obtained, are abolished by 32 and 33 Vict. c. 62, § 6; an exception, however, is made in cases in which the plaintiff proves, at any time before final judgment, by evidence on oath to the satisfaction of a judge of one of the superior courts, that he has a good cause of action to the amount of £50, that the defendant is about to quit the country, and that his absence will materially prejudice the plaintiff in prosecuting his action. In such cases an order for arrest may be obtained till security to the amount of the claim be found.

Until a recent period a judgment creditor might arrest his debtor under a writ of *capias ad satisfaciendum*, but since 32 and 33 Vict. c. 62 (the Debtor's Act, 1869), imprisonment for debt has been abolished in England, except in certain cases, and in these the period of detention must not exceed one year.

The following persons are privileged from arrest, viz., 1*st*, Members of the Royal Family and the ordinary servants of the king or queen regnant, chaplains, lords of the bedchamber, &c. This privilege does not extend to servants of a queen consort or dowager. 2*d*, Peers of the realm, peeresses by birth, creation, or marriage, Scotch and Irish peers and peeresses. 3*d*, Members of the House of Commons during the session of Parliament, and for a convenient time (forty days) before and after it. Members of Convocation appear to have the same privilege. *4th*, Foreign ambassadors and their "domestics and domestic servants." Temporary privilege from arrest is enjoyed by barristers travelling on circuit, by parties, witnesses, or attorneys connected with a cause, and by clergymen whilst performing divine service.

The arrest of any privileged person is irregular *ab initio*, and the party may be discharged on motion. The only exception is as to indictable crimes, such as "treason, felony, and breach of the peace."

There are no longer any places where persons are privileged from arrest, such as the Mint, Savoy, Whitefriars, &c., on the ground of their being ancient palaces; but near the Palace of Holyrood, Edinburgh, a sanctuary still exists for the benefit of debtors, who resort there for such protection, and take lodgings within the precincts.

Except in cases of treason, felony, or breach of the peace, an arrest cannot be made on a Sunday, and if made it is void (29 Car. II. c. 7); but it may be made in the night as well as in the day.

II. *In Criminal Cases.*—All persons whatsoever are, without distinction, equally liable to this arrest, and any man may arrest without warrant or precept, and outer doors may be broken open for that purpose. The arrest may be made,—*1st*, by warrant; *2d*, by an officer without warrant; *3d*, by a private person without warrant; or, *4th*, by a hue and cry.

1. Warrants are ordinarily granted by justices of the peace on information or complaint in writing and upon oath, and they must be indorsed when it is intended they should be executed in another county (see 11 and 12 Vict. c. 42). They are also granted in cases of treason or other offence affecting the Government by the Privy Council, or one of the secretaries of state, and also by the chief or other justice of the court of Queen's bench in cases of felony, misdemeanour, or indictment found, or criminal information granted in that court. Every warrant ought to specify the offence charged, the authority under which the arrest is to be made, the person who is to execute it, and the person who is to be arrested.

2. The officers who may arrest without warrant are,—justices of the peace, for felony or breach of the peace committed in their presence; the sheriff and the coroner in their county, for felony; constables, for treason, felony, or breach of the peace committed in their view,—and within the metropolitan police district they have even larger powers; and watchmen from sunset to sunrise.

3. A private person is bound to arrest for a felony committed in his presence, under penalty of fine and imprisonment.

4. The arrest by hue and cry is where officers and private persons are concerned in *pursuing* felons, or such as have dangerously wounded others.

The remedy for a wrongful arrest is by an action for false imprisonment.

In Scotland the law of arrest in criminal procedure has a general constitutional analogy with that of England, though the practice differs with the varying character of the judicatories. Colloquially the word arrest is used in compulsory procedure for the recovery of debt; but the technical term applicable in that department is caption, and the law on the subject is generically different from that of England. There never was a practice in Scottish law corresponding with the English arrest in mesne process; but by old custom a warrant for caption could be obtained where a creditor made oath that he had reason to believe his debtor meditated flight from the country, and the writ so issued is called a warrant against a person *in meditatione fugæ*. Imprisonment of old followed on ecclesiastical cursing, and by fiction of law in later times it was not the creditor's remedy, but the punishment of a refractory person denounced rebel for disobedience to the injunctions of the law requiring fulfilment of his obligation. The system was reformed and stripped of its cumbrous fictions by an Act of the year 1837. Although the proceedings against the person could only follow on completed process, yet, by a peculiarity of the Scottish law, documents executed with certain formalities, and by special statute bills and promissory-notes, can be registered in the records of a court for execution against the person as if they were judgments of the court.

Arrest of Judgment is the assigning just reason why judgment should not pass, notwithstanding verdict given, either in civil or in criminal cases, and from intrinsic causes arising on the face of the record.

ARRESTMENT, in *Scottish Law*, denotes that process by which a creditor detains the goods or effects of his debtor in the hands of third parties till the debt due to him shall be paid. It is divided into two kinds,—*1st*, Arrestment in security, used when proceedings are commencing, or in other circumstances where a claim may become, but is not yet, enforceable; and *2d*, Arrestment in execution, following on the decree of a court, or on a registered document, under a clause or statutory power of registration, according to the custom of Scotland. By the process of arrestment the property covered by it is merely retained in its place; to realise it for the satisfaction of the creditor's claim a farther proceeding called "Forthcoming" is necessary. By old practice, alimentary funds, or those necessary for subsistence, were not liable to arrestment. By 33 and 34 Vict. c. 63, the wages of all labourers, farm-servants, manufacturers, artificers, and work-people, are not arrestable except (1) in so far as they exceed 20s. per week; but the expense of the arrestment is not to be charged against the debtor unless the sum recovered exceed the amount of the said expense; or (2) under decrees for alimentary allowances and payments, or for rates and taxes imposed by law.

ARRIA, the wife of Cæcina Pætus, who, having been engaged in the conspiracy of Scribonianus against the Emperor Claudius, 42 A.D., was condemned to death. Arria, resolving not to survive her husband, stabbed herself with a dagger, which she then handed to him with the words, "Pætus, it does not pain me." Her daughter, also called Arria, was the wife of Thrasea; and when he was condemned to death by Nero, she would have imitated her mother's example. but was dissuaded by her husband, who entreated her to live for the sake of their children. She was sent into banishment.

ARRIAN (Ἀῤῥιανός), a distinguished Greek historian and philosopher, who lived in the time of the Emperors Hadrian, Antoninus Pius, and Marcus Aurelius. He was a native of Nicomedia, born about the end of the 1st century of our era, and was one of the most distinguished disciples of the famous Epictetus. In 124 A.D. he lived at Athens, where he made the acquaintance of the Emperor Hadrian, who was so much struck with his practical wisdom as to raise him to several high offices; and under Antoninus he obtained even the consulship. The only other event of his life of which we know anything is, that he was appointed governor of Cappadocia, and in that capacity distinguished himself by the victory he gained over the Alani. Arrian proudly disdained to give any information regarding himself; and his life, written by Dion Cassius, is lost. History and philosophy are greatly indebted to Arrian; for, being a disciple of Epictetus, who himself did not write any work, Arrian determined to be to him what Xenophon had been to Socrates, and published his philosophical lectures in eight books, of which only the first half is extant: but the portion which has come down to us gives us a most exalted view of the ethical philosophy of Epictetus and the Stoics generally. The work bears the title Διατριβαὶ Ἐπικτήτου, and is contained in Schweighäuser's *Philosophiæ Epicteteæ Monumenta*, vol. iii. A second work, by which Arrian testified his attachment to his great master, bears the title Ἐγχειρίδιον Ἐπικτήτου, a short manual of moral philosophy, compiled from the lectures of Epictetus, which for many centuries was regarded both by Pagans and Christians as the best book on the subject. It has been published in a great many editions; the best is in the collection of Schweighäuser mentioned above. Of Arrian's original works the one of greatest importance is his account of the expedition of Alexander the Great in seven books. It contains the most complete and authentic account of that conqueror's career, being based upon the lost works of Aristobulus and Ptolemy, the son of Lagus, both of whom accompanied the king during the expedition. The best modern editions are those of Ellendt, 1832, 2 vols. 8vo; Krüger, Berlin, 1835 and 1848, 2 vols. 8vo, and 1851, 1 vol. 8vo; Sintenis, Lips. 1849; and Dübner and Müller, 1846. Connected with his history of Alexander is a treatise on India, in the Ionic dialect, which he wrote separately, in order not to break the continuity of the narrative. He also wrote a work on the chase, a periplus or voyage round the coasts of the Black Sea, and a manual of tactics; but of many other works ascribed to him by the ancients there are extant only a few fragments. Certain descriptions of the coasts of the Sea of Azov and the Red Sea, which are ascribed to him, are probably the productions of a later period. Arrian's style is simple, lucid, and manly. His imitation of Xenophon is visible, not only in his style and diction, but even in the subjects on which he wrote. His language, though pure Attic, presents some peculiarities which are not found in the works of his great model.

ARROWROOT. A large proportion of the edible starches obtained from the rhizomes or root-stocks of various plants are known in commerce under the name of arrowroot. Properly the name should be restricted to the

Fig. 1. Fig. 2.
Arrowroot Plant (*Maranta arundinacea*).—Fig. 1, stem, leaves, and flowers; fig. 2, roots.

starch yielded by two or three species of *Maranta*, the chief of which is *M. arundinacea*; and when genuine or West Indian arrowroot is spoken of, it is understood that this is the variety meant. *Maranta arundinacea* is originally a native of the American continent, but it has long been cultivated in the West Indian Islands, and it has now spread to most tropical countries. The plant produces a scaly, white, tuberous rhizome, and it is at the period when this organ is gorged with starch-cells, immediately before the season of rest, that it is ripe for use. In addition to about 25 per cent. of starch, the fresh roots contain a proportion of woody tissue, vegetable albumen, and various salts. The arrowroot may be separated on a small scale in the same manner as potato-starch is frequently prepared, that is, by peeling the root and grating it in water, when the starch falls to the bottom The liquor is then drained off, and the starch purified by repeated washings till it is ready for drying. On a large scale the manufacture of arrowroot is conducted with specially prepared machinery. The rhizomes when dug up are washed free of earthy impurities and afterwards skinned. Subsequently, according to Pereira's *Materia Medica*, "the carefully skinned tubers are washed, then ground in a mill, and the pulp washed in tinned-copper cylindrical washing-machines. The fecula is subsequently dried in drying-houses. In order to obtain the fecula free from impurity, pure water must be used, and great care and attention paid in every step of the process. The skinning or peeling of the tubers must be performed with great nicety, as the cuticle contains a resinous matter which imparts colour and a disagreeable flavour to the starch. German-silver palettes are used for skimming the deposited fecula, and shovels of the same metal for packing the dried fecula. The drying is effected in pans, covered with white gauze to exclude dust and insects."

Arrowroot is distinguished by the granules agglomerating into small balls, by slightly crepitating when rubbed between the fingers, and by yielding with boiling water a fine, transparent, inodorous, and pleasant-tasted jelly. In microscopic structure the granules present an ovoid form, marked with concentric lines very similar to potato-starch, but readily distinguished by having a "hilum" marking at the thick extremity of the granule, while in potato-starch the same appearance occurs at the thin end (compare figs. 3 and 4 below). In addition to the West Indian supplies, arrowroot is now found in the commerce of Brazil, the East Indies, Australia, Cape Colony, and Natal, in the last of which localities it has become a staple of some importance. Bermuda arrowroot has always been held in the highest esteem, but on those islands the cultivation is gradually giving way to more profitable crops. In 1872 only 26,710 ℔, of the value of £1323, were exported from the Bermudas, while in 1851 the value of the export trade was more than £10,000. St Vincent is now the chief seat of arrowroot culture in the West Indies.

Tous-les-mois, or Tulema arrowroot, is obtained from several species of *Canna*, a genus closely allied to *Maranta*, and cultivated in the same manner. The granules of *tous-les-mois* are readily distinguishable by their very large size (fig. 5). *East Indian arrowroot* is obtained from the root-stocks of several species of the zingiberaceous genus, *Curcuma*, chiefly *C. angustifolia*. *Brazilian arrowroot* is the starch of the cassava plant, *Jatropha Manihot* (fig. 6); which when agglutinated on hot plates forms the tapioca of commerce. The cassava is now cultivated in the East Indian Archipelago as well as in South America. *Tacca*, or *Otaheite arrowroot*, is the produce of *Tacca pinnatifida*, the Pia plant of the South Sea Islands. *Portland arrowroot* was formerly prepared on the isle of Portland from the tubers of the common Cuckoo Pint. *Arum maculatum*. Various other species of *Arum* yield valuable food-starches in hot countries. Under the name of *British arrowroot* the farina of potatoes is sometimes sold, and the French excel in the preparation of imi-

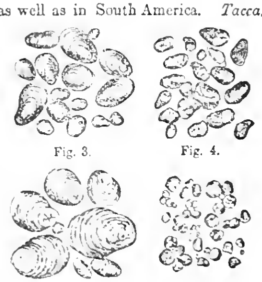


Fig. 3. Fig. 4. Fig. 5 Fig. 6.
Starch Granules magnified.—Fig. 3, potato; fig. 4, arrowroot; fig. 5, tous-les-mois; fig. 6, jatropha.

tations of the more costly starches from this source. The chief use, however, of potato-farina as an edible starch is for adulterating other and more costly preparations. This falsification can readily be detected by microscopic examination, and the accompanying drawings exhibit the appearance under the microscope of the principal starches we have described. Although these starches agree in chemical composition, their value as articles of diet varies considerably, owing to different degrees of digestibility and pleasantness of taste. Arrowroot is found frequently to remain in the stomach of invalids when most other forms of food are rejected, and on this account it has considerable therapeutic value. Being destitute of nitrogen, arrowroot and the other edible starches belong to the force-producing class of foods, and cannot of themselves form a perfect diet. They require to be associated with milk, eggs, meat, or other substances rich in nitrogenous compounds as articles of diet; and they should not be given to young infants, whose organs are not suited for the digestion of starchy food.

ARROWSMITH, the name of a family of geographers. The first of them, Aaron Arrowsmith, was born in 1750 at Winston in Durham. When about twenty years of age he came to London, and was employed by Cary, the engraver. In 1790 he made himself famous by his large chart of the world on Mercator's projection. Four years later he published another large map of the world on the globular projection, with a companion volume of explanation. The maps of North America and Scotland are the most celebrated of his many later productions. He died in 1823, leaving two sons, Aaron and Samuel, the elder of whom was the compiler of the *Eton Comparative Atlas*, of a Biblical atlas, and of various manuals of geography. John Arrowsmith, nephew of the elder Aaron, was born at Winston in 1790, and in 1810 joined his uncle in London. In 1834 he published his *London Atlas*, the best set of maps then in existence. He followed up the atlas with a long series of elaborate and carefully-executed maps, those of Australia, America, Africa, and India being especially valuable. In 1862 he received the gold medal of the Royal Geographical Society, of which body he was one of the founders. He died 2d May 1873.

ARSACIDÆ, the dynasty of Parthian kings, so called from the name of the founder, Arsaces. Very little is known of the circumstances attending the sudden rise of the Parthian power, or of the leader under whom it was effected. He is said by some to have been a Parthian noble, by others to have been a predatory Scythian chief. But at all events, about 250 B.C., when the Seleucid empire of Antiochus II. was distracted by an Egyptian war and the successful rebellion of Bactria, the Parthians, hitherto subject and almost unknown to history, revolted, established an independent kingdom, and made their leader, Arsaces, their first sovereign. He is said to have been killed in battle, after a short reign of three years, and the throne was then occupied by his brother, Tiridates, who, like all succeeding sovereigns of Parthia, assumed the name Arsaces as a regal title. The empire increased rapidly in extent and strength, and for a time was the most formidable rival of the Roman power. Towards the close of the 2d century A.D. it had fallen somewhat into decay, as is manifest from the successful Roman invasions under Avidius Cassius and the Emperor Severus; and it finally succumbed to the Persians, who (224 A.D.) revolted under Artaxerxes, and slew in battle Artabanus, the twenty-ninth and last of the Arsacidæ. See PARTHIA.

ARSAMASS, a town in Russia, in the government of Nijni-Novgorod, at the confluence of two minor tributaries of the Volga, the Arsha and Tesha. It has thirty-four churches, three monasteries, several schools, and various benevolent institutions. There are dye-works, soap-factories iron-works, and extensive tanneries; and a large trade, stimulated by two annual fairs, is carried on, more especially in sheep-skins and sail-cloth. Population, 10,517.

ARSENAL (supposed to be derived from *arx navalis*, whence the Romaunt word *arthenal*, signifying generally a "citadel," though primarily it meant simply a naval citadel[1]), is an establishment for the construction, repair, receipt, storage, and issue of warlike stores.

A first class arsenal, which can renew the materiel and equipment of a large army must embrace a gun factory, carriage factory, laboratory, and small arms ammunition factory, small arms factory, harness, saddlery, and tent factories, and a powder factory; in addition it must possess great store-houses In a second class arsenal the factories would be replaced by workshops. The situation of an arsenal should be governed by strategical considerations. If of the first class, it should be situated at the base of operations and supply; it must be secure from attack, not too near a frontier, and placed so as to draw in readily the resources of the country. The defences of a large arsenal would be provided for by a chain of detached forts and an *enceinte* of sufficient strength.

Situation.

Defences.

The great point in arranging stores is their proper preservation and facility for issue. The branches of an arsenal may be divided into A, Storekeeping; B, Construction; C, Administration. Under A we should have the following departments and stores:—Departments of issue and receipt, pattern room, armoury department, ordnance or park, harness, saddlery, and accoutrements, camp equipment, tools and instruments, engineer store, magazines, raw material store, timber yard, breaking up store, unserviceable store. Under B,—Gun factory, carriage factory, laboratory, small arms factory, harness and tent factory, powder factory, &c. In a second class arsenal there would be workshops instead of these factories. C.—Under the head of administration would be classed the chief director of the arsenal, the superintendents and assistant-superintendents of the factories and branches of the arsenal. Besides these, who would usually be artillery officers, there would be required managers or foremen (civil and military), non-commissioned officers, artificers, workmen, and labourers. In addition a staff of clerks and writers are necessary for all the office work of the establishments. In the manufacturing branches we should want skill, and efficient and economical work, both executive and administrative; in the storekeeping part, good arrangement, great care, thorough knowledge of all warlike stores, both in their active and passive state, and scrupulous exactness in the custody, issue, and receipt of stores. For fuller details than can be given here the reader is referred to a paper on the organisation of an arsenal, by Lieut. Collen, R.A., in vol. viii. *Proceedings R.A. Inst.*

Organization.

In England the Royal Arsenal, Woolwich, manufactures and stores the requirements of the army and navy. Under the scheme of army localisation now in force, there are district-issuing stores for the troops for camp equipage, field stores, and reserve ammunition. The concentration of nearly the whole of our military factories and stores at one place, Woolwich, has long been considered an evil, and it has been proposed to establish, at some central spot, a large military depôt or arsenal, which should be complementary to Woolwich.

Royal Arsenal.

The history of the Royal Arsenal is treated in the paper by Lieut. Grover before referred to. As a manufacturing establishment it has existed about 150 years, but as a military post and store depôt it possesses a greater antiquity. Before 1805 it was called the "Tower Place" or King's Warren, and the land had been probably acquired in 1667

[1] See a very interesting paper by Lieut. C. E. Grover, R.E., in vol. vi. *Proceedings R. A. Inst.*, on the Royal Arsenal at Woolwich.

as sites for batteries to protect Woolwich against the invading Dutch fleet, although in 1664 mention is made of storehouses, &c., and sheds for repairing ship carriages. In 1668 guns, carriages, and stores were concentrated at Woolwich, and in 1695 the laboratory establishment was moved from Greenwich to the former place. Prior to 1716 ordnance was obtained from private manufacturers, and proved by the Board of Ordnance. In 1716 a dangerous explosion took place at the Moorfields Foundry, and it was decided to build a royal brass foundry at the Tower Place, Woolwich. Founders were advertised for, and the records of those times show that Mr Andrew Schalch of Douay was selected. The popular story of Schalch's foreseeing the explosion, and being afterwards commissioned to search for a site and build a foundry is completely disproved by Lieut. Grover. The original Tower Place consisted of 42 acres only, while the present Royal Arsenal occupies 333 acres. In 1741 an academy or school for instructing the people of the military branch of the ordnance was established at the Warren. It was not till 1805 that the collection of establishments, consisting of a foundry, laboratory, repository, &c., and stores, became the Royal Arsenal.

Having thus glanced at the history of the arsenal, we shall now endeavour to describe the various manufacturing establishments concentrated at Woolwich, and those at Enfield and Waltham.

The Woolwich establishments consist of the Royal Gun Factories, the Royal Laboratory, the Royal Carriage Department, a Chemical and Photographic establishment, a Gas Factory, and the Control Department Stores. The others are the Royal Small Arms Factory at Enfield, and the Royal Gunpowder Factory at Waltham Abbey.

Royal Gun Factories. The Royal Gun Factories consist of forges, smith's shop, rolling mills, pattern shop, brass and iron foundry, gun-boring mill, tool rooms, turneries, lighting room, field-gun section, engine repairing shop, examining branch, pattern room. The factories employ the following machinery:—291 lathes, 42 boring machines, 57 drilling machines; 12 rifling, 13 planing, 37 slotting, 64 shaping, 42 milling, 7 screwing, 3 lapping, 3 wheel cutting, and 20 weighing machines; 2 saws, 240 vices, 54 furnaces, 6 blowing fans. The total horse-power employed is—engines, 653, and boilers, 1620. Besides the elaborate machinery detailed there are no less than 86 cranes of all kinds, giving a collective power of 1172 tons, and 17 steam hammers, from 8 cwt. up to 30 tons. The average value of the work turned out is about £253,700 annually, and the department is capable of producing 6000 tons of guns of various calibres per year, or 7500 tons of forgings.

Personnel. The *personnel* consists of a superintendent and assistant-superintendent (artillery officers), deputy-assistant superintendent, 24 clerks and writers, draftsmen, proof-master and proof-sergeants, and time-keepers; 22 masters and foremen, 386 artificers, and 571 labourers and boys.

Royal Laboratory. The Royal Laboratory comprises an extensive series of factories and workshops. Under the head of small arm ammunition alone we find a paper factory, lead or bullet factory, small arms factory, containing 456 machines, and the "magazines," which include capping machines, and all those required for filling and finishing cartridges. The whole plant of 894 machines is capable of producing, in a week of fifty-four hours, 1,500,000 ball cartridges, and 500,000 blank cartridges.

Rockets. For the manufacture of rockets there is the smith's shop in the main factory, and the rocket factory in the marshes. In these, a plant of 73 machines is capable of producing, per week of fifty-four hours, 4450 rockets of all kinds.

Fuzes. The manufacture of fuzes is divided into two parts, for wood and metal fuzes. In the workshops of the former 93 machines are used, and 7000 wood fuzes can be turned out in a week. For metal fuzes are required metal turners' shops, brass foundry, paper factory, composition buildings, containing the machines for filling, pressing, and finishing fuzes. The whole plant of 142 machines and apparatus can turn out 8000 fuzes in a week.

Projectiles. For the manufacture of projectiles there are a shell foundry, brass foundry, smiths' shops, metal and turners' shops, tinman's shop, rifle shell factory, repairing and tool shop. The whole of the plant consists of 971 machines, capable of turning out weekly 6516 projectiles, field and heavy, taking the 16 pounder and the 9-inch gun as an average, and the weight of such out-turn would be 281¼ tons. The wood machinery department of the Laboratory for making powder barrels and general work consists of carpenter's shop, saw-mills, and cooperage. The plant of 116 machines can turn out 1000 small arms ammunition boxes, and 2700 barrels weekly. The torpedo factory adjoins the main factory, and contains 65 machines. For the manufacture of corrugated brass cases and zinc cylinders (to contain common cartridges), there is a metal-turner's shop capable of producing weekly 160 brass cases, and 500 zinc cases. The brass foundry can turn out 12 tons of castings weekly. Besides the above there are many miscellaneous shops and machine-rooms. In the Royal Laboratory there are 66 engines and boilers of 5155 horse-power (indicated), and a total of 2847 machines, the fuel consumed weekly by this immense establishment amounting to 93 tons. The average value of the out-turn is £472,000.

Personnel. The *personnel* consists of a superintendent and assistant-superintendent (artillery officers), 40 clerks and writers, manager and assistant-manager, 30 masters and foremen, 569 artificers, and 1772 labourers.

Royal Carriage Department. The Carriage Department manufactures all carriages, platforms, artillery machines, for the artillery, royal navy, and transport services. Its shops are as follows:—main forge, scrap forge, 6 smithies, containing in all 173 fires; 10 furnaces, with steam hammers, forging machines, &c.; 11 fitters' shops, 6 being for general work, and the remainder for work classed according to the divisions of the artillery service; general foundry, painters' shops, wheelers' shops, carpenters' shops, pattern makers' shops, saw-mills, collar makers' shops. In these different workshops there are 17 steam hammers; 16 forging machines, bolt and nut making machines, rivetting machines, &c.; 22 shearing, punching, and cutting machines; 9 planing machines; 19 shaping, 17 slotting, 10 boring and facing, 49 boring and drilling machines; 85 lathes, 17 bolt-screwing and nut-facing, 8 milling, 4 band sawing, 2 bending machines. For tin work there are 7 machines, and numerous machines for cleaning castings and turnings, grindstones, &c. For woodwork there are 43 saws of various kinds; 5 planing circular, 14 boring, 8 mortising and tenoning, 19 shaping machines; 17 lathes, and machines for sharpening saws and spoke dressing, hydraulic presses, &c. Besides these there are various miscellaneous machines. The total nominal horse-power is 250. The value of the annual out-turn is about £210,000. This department is able to turn out in one year 65 field batteries, 180 naval or garrison carriages with slides or platforms, 24 turret carriages, 360 transport carriages. In addition to this work a large quantity of repairs, conversions, and experimental work could be carried out. By working at night the out-turn could be increased 30 per cent.

Personnel. The *personnel* of the establishment consists of 1 superintendent, 1 assistant-superintendent, manager, assistant-manager, 38 clerks and writers, 38 masters and foremen, 792 artificers, 430 labourers and boys.

Store-keeping Department. In the storekeeping branch of the Arsenal, which is under the Control Department, we find 1 controller, 1 deputy-controller, 4 assistant-controllers, 2 commissaries, 7 deputy-commissaries, 8 assistant-commissaries, 5 sub-assistant-commissaries, 11 clerks and writers, 114 masters and foremen, 58 artificers, 668 labourers and boys, 60 women and girls employed.

The Royal Small Arms Factory at Enfield, and the Powder Factory at Waltham Abbey, scarcely fall under the heading *Arsenal*, but as in other countries similar factories are sometimes found within the precincts of an arsenal, and they belong theoretically to the subject, we shall speak of them here.

Royal Small Arms Factory. The factory at Enfield Lock consists of the following shops:—barrel mill, machine room, polishing room, grinding room, tempering room, tool room, smithery, millwright's room, foundry and annealing shop, joiner's shop, containing an enormous quantity of beautiful machinery worked by steam and water power. The average annual value of the work turned out is £214,482. The capability of the factory, if worked to its highest pressure, would be about 3000 arms per week with two gangs of workmen.

Personnel. The *personnel* consists of 1 superintendent and 1 assistant-superintendent (artillery officers), a chief inspector of small arms, 27 clerks, writers, and time-keepers, 1 manager, 78 masters and foremen, 715 artificers, 806 labourers and boys.

Royal Gunpowder Factory, Waltham Abbey. The Powder Factory consists of 1 saltpetre refinery, 1 house for extracting saltpetre from damaged powder, 1 sulphur refinery, 1 cylinder house with retorts for burning charcoal, 2 steam stores, 2 heading-up houses, 1 barrel house, 1 proof house, 1 mechanic's shop, houses for charcoal and composition mills, incorporating mills, breaking-down machines, press boxes with pumps, granulating machines, pellet press, glazing barrels, horizontal reels, slope reels, fire engines, and houses for all the machines required in the manufacture of gun-cotton. Both steam and water power are used. The annual value of the out-turn is £41,000. The capacity of the factory working at highest pressure would be about 30,000 barrels pebble powder per annum, or 20,000 pebble and 4000 R F.G. powder (each barrel containing 100 lb), and 150 tons gun-cotton.

Personnel. The *personnel* comprises 1 superintendent, 1 assistant-superintendent (artillery officers), 1 superintendent and 1 assistant-superintendent of machinery, 1 master worker, 1 master refiner, 9 clerks, writers, and time-keepers, 12 masters and foremen, 71 artificers, 196 labourers and boys.

There are no arsenals, properly so called, in the British colonies. The troops are supplied from stores and workshops in charge of the Control Department. In India the army is equipped and supplied by the Ordnance Departments of Bengal, Madras, and Bombay: and the arsenals come under the head of second class, being establishments for storage, issue, receipt, repair, and partial manufacture. Warlike stores are partly obtained from England, but to a great extent manufactured in the military factories of India. The chief arsenals are those of Fort William (Calcutta), Madras, Bombay, Allahabad (in the N.W. Provinces), and Ferozpore (in the Panjab). These arsenals are administered by commissaries of ordnance (artillery officers), assisted by warrant officers chosen from the army, and non-commissioned officers. Natives are employed as artificers, writers, and labourers. The native establishment is usually divided into "permanent" and "extra," the former class being permanent Government servants, and the latter merely hired according to requirements.

The detail of a chief Indian arsenal may be taken to be somewhat as follows —2 commissaries of ordnance, 10 or 12 warrant officers (conductors, &c.); 2 armourer sergeants, 9 or 10 sergeants and laboratory men, 300 to 400 native foremen, artificers, and workmen, and about 300 labourers. Besides these main arsenals, each of which supplies on an average a force of 36,000 troops of all arms, there are many minor arsenals, ordnance magazines, and ordnance depôts. In India an ordnance magazine is a place for the storage, issue, and receipt of warlike stores, and has small workshops. In by-gone days numerous ordnance establishments were necessary, but now, when means of communication by rail and road have increased so largely, there is an obvious military disadvantage in scattering military stores broadcast over the country. In India, also, the principle is observed of making regiments and batteries independent of outside aid They possess the means of executing all repairs of regimental equipment, and as the greater portion of the army of India are in possession of their camp equipage and reserve ammunition, they are able to move at short notice, while the chief arsenals at the bases of operations would form the bases of the equipment of any large force of all arms entering on a campaign. The military factories comprise—(1.) Foundry and shell factory at Cossipore, near Calcutta; (2.) Gun carriage factories at Fathighur (N.W. Provinces), Madras, and Bombay; (3.) Small arm ammunition factories at Dumdum (near Calcutta), and Kirkee (Bombay). (4.) Powder factories at Ishapore (near Calcutta), Madras, and Kirkee. (5.) Harness and saddlery factory at Cawnpore (N.W. Provinces). These factories are administered by artillery officers as superintendents, assisted by warrant officers, civil and military mechanics, native artificers, workmen, and labourers.

United States. The United States depend largely on private industry for war material, large trade factories existing for the supply of small arms and guns There were also foundries at Reading, South Boston, and Providence during th war; and arsenals of construction at Boston, New York, Washington, Bridesburg, St Louis, Alleghany, Fort Monro. These, however, have been largely reduced

France. Like most of the details of the French military organisation, the system of the supply of war material is somewhat unsettled Previous to the war of 1870–71, France possessed manufactories and arsenals for store and construction. These were not, however, placed in accordance with true strategical principles,[1] or with reference to the quick supply of the army. Thus the camp equipment was mainly stored at Paris and Versailles, and carriages at Vernon and Châteauroux. Artillery officers and men were employed in the military factories It is understood that in future each territorial district of the army will have its own arsenal or, at least, its own depôt of military stores; but while military factories are maintained, war materiel will also be drawn from private industry

Germany. The chief German arsenals are at Spandau, Cologne, Dantzig There are second class arsenals at Dresden, Ludwigsburg, Carlsruhe, Augsburg, Munich, in the confederated states, but the tendency is to reduce these; and a considerable concentration has taken place at Spandau, which now forms the great centre of the military manufactories. In every artillery garrison and fortress there are artillery depôt for the storage of materiel. The system of the German army is to make regiments as independent as possible, and with their depôt "work detachments" even re-equipment is performed. Spandau embraces a gun and projectile foundry, powder factory, laboratory, small arms factory, and a large arsenal of construction. There are also a powder factory at Neisse, small arm factories at Erfurt and Dantzig, in addition to Krupp's great factory at Essen, in Westphalia. It is said Krupp employs good workmen, and that, so far as guns and carriages are concerned, his factory can turn out three to five field batteries daily. Artillery officers are largely employed in Germany in all the work of the arsenals.

[1] *E g*, Metz and Strasbourg, containing military factories and extensive arsenals, were situated on the front line of danger.

Austria. At Vienna are united in one enormous arsenal a gun-carriage factory, laboratory, foundry, small arms factory, &c. The arsenal can turn out 300,000 to 400,000 projectiles, 1400 guns, 960 field-carriages, and harness for 1800 carriages. There is also an artillery depôt in each military district, besides laboratories, &c. Austria also draws from the trade. She has an organised service, called the Technical Artillery, for the performance of the work connected with her factories and arsenals.

Russia. Russia has made considerable strides in the improvement of her military manufactories within the last few years. She possesses small arms factories at Tonla near St Petersburgh, Sestroetz near Moscow, and at Ijewsk. There are foundries at St Petersburg and Olonetz. The arsenal at St Petersburg includes the foundry and other military establishments. The arsenals of Briansk and Kiev also contain military factories. Foundry establishments for furnishing projectiles and guns also exist at St Petersburg, Alexandro-Olonetz (government of Olonetz), Longane (government of Ekaterinoslav), Perm, Ekaterinburg, Kamensk, Nijni-Isetsk, Werkhué-Tournisk, Barentschin, Glatonstov, &c. There are imperial powder factories at Ochta (near St Petersburg), Schosta, and Kasan. There are also mobile artillery arsenals, the materiel of which is kept in time of peace at St Petersburg, Warsaw, Kiev.

Italy. Italy has small arms factories at Brescia, Torre-Annunziata near Naples, and Turin; powder factories at Fossano and Scafati. Turin is the centre of the military factories.

Spain. Spain possesses an arsenal of construction at Seville, a factory at Toledo, a foundry at Trubia, and a small arms factory at Oviedo. There are also the powder factories of Murcia and Grenada; the laboratory of Seville; and the factory of Orbaicete.

Belgium. The military factories of Belgium consist of a gun foundry and small arms foundry at Liége. Powder is supplied from a private factory at Ghent. Guns are also obtained from Krupp. At Antwerp there is an arsenal of construction and a laboratory.

Holland. Holland possesses a gun foundry at The Hague, and workshops, small arms factory, laboratory, and powder factory at Delft.

Sweden and Norway. In Sweden and Norway the materiel of war is mainly furnished from the trade.

Denmark. Denmark has a state gun foundry and a powder factory at Frederikswoerk. Warlike materiel is also drawn from the trade, but supervised by artillery officers. There are arsenals for store and repair at Copenhagen, Halleboeck, and Frederikswoerk.

Switzerland. Switzerland has a federal foundry at Aarau, and arsenals of construction at Berne and Thun, at which latter place there is also a small arms factory. (E. H. H. C.)

ARSENIC AND ITS COMPOUNDS. Although arsenic was not recognised as a metallic element till the 18th century several of its compounds were known from remote antiquity and the name ἀρσενικόν (from ἄρσην, male) was applied by Dioscorides to the yellow sulphide of arsenic, orpiment, on account of its very potent properties. To the present day the term arsenic is more frequently applied to arsenious acid (the white arsenic of commerce) than to the metallic element to which it strictly applies. Although not very abundant, arsenic is one of the most widely disseminated of all metallic elements, few sulphur ores being free from traces of it. Metallic arsenic is found native in veins in metamorphic rocks in the mining districts of Saxony and Bohemia, and other European localities, at Zmeov in Siberia, and very abundantly in the silver mines at Chanarçillo in Chili. The ores employed in the metallurgy of arsenic are mispickel or arsenical pyrites, smaltite, and cobaltite; the arsenic in the case of the two last being a bye-product of the preparation of cobalt and nickel.

Arsenic is a highly brittle metal of a steel-grey colour, and of no very great importance in the arts. It may be prepared direct from arsenical pyrites by subliming in closed retorts, but it is more commonly reduced with powdered charcoal from arsenious acid. The physical characteristics of the metal vary according to the mode of its preparation; that produced directly from pyrites being compact, crystalline, and nearly white, while the metal reduced from arsenious acid is grey and pulverulent. It is chiefly used for mixing with lead in the manufacture of small shot, the alloy dropping in rounder forms than pure lead, which produces tailed drops. Arsenic is added to iron and steel for the manufacture of chains and ornaments, the resulting combination taking a very brilliant polish; and an alloy of copper and arsenic produces a brittle grey metal of a brilliant silvery hue, used in the manufacture of buttons.

Arsenious acid, or more properly anhydride, the arsenic or white arsenic of commerce, is the form in which arsenic is chiefly produced in metallurgical operations. It is found native to a small extent, and known by the mineralogical name arsenite. The greater proportion of arsenious acid is obtained as a bye-product of the reduction of cobalt and nickel from their ores. At Reichenstein in Silesia, and Ribas in Catalonia, mispickel is worked for arsenic. From the returns received at the English Mining Record Office it appears that 5449 tons of arsenic were produced in England in 1873. More than one-third of this came from one mine in Devonshire, where the arsenical pyrites is converted into white arsenic by roasting. In the reduction of the ores, which is accomplished in reverberatory furnaces, special precautions have to be employed to defend the workman against arsenical fumes and dust. The arsenic is obtained as an impure white powder, which is sublimed till sufficiently pure; and thereafter, by sublimation at a high temperature, the product is formed into a glassy mass. This glass is at first perfectly transparent, but it soon assumes the opaque white appearance arsenic presents in commerce. Besides being the basis of most arsenical preparations and compounds, it is used in the manufacture of glass for reducing the iron oxide contained in sand. White arsenic is one of the most violent of the acrid poisons. Its toxicological relations, the tests for it, &c., will be treated of under MEDICAL JURISPRUDENCE.

Arsenic acid is prepared from arsenious acid on the manufacturing scale by oxidising with strong nitric acid. It also is poisonous, but to a less degree than arsenious acid; and it is noticed that people employed about it become very fat, without any injury to health being apparent. It is now very extensively employed in the manufacture of aniline dyes, and also as a substitute for tartaric acid in discharging colours in calico printing. Both arsenite and arseniate of soda are used as "dung-substitutes" in calico-printing. Scheele's green is an arsenite of copper, and Schweinfurth green is the aceto-arsenite of copper. Both are brilliant green pigments in extensive use, and their employment by paper-stainers has caused a good deal of excitement and unnecessary terror. The rubbing off of arsenical particles in cleaning wall-papers may be injurious to health, but there is no possibility of any arsenical exhalation arising from the walls as has been alleged.

Two sulphur compounds of arsenic—realgar and orpiment—are also of industrial importance. Realgar, or ruby sulphur, is the disulphide of arsenic; and in its native form it was known to the ancients, being the σανδαράκη of Theophrastus. It is prepared usually from arsenious acid by mixing and melting it with the required proportion of sulphur. It is used only to a limited extent as a pigment, and is a constituent of the Indian white fire used in fire signals and pyrotechny. Orpiment (*auripigmentum*), the yellow sulphide of arsenic (the ἀρσενικόν of Dioscorides), occurs native in many localities. It is, like realgar, artificially prepared by mixing arsenious acid with the requisite quantity of sulphur, and subliming the mixture. Sulphur is used in proportions varying according to the depth of yellow desired, the orpiment of commerce not being a definite chemical compound, but a mixture of arsenious acid and the yellow sulphide, the light tints sometimes containing as much as 97 per cent. of white arsenic. It forms the artists' colour called king's yellow; and in addition to some use as a common pigment, it is employed in dyeing and calico-printing. The preparations of arsenic used in pharmacy, in addition to arsenious acid, are *Liquor arsenicalis*, or Fowler's solution, the hydrochloric solution of arsenic, arseniate of iron, and the arseniate of soda.

ARSON has been defined as the malicious and wilful burning of the house of another, and is at common law an offence of the degree of felony. Some part of the house must be actually burnt; a bare intention or attempt will not constitute the offence, but the burning of any part, however trifling, is sufficient. The burning must be malicious and wilful. If a man by wilfully setting fire to his own house burn the house of his neighbour also, it will be felony. The word *house*, in the definition of the offence at common law, extends not only to dwelling-houses, "but to all out-houses which are parcel thereof, though not adjoining thereto." Barns, with corn and hay in them, though distant from a house, are within the definition.

The different varieties of the offence are specified in the statute 24 and 25 Vict. c. 97 (Malicious Injuries to Property Act). The following crimes are thereby made felonies:—(1.) Setting fire to churches or other places of divine worship; (2.) Setting fire to a dwelling-house, any person being therein; (3.) Setting fire to a house, outhouse, manufactory, farm-building, &c., with intent to impose and defraud any person; (4.) Setting fire to buildings appertaining to any railway, port, dock, or harbour; or, (5.) Setting fire to any public building. In these cases the Act provides that the person convicted shall be liable, at the discretion of the court, to be kept in penal servitude for life, or for any term not less than three years (now *five* years by the 27 and 28 Vict. c. 47), or to be imprisoned for any time not exceeding two years, with or without hard labour, and with or without solitary confinement, and, if a male under sixteen years of age, with or without whipping. Setting fire to other buildings, and setting fire to goods in buildings in such circumstances that, if the same were thereby set on fire, the offence would be felony, are subject to the punishments last enumerated, with this exception, that the period of penal servitude is limited to fourteen years. The attempt to set fire to any building, or any matter or thing (as in last offence), is to be punished in the same way. So also is the crime of setting fire to crops of hay, grass, corn, &c., but setting fire to stacks of the same, or any cultivated vegetable produce, or to peat, coals, &c., is regarded as a more serious offence, and the penal servitude may be for life. For the attempt to commit the last two offences penal servitude is limited to seven years. Setting fire to mines is visited with the full measure of penalty, and in the case of the attempt, the penal servitude is limited to fourteen years. Setting fire, or attempting to set fire to ships is punishable by the full penalties already enumerated. Setting fire to her Majesty's vessels of war is a felony punishable by death.

In Scotland the offence, equivalent to arson in England, is known by the more expressive name of wilful fire-raising. The later statutes cited above do not apply to Scotland, where the crime is punishable capitally by old consuetudinary law. The public prosecutor has the privilege, as in other such cases, of declining to demand capital punishment, and invariably does so.

ART, in the most extended and most popular sense of the word, means everything which we distinguish from Nature. Art and Nature are the two most comprehensive genera of which the human mind has formed the conception. Under the genus Nature, or the genus Art, we include all the phenomena of the universe. But as our conception of Nature is indeterminate and variable, so in some degree is our conception of Art. Nor does such ambiguity arise only because some modes of thought refer a greater number of the phenomena of the universe to the genus Nature, and others a greater number to the genus Art. It arises also because we do not strictly limit the one genus by the other. The range of the phenomena to which we point when we say Art, is never very exactly determined by the range of the other phenomena which at the same time we tacitly refer to the order of Nature. Everybody understands the general meaning of a phrase like Pope's "Blest with each grace of nature and of art." In such phrases we intend to designate familiarly as Nature all which exists independently of our study, forethought, and exertion—in other words, those phenomena in ourselves or the world which we do not originate but find; and we intend to designate familiarly as Art, all which we do not find but originate—or in other words, the phenomena which we do add by study, forethought, and exertion to those existing independently of us. But we do not use these designations consistently. Sometimes we draw an arbitrary line in the action of individuals and societies, and say, Here Nature ends and Art begins—such a law, such a practice, such an industry even, is natural, and such another is artificial; calling those natural which happen spontaneously and without much reflection, and the others artificial But this line different observers draw at different places. Sometimes we adopt views which waive the distinction altogether. One such view is that wherein all phenomena are regarded as equally natural, and the idea of Nature is extended so as to include "all the powers existing in either the outer or the inner world, and everything which exists by means of those powers." In this view Art becomes a part of Nature. It is illustrated in the familiar passage of Shakspeare, where Polixenes reminds Perdita that—

> "Nature is made better by no mean,
> But nature makes that mean: so, over that art
> Which, you say, adds to nature, is an art
> That nature makes."
> "there is an art
> Which doth mend nature,—change it, rather, but
> The art itself is nature."

A posthumous essay of Mr John Stuart Mill contains a full philosophical exposition and defence of this mode of regarding the relations of Nature and Art. Defining Nature as above, and again as a "collective name for all facts, actual and possible," that writer proceeds to say that such a definition—

"Is evidently inapplicable to some of the modes in which the word is familiarly employed. For example, it entirely conflicts with the common form of speech by which Nature is opposed to Art, and natural to artificial. For in the sense of the word Nature which has thus been defined, and which is the true scientific sense, Art is as much Nature as anything else; and everything which is artificial is natural—Art has no independent powers of its own: Art is but the employment of the powers of Nature for an end. Phenomena produced by human agency, no less than those which, as far as we are concerned, are spontaneous, depend on the properties of the elementary forces, or of the elementary substances and their compounds. The united powers of the whole human race could not create a new property of matter in general, or of any one of its species. We can only take advantage for our purposes of the properties we find. A ship floats by the same laws of specific gravity and equilibrium as a tree uprooted by the wind and blown into the water. The corn which men raise for food, grows and produces its grain by the same laws of vegetation by which the wild rose and the mountain strawberry bring forth their flowers and fruit. A house stands and holds together by the natural properties, the weight and cohesion of the materials which compose it. A steam engine works by the natural expansive force of steam, exerting a pressure upon one part of a system of arrangements, which pressure, by the mechanical properties of the lever, is transferred from that to another part, where it raises the weight or removes the obstacle brought into connection with it. In these and all other artificial operations the office of man is, as has often been remarked, a very limited one; it consists of moving things into certain places. We move objects, and by doing this, bring some things into contact which were separate, or separate others which were in contact; and by this simple change of place, natural forces previously dormant are called into action, and produce the desired effect. Even the volition which designs, the intelligence which contrives, and the muscular force which executes these movements, are themselves powers of Nature."

Another mode of thought, in some sort complementary to the last, is based on the analogy which the operations of forces external to a man bear to the operations of man himself. Study, forethought, and exertion are assigned to Nature, and her operations are called operations of Art. This view was familiar to ancient systems of philosophy, and especially to that of the Stoics. According to the report of Cicero, Nature as conceived by Zeno was a fire, and at the same time a voluntary agent having the power or art of creating things with regularity and design (naturam esse ignem artificiosum ad gignendum progredientem via). To this fire not merely creative force and systematic action were ascribed, but actual personality. Nature was "non artificiosa solum, sed plane artifex." "That which in the works of human art is done by hands, is done with much greater art by Nature, that is, by a fire which exercises an art and is the teacher of other arts." This conception of Nature as an all-generating fire, and at the same time as a personal artist both teaching and including in her own activity all the human arts, on the one hand may be said, with Polixenes and Mr Mill, to merge Art in Nature; but on the other hand it finds the essence of Nature in the resemblance of her operations to those of Art. "It is the *proprium* of art," according to the same system, "to create and beget," and the reasoning proceeds—Nature creates and begets, therefore Nature is an artist or Demiurgus.

But these modes of thought by which Art is included under Nature, or Nature identified with Art, or both at once, are exceptional. In ordinary use the two conceptions, each of them somewhat vague and inexact, are antithetical. Their antithesis was what Dr Johnson had chiefly in his mind when he defined Art as "the power of doing something which is not taught by Nature or by instinct." But this definition is insufficient, because the abstract word Art, whether used of all arts at once or of one at a time, is a name not only for the power of doing something, but for the exercise of the power; and not only for the exercise of the power, but for the rules according to which it is exercised; and not only for the rules, but for the result. Painting, for instance, is an art, and the idea includes not only the power to paint, but the act of painting; and not only the act, but the laws for performing the act rightly; and not only all these, but the material consequences of the act or the thing painted. So of agriculture, navigation, and the rest. Exception might also be taken to Dr Johnson's definition on the ground that it excludes all actions of instinct from the genus Art, whereas usage has in more languages than one given the name of Art to several of those ingenuities in the lower animals which popular theory at the same time declares to be instinctive. Dante, for instance, speaks of boughs shaken by the wind, but not so violently as to make the birds forego their Art,—

> "Non però dal lor esser dritto sparte
> Tanto, che gl'augelletti per lor cime
> Lasciasser d'operar ogni lor *arte.*"

And Fontenelle, speaking the language not of poetry but of science :—"Most animals—as, for instance, bees, spiders, and beavers—have a kind of art peculiar to themselves; but each race of animals has no more than one art, and this one has had no first inventor among the race. Man, on the other hand, has an infinity of different arts which were not born with his race, and of which the glory is his own." Dr Johnson might reply that those properties of variety and of originality or individual invention, which Fontenelle himself alleges in the ingenuities of man but not in those of the lower animals, are sufficient to make a generic difference, and to establish the impropriety of calling a honeycomb or a spider's web a work of Art. It is not our purpose to trespass on ground so debateable as that of the nature of consciousness in the lower animals. Enough that when we use the term Art of any action, it is because we are thinking of properties in the action from which we infer, whether justly or not, that the agent voluntarily and designedly puts forth skill for known ends and by regular and uniform methods. If, then, we were called upon to frame a general definition of Art, leaving room for every accepted usage of the word, it would run thus :—*Every regulated operation or dexterity by which organised beings pursue ends which they know beforehand, together with the rules and the result of every such operation or dexterity.*

Here it will be well to consider very briefly the natural history of the name which has been given to this very comprehensive conception by the principal branches of civilised mankind. Our own word Art the English language has taken, as all the Romance languages of modern Europe have taken theirs, directly from the Latin. The Latin *ars* proceeds from a root the primitive force of which is open to question. One distinguished philologist thinks that this syllable AR, in that root from which *ars* is descended, means to plough, and is the same as appears in the Greek ἀρ-οῦν, ἄρ-οτρον, ἄρ-ουρα, and Latin *ar-are, ar-atrum, arvum* "As agriculture was the principal labour in that early state of society when we must have supposed most of our Aryan words to have been formed and applied to their definite meanings, we may well understand how a word which originally meant this special kind of labour was after wards used to signify labour in general. . . . . . And as ploughing was not only one of the earliest kinds of labour, but also one of the most primitive arts, I have no doubt that the Latin *ars, artis,* and our own word *art,* meant originally the art of all arts, first taught by the goddess of all wisdom, the art of cultivating the land."—(Max Müller, *Lect. on Science of Language,* i. 294.) The more common supposition refers the word to a root AR, of which the primitive signification will have been to put or fit two things together, and which is to be found in a large family of Greek words, such as ἀράρ-ισκε, ἀρ-μένος, ἄρ-θρον, ἀρ-ιθμος, ἀρ-τύω, κ.τ.λ. As a question of historical probability, the latter account seems the likelier, inasmuch as predatory and nomadic man was certainly in possession of many dexterities, as that of fitting a stone arrow-head to its shaft,—or say, that of putting two and two together,—from which, rather than from the later invention of agriculture, the group of human dexterities in general is likely to have received its name.

The Greek τέχνη, the name both for arts in the particular and art in the abstract, is by its root related both to τέκ-των and τέκ-νον, and thus contains the allied ideas of making and begetting. The *proprium* of art in the logic of the Stoics "to create and beget" (see above) was strictly in accordance with this etymology.

The Teutonic *Kunst* is formed from *können,* and *können* is developed from a primitive *Ich kann.* In *kann* philology recognises a preterite form of a lost verb, of which we find the traces in *Kin-d,* a child; and the form *Ich kann,* thus meaning originally "I begot," contains the germ of the two several developments,—*konnen,* "to be master," "to be able," and *kennen,* "to know."

Putting by, then, as too doubtful the etymology of *ars* from ploughing, we see that the chief Aryan languages have with one consent extended a name for the most elementary exercise of a constructive or productive power, till that name has covered the whole province of the skilled and deliberate operations of sentient beings.

In proportion as men left out of sight the idea of creation, of constructing or producing, "artificiosum esse ad gignendum," which is the primitive half of this extended notion, and attended only to the idea of skill, of proceeding by regular and disciplined methods, "progredi via," which is the superadded half, the whole notion Art, and the name for it, might become subject to a process of thought which, if analysed, would be like this :—What is done by regular and disciplined methods is Art; facts are observed and classified, and a systematic view of the order of the universe obtained, by regular and disciplined methods; the observing and classifying of facts, and obtaining a systematic view of the order of the universe, is therefore Art. To a partial extent this did unconsciously take place. Science, of which the essence is only in knowledge and contemplation, came to be spoken of as Art, of which the essence is all in practice and production. Cicero, notwithstanding his citation of the Stoical dictum that practice and production were of the essence of Art, elsewhere divides Art into two kinds—one by which things are only contemplated in the mind, another by which something is produced and done. ("Quumque artium aliud eiusmodi sit, ut tantummodo rem cernat; aliud, ut moliatur aliquid et faciat."—*Acad.* ii. 7.) Of the former kind his instance is geometry; of the latter the art of the violin player. Now geometry, understanding by geometry an acquisition of the mind, that is, a collected body of observations and deductions concerning the properties of space and magnitude, is a science and not an art; although there is an art of the geometer, which is the skill by which he solves any given problem in his science, and the rules of that skill, and his exertion in putting it forth. And so every science has its instrumental art or practical discipline; and in as far as the word Art is used only of the practical discipline or dexterity of the geometer, the astronomer, the logician, the grammarian, or other person whose business it is to collect and classify facts for contemplation, in so far the usage is just. The same justification may be extended to another usage, whereby in Latin, and some of its derivative languages, the name Art came to be transferred in a concrete sense to the body of rules, the written code or manual, which lays down the discipline and regulates the dexterity; as *ars grammatica, ars rhetorica,* and the rest. But when the word is stretched so as to mean the sciences themselves as acquisitions of the mind, that meaning is illegitimate. Whether or not Cicero, in the passage above quoted, had in his mind the science of geometry as a collected body of observations and deductions, it is certain that the Ciceronian phrase of the *liberal arts*, the *ingenuous arts*, both in Latin and its derivatives or translations in modern speech, has been used currently to denote the sciences themselves, and not merely the disciplines instrumental to them. The *trivium* and the *quadrivium* (grammar, logic, and rhetoric—geometry, astronomy, music, and arithmetic) have been habitually called arts, when some of them have been named in that sense in which they mean not arts but sciences, "only contemplating things in the mind." In the German language particularly the words Art and Science have in general been loosely interchanged. The etymology of the word for Art secured a long continuance for this ambiguity. *Kunst* was employed indiscriminately in both the senses of the primitive *Ich kann*, to signify what I know, or Science, and what I can do, or Art. It was not till the end of the 17th century that a separate word for Science, the modern *Wissenschaft*, came into use. On the other hand, the Greek word τέχνη, with its distinct suggestion of the root signification to make or get, acted probably as a safeguard against this tendency. The distinction between τέχνη, Art or practice, and ἐπιστήμη, knowledge or Science, is observed, though not systematically, in Greek philosophy. But for our present purpose, that of making clear the true relation between the one conception and the other, further quotation is rendered superfluous by the discussion the subject has received at the hands of the modern writer already quoted. Between Art, of which we practise the rules, and Science, of which we entertain the doctrines, Mr Mill establishes the difference in the simplest shape, by pointing out that one grammatical mood is proper for the conclusions of Science, and another for those of Art. Science enunciates her conclusions in the indicative mood, whereas "the imperative is the characteristic of Art, as distinguished from Science." And as Art utters her conclusions in her own form, so she supplies the substance of her own major premise.

"Every art has one first principle, or general major premise, not borrowed from science, that which enunciates the object aimed at, and affirms it to be a desirable object. The builder's art assumes that it is desirable to have buildings; architecture (as one of the fine arts) that it is desirable to have them beautiful and imposing. The hygienic and medical arts assume, the one that the preservation of health, the other that the cure of disease, are fitting and desirable ends. These are not propositions of science. Propositions of science assert a matter of fact—an existence, a co-existence, a succession, or a resemblance. The propositions now spoken of do not assert that anything is, but enjoin or recommend that something should be. They are a class by themselves. A proposition of which the predicate is expressed by the words *ought* or *should be* is generically different from one which is expressed by *is* or *will be.*"

And the logical relation of Art and Science, in other words, the manner of framing the intermediate member between the general major premise of Art and its imperative conclusion, is thus defined :—

"The Art [in any given case] proposes to itself an end to be attained, defines the end, and hands it over to the Science. The Science receives it, considers it as a phenomenon or effect to be studied, and having investigated its causes and conditions, sends it back to Art with a theorem of the causes and combinations by which it could be produced. Art then examines these combinations of circumstances, and according as any of them are or are not in human power, pronounces the end attainable or not. The only one of the premises, therefore, which Art supplies, is the original major premise, which asserts that the attainment of the given end is desirable. Science, then, lends to Art the proposition (obtained by a series of inductions or deductions) that the performance of certain actions will attain the end. From these premises Art concludes that the performance of these actions is desirable, and finding it also practicable, converts the theorem into a rule or precept . . . . The grounds, then, of every rule of Art are to be found in the theorems of Science. An Art, or a body of Art, consists of the rules, together with as much of the speculative propositions as comprises the justification of these rules. The complete Art of any matter includes a selection of such a portion from the Science as is necessary to show on what conditions the effects, which the Art aims at producing, depend. And Art in general consists of the truths of Science arranged in the most convenient order for practice, instead of the order which is most convenient for thought. Science groups and arranges its truths so as to enable us to take in at one view as much as possible of the general order of the universe. Art, though it must assume the same general laws, follows them only into such of their detailed consequences as have led to the formation of rules of conduct, and brings together from parts of the field of Science most remote from one another, the truths relating to the production of the different and heterogeneous causes necessary to each effect which the exigencies of practical life require to be produced."—(Mill's *Logic*, vol. ii. pp. 542-549.)

The whole discussion may be summed up thus. Science consists in knowing, Art consists in doing. What I must do in order to know, is Art subordinate to or concerned in Science. What I must know in order to do, is Science subordinate to or concerned in Art.

Art, then, is defined by two broad distinctions: first, its popular distinction from Nature; and next, its practical and scientific distinction from Science. Both of these distinctions are observed in the terms of our definition given above. Within the proper limits of this definition, the conception of Art, and the use of the word for it, have undergone sundry variations. These variations correspond to certain vicissitudes or developments in the order of historical facts and in society. It remains very briefly to consider the chief of these. The requirements of society, stimulating the ingenuity of its individual members, have led to the invention of arts and groups of arts, constantly progressing, with the progress of civilisation, in number, in complexity, and in resource. The religious imagination of early societies, who find themselves in possession of such an art or group of arts, forgets the history of the invention, and assigns it to the inspiration or special grace of some god or hero. So the Greeks assigned the arts of agriculture to Triptolemus, those of spinning and navigation to Athene, and of music to Apollo. At one stage of civilisation one art or group of arts is held in higher esteem, another at another. In societies, like most of those of the ancient world, where slaves were employed in domestic service, and upon the handicrafts supplying the immediate utilities of life—food, shelter, and clothing—these constituted a group of servile arts. The arts of husbandry or agriculture, on the other hand, have alternately been regarded as servile and as honourable according as their exercise has been in the hands of a subject class, as under feudal institutions, or, as under the Roman republic, of free cultivators. Under feudal institutions, or in a society in a state of permanent war, the allied arts of war and of government have been held the only honourable class. In commercial states, like the republics of Italy, the arts of gain, or of production (other than agricultural) and distribution, have made good their title to equal estimation and greater power beside the art of captains. But among peaceful arts, industries, or trades, some have always been held to be of higher and others of lower rank; the higher rank being assigned to those that required larger operations, higher training, or more thoughtful conduct, and yielded ampler returns—the lower rank to those which called for simple manual exercise, especially if such exercise was of a disagreeable or degrading kind. In the cities of Italy, where both commerce and manufactures were for the first time organised on a considerable scale, the name *arte*, Art, was retained to designate the guilds or corporations by which the several industries were exercised; and, according to the nature of the industry, the art was classed as higher or lower (*maggiore* and *minore*).

The arts of which we have hitherto spoken have arisen from positive requirements, and supply what are strictly utilities, in societies, not excluding the art of war, at least so far as concerns one-half of war, the defensive half. But war continued to be an honourable pursuit, because it was a pursuit associated with birth, power, and wealth, as well as with the virtue of courage, in cases where it had no longer the plea of utility, but was purely aggressive or predatory; and the arts of the chase have stood in this respect in an analogous position to those of war.

There are other arts which have not had their origin in positive practical needs, but have been practised from the first for pleasure or amusement. The most primitive human beings of whom we have any knowledge, the cave-dwellers of the palæolithic period, had not only the useful art of chipping stones into spear-heads, knife-heads, and arrow-heads, and making shafts or handles of these implements out of bone; they had also the ornamental art of scratching upon the bone handle the outlines of the animals they saw—mammoth, rhinoceros, or reindeer—or of carving such a handle into a rude resemblance of one of these animals. Here we have a skill exercised, in the first case, for pure fancy or pleasure, and in the second, for adding an element of fancy or pleasure to an element of utility. Here, therefore, is the germ of all those arts which produce imitations of natural objects for purposes of entertainment or delight, as painting, sculpture, and their subordinates; and of all those which fashion useful objects in one way rather than another because the one way gives pleasure and the other does not, as architecture and the subordinate decorative arts of furniture, pottery, and the rest. Arts that work in a kindred way with different materials are those of dancing and music. Dancing works with the physical movements of human beings. Music works with sound. Between that imitative and plastic subdivision, and the subdivision of these which only produce motion or sound and pass away, there is the intermediate subdivision of eloquence and the drama, which deal with the expression of human feeling in spoken words and acted gestures. There is also the comprehensive art of poetry, which works with the material of written words, and can ideally represent the effects proper to any or all of the other arts. All of these arts have, as a matter of history, been at one time or another intimately associated with religion. Painting, sculpture, architecture, drawing, music, poetry, have all been at one time or another principally devoted to the honour of supernatural beings imagined to have power over mankind for good and evil. But this use, though a part of their history, is not inseparable from their nature. What is inseparable from them, and essential to the nature of this group of arts, is twofold. First, of their effect upon those to whom they are addressed: there are certain highly complex properties and relations of rhythm, proportion, and harmony, upon which the pleasurableness of these arts depends, and which each of them, if its appeal to the perceptions and the imagination is to be successful, is bound to observe. Secondly, of the mode in which they are practised: these complex effects can only be produced by the exercise of an equally complex set of faculties in the artist; it is therefore of the essence of this group of arts, that they cannot be practised by habit, rote, or calculation; habit, rote, and calculation may help the artist a certain way, but in the essential parts of his art he passes beyond the reach of rules, and acts by what is called inspiration, that is, by the spontaneous and unreasoned working together of infinitely complex and highly developed sensibilities and dexterities in his constitution.

We shall not concern ourselves with the many definitions that have been framed by thinkers seeking to classify these arts either according to simple observation and comparison, or according to the principles each of his chosen metaphysical system. (For an account of these matters, see articles Æsthetics and Fine Arts.) Enough that together with the useful arts, there exists this great group of arts of which the end is not use, but pleasure, or pleasure before use, or at least pleasure and use conjointly. In modern language, there has grown up a usage which has not only put these and their congeners into a class by themselves, but sometimes appropriates to them alone the use of the generic word Art, as if they and they only were the arts, κατ' ἐξοχήν. First as the liberal or polite arts, and then as the fine arts, the languages of modern Europe have separated from the class of arts which exist only for use the class which exist only or chiefly for pleasure. They have gone further, and have reduced the number which the class-word is meant to include. When Art is now currently spoken of in this sense, not even music or poetry is frequently denoted, but only architecture, sculpture, and painting by themselves, or with their subordinate and decorative branches. And in correspondence with this usage, another usage has removed from the class of *arts*, and put into a contrasted class of *manufactures*, a large number of industries and their products, to which the generic term Art, according to our definition, properly applies. That definition covers the mechanical arts, which can be efficiently exercised by mere habit, rote, or calculation, just as well as the fine arts, which have to be exercised by a higher order of powers. But the word Art, becoming appropriated to the fine arts, has been treated as if it necessarily carried along with it, and as if works to be called works of art must necessarily possess, the attributes of individual skill and invention expressing themselves in ever new combinations of pleasurable contrivance. The progress of what an older nomenclature called the mechanical arts—the consequence of inventions for making production easier and more rapid by the application of physical agencies and the economising of human labour—has led to the multiplication of products all alike, all equally bearing the stamp of habit, rote, and calculation, and all equally destitute of those properties of individual contrivance and pleasureableness. And so works of Manufacture, or the products of machinery, which bear only very dully and remotely the mark of their original source in the hand and brain of man, have come to be contrasted with works of Art which bear such marks vividly and directly. For a century the mechanical kingdom, or reign of pure Manufacture, had spread apace in Europe, engrossing an ever larger field of human production. Of late years there is a sign of a reaction in favour of an extension of the kingdom of Art, or at least of endeavours to bring reconciliation and alliance between the two. (S. C.)

ART and PART, a term used in Scottish Law to denote the aiding or abetting in the perpetration of a crime,—the being an accessory before or at the perpetration of the crime. There is no such offence recognised in Scotland as that of being an accessory after the fact.

ARTA (Narda, *i.e.*, ἐν Ἄρδα, or Zarta, *i.e.*, εἰς Ἄρτα, the ancient Ambracia), a town of Albania, in the eyalet of Joannina, deriving its present designation from a corruption of the name of the river Arachthus on which it stands. It is a place of some six or seven thousand inhabitants, who are mostly Greek. There are a few remains of its old cyclopic walls; and the town contains a castle, built on the lofty site of the ancient citadel by Nicephorus (1357); a palace belonging to the Greek Metropolitan; and a number of mosques, synagogues, and churches, the most remarkable being the church of the Virgin of Consolation, founded (1071) by Michael Ducas. The streets of the town were widened and improved in 1869. Manufacture of woollens, cottons, Russian leather, and embroidery is carried on, and there is trade in cattle, wine, tobacco, hemp, hides, and grain. Much of the neighbouring plain is very fertile, and the town is surrounded with gardens and orchards, in which the orange, lemon, and citron come to great perfection. In 1083 Arta was taken by Bohemund of Tarentum; in 1449 it fell into the hands of the Turks, and in 1688 it was captured by the Venetians. In 1797 it was held by the French, but in the following year, 1798, Ali Pasha of Joannina made himself master of it. During the Greek struggle for independence it suffered severely, and was the scene of several conflicts, in which the ultimate success was with the Turks. An insurrection in 1854 was at once repressed.

ARTA (*Arachthus*), a river of Albania, which rises partly in Mount Lakmon, and partly in the heights between Lingon and Mitzekeli, flows south for upwards of forty miles along the eastern side of the Kilberini Mountains, and falls into the Gulf of Arta.

ARTA, GULF OF, the *Sinus Ambracius* of the ancients, is a large and beautiful inlet of the Ionian sea, twenty-five miles long and ten broad, the northern shores of which belong to Turkey, and the southern and eastern to Greece. Its only important affluent, besides the Arta, is the Luro (*Charadra*) also from the north. It abounds with mullets, soles, and eels. Around its shores are numerous ruins of ancient cities, as well as several flourishing modern towns, of which may be mentioned *Actium* at the entrance, *Nicopolis*, Previsa, Arta, *Argos*, Limnæa, Karavasaras, *Olpæ*, and Vonitza.

ARTAXERXES, a royal Persian name, borne first by several of the kings of the Achæmenian dynasty of the Persian empire, and found also in the later Sassanian dynasty. The original and native form of the name, as ascertained from the cuneiform inscriptions of ancient Persia, is *Artakhshatra* (see Rawlinson, *Jour. Asiat. Soc.* xi p. 35). The Hebrew transcript, occurring with slight differences of spelling in different passages of the Old Testament, is *Artakhshasta*—the Assyrian, *Sartakhshatra*—the Scythic, *Irtaksassa*,—all closely answering to the original. The Greek Ἀρταξέρξης, from which the English form is taken, is less correct, and is misleading through the assimilation of the latter part of the name to the other royal name Xerxes, with which the word before us has etymologically no connection In later times the name assumes the slightly modified forms of *Artachshetr* (De Sacy, *Antiquités de la Perse*, p. 100), and *Ardeshir* (Ἀρταξάρης and Ἀρταξήρ, in Agathias). In regard to the etymology and meaning of the name there is a general consensus of opinion among modern scholars. Herodotus (vi. 98) was misled by the Greek transcription, when, having rendered Xerxes, *Warrior* (ἀρήιος), he rendered Artaxerxes, *Great Warrior* (μέγας ἀρήιος). The elements of the name are *arta*, an intensive particle or adjective, connected with the Zend *areta*, high or honoured (in Skr. *rita*); and *khshatra*, kingdom or dominion, which occurs both in Zend and Sanscrit (Rawlinson, *Jour Asiat. Soc.*, xi. 35; Lassen, *Ueber die Keilinschriften*, p. 161; Oppert, *Les inscriptions des Achéménides*, p. 299; Spiegel, *Die altpersischen Keilinschriften*, p. 185). Lassen translates the name, Exalted in dominion

It is known that throne-names, or names appropriated to royalty, were in use among the Persians as among other Eastern nations (*cf.* Heeren, *Ideen*, i pp 138, 401, Baehr's *Ctesias*, p. 195). Thus the great Cyrus is said to have been called Agradatus before his accession to the throne. The second and third Darius had both also private names, the one Ochus, and the other Codomannus. To the class of royal names belongs the name Artaxerxes To this use its significance is alone suitable, and in the earliest times, at least, it is not found appropriated by any save either the possessors of, or the pretenders to, royalty. In regard to the most of those about to be mentioned, we have express testimony that they took this name only when they ascended the throne.

It will be convenient first to mention the Achæmenian kings thus designated in the Greek historians and the old Persian inscriptions, and then consider the questions connected with the identification of these with the kings of this name occurring in Scripture.

1. Artaxerxes, surnamed Μακρόχειρ, or Longimanus (by Persian authors, Diraz-dest), the long-handed, so called, says Plutarch (*Vita Artax.*, i.), because his right hand was longer than his left, or perhaps (see Malcolm, *Hist. of Persia*, i. p. 66) the long-armed (*cf.* Edward Longshanks), was the son of the famous Xerxes, the invader of Greece, and succeeded his father in 465 B.C. According to Josephus (*Ant. Jud.*, xi. 6, 1), he was originally called Cyrus. His reign was marked by the revolt of Egypt under Inarus, in which the Athenians were abettors of the Egyptians, and which was quelled by the Persian general Megabyzus, in 455 B.C.; and by the ratification of the peace of Callias with Athens in 449 B.C Of the architectural and inscribed remains of the ancient Persian empire very little is recognisable as due to this king. He is recorded in an inscription by his grandson, the next Artaxerxes, as the *repairer* (?) of the palace at Susa (Loftus, *Chaldæa and Susiana*, p. 372; Norris, *Jour. Asiat. Soc*, xv. pp. 157-162). There is extant a fragmentary inscription in old Persian, with an Assyrian translation, which seems to have proceeded from him; and a legend upon a vase at Venice, of Egyptian origin, which reads "Artaxerxes the great king," may with considerable assurance be also referred to this monarch (Oppert, *op. cit.* pp. 288-290). Artaxerxes died in 425 B C. after a reign of forty years.

2. The next sovereign that falls to be noticed here was the grandson of the preceding, and the son of the intermediate monarch, Darius Nothus. His original and private name was Arsaces, and he assumed that of Artaxerxes on ascending the throne (Ctesias, *Exc. Pers.* § 57; Plutarch, *Vita Artax*, c. 2). The date of his accession is 405 B.C. It is this Artaxerxes, commonly surnamed Mnemon, from the retentiveness of his memory, whose reign was distinguished by the attempt of his brother, the younger Cyrus, to gain possession of the crown, and by the victory of Cunaxa 401 B.C., the death of Cyrus, and the retreat of the ten thousand Greeks, immortalised by Xenophon. Other prominent events of this reign were the peace of Antalcidas in 399 B C., and the Cyprian revolt, with the defeat of Evagoras its leader, about 380 B.C. Artaxerxes Mnemon died in 359 B C., after a reign of forty-six years The Greek sources for this reign are comparatively abundant. Besides Xenophon, Ctesias, Diodorus, and others, Plutarch has furnished a special life of this monarch The only native memorial of his reign is the inscription already referred to, found at Susa on the bases of pillars belonging to the royal residence there, which runs thus—"Says Artaxerxes, the great King, the King of Kings, the King of the countries, the King of this earth, the son of King Darius; Darius was the son of King Artaxerxes, Artaxerxes was the son of Xerxes, Xerxes was the son of King Darius, Darius was the son of Hystaspes, the Achæmenian. Darius, my ancestor, built this temple (or edifice), and afterwards it was repaired (?) by Artaxerxes, my grandfather. By the help of Ahuramazda I placed Anahita and Mithra in this temple. May Ahuramazda, Anahita, and Mithra protect me." (See Norris in Loftus, *op. cit.* p 372, *Jour. Asiat. Soc.*, xv p. 159; Spiegel, *op. cit* p. 65.) The inscription, compared with earlier texts, shows a certain negligence of style, and is interesting for the prominence, unparalleled in previous records, given to the worship of the subordinate deities Anahita, or Tanaitis, and Mithra.

3 This sovereign was succeeded by his son Ochus, who, on securing the crown, took the same royal name, and is usually known as Artaxerxes Ochus. The commencement

of his reign was marked by numerous formidable revolts throughout the western provinces of the empire, which, however, were vigorously repressed, and after the re-subjugation of the revolted countries, the power of the empire was advanced to an extent and to an apparent stability unequalled since the time of the great Darius. This Artaxerxes perished by poison in 338 B.C. He is known as the builder of one of the palatial structures which stood on the platform of Persepolis; and an inscription proceeding from him (wrongly ascribed to the previous Artaxerxes by Benfey, *Die persischen Keilinschriften*, p. 67) has been found there, marked, like that already spoken of, and to a greater degree, by defects of style, and presenting his genealogy in entire accordance with the preceding. (See Rawlinson, *op. cit.* x. p. 341; Oppert, *op. cit.* p. 297; Spiegel, *op. cit.* p. 67.)

4. We find yet another instance in the classical writers of the use of Artaxerxes as a royal name during the Achæmenian period. After Darius Codomannus, the successor of Artaxerxes Ochus, had been finally and decisively defeated by Alexander at Arbela, he was, while fleeing before the conqueror, traitorously slain by Bessus, the satrap of Bactria, who thereupon, we are told, "assumed the upright tiara and the royal robe, and the name Artaxerxes instead of Bessus, proclaiming himself king of Asia" (Arrian, *Exp. Alex.*, iii. 25, 3, *cf.* Curtius, vi. 6, 13).

Such are the Achæmenian kings known to the classical writers by the name Artaxerxes. But the name also occurs in the Scriptural books of Ezra and Nehemiah, as well as in some of the Apocryphal books, and in Josephus; and it remains to be considered whether the persons there referred to are to be identified with any of the kings now mentioned, and if so, with whom? In the book of Nehemiah, Artaxerxes, king of Persia, appears as the monarch to whom Nehemiah acted as cup-bearer (i. 2), from whom he received a commission, in the twentieth year of the king, to rebuild the wall and other ruined edifices in Jerusalem (ii. 1), and whose thirty-second year is also mentioned (v. 14, xiii. 6). In attempting to identify this Artaxerxes with one of those above named, our choice is at once limited by the length of his reign to those surnamed Longimanus and Mnemon. A sufficient proof that it is the former of these who is meant, is found in the genealogy of Eliashib, the high priest when Nehemiah came to Jerusalem (Neh. iii. 1, and xii. 10). For Eliashib was the grandson of Jeshua, and Jeshua was high priest when Zerubbabel led the first company of returned exiles to Judah, in the days of Cyrus (Ezra ii. 2, iii. 2). Now, the reign of Cyrus dates from 536 B.C.; and from this to the twentieth year of Artaxerxes Longimanus, or 445 B.C., is a period of ninety-one years, leaving room for precisely three generations. The opinion, which is the common one, that the Artaxerxes of Nehemiah is Artaxerxes Longimanus, is thus fully warranted (though some, as De Saulcy, *Sept siècles de l'histoire judaique*, p. 28, identify him with Artaxerxes Mnemon), and this enables us to proceed with confidence when inquiring into the reference of the name as it occurs in the book of Ezra. Ezra was contemporary with Nehemiah (Neh. viii. 1), and mention is made in his book of an Artaxerxes who was his own contemporary (Ezra vii. 1, 7, 11; viii. 1), in whose seventh year a decree was issued, giving authority to Ezra to levy whatever supplies were needful for the service of the temple at Jerusalem. This, therefore, must have been also Artaxerxes Longimanus, and the year referred to is 458 B.C. Hence, also, when it is said (Ezra vi. 14) that "the elders of the Jews builded, and they prospered, . . . according to the commandment of Cyrus, and Darius, and Artaxerxes king of Persia," it may without difficulty be understood that the same monarch is here named, the writer singling out the three kings who, of all the Persian monarchs, distinguished themselves by the favour shown to the Jews.

The name occurs again in an earlier part of the same book, chapter iv. In verse 5 of that chapter mention is made of efforts of the enemies of the Jews to hinder the rebuilding of the temple, put forth "all the days of Cyrus, king of Persia, even until the reign of Darius, king of Persia." Then in the two succeeding verses Ahasuerus and Artaxerxes are specified as kings in whose reigns representations adverse to the Jews were made at the court of Persia; and after the detailed accounts of the second of these representations, and its success with Artaxerxes, it is said (ver. 24), "Then ceased the work of the house of God which is at Jerusalem. So it ceased unto the second year of Darius, king of Persia." The narrative has all the appearance of consecutive history, and the natural interpretation obviously is that the two kings, Ahasuerus and Artaxerxes, intervened between Cyrus and Darius. It is true, mention is made in the memorial presented to king Artaxerxes of the building of the city and the walls, rather than of the temple, the rebuilding of which was at the time the great enterprise of the returned exiles; but this may be easily accounted for, from the interest of the writers to make out the strongest possible case at the Persian court. Besides, it is impossible to believe that the city and its walls remained utterly desolate as the Chaldeans had left them while the temple was being rebuilt. There is, indeed, express testimony to the contrary. Notice is taken of the "ceiled houses" of Jerusalem at this period (Haggai i. 4). Mention is also made of a "wall" of defence for its inhabitants (Ezra ix. 9), and Josephus (*Ant. Jud.*, xi. 4, 4) records the "strong walls about the city" while the temple was still unfinished. It has indeed been argued, and that quite reasonably, that the wall mentioned in Nehemiah i. 3, which was reported to Nehemiah as "broken down," is that to which reference is made in the passages just cited from Ezra and Josephus, built by the first colony of returned Jews, and not that destroyed by the Chaldeans nearly a century and a half before (see Kitto's *Cyclopædia*, article "Ahasuerus"). There seems, therefore, to be nothing in the narrative to hinder the two kings to whom it relates, and whom it places between Cyrus and Darius, from being identified with the two kings who did actually intervene between these monarchs, viz., Cambyses and the pseudo-Smerdis; and this is the view which is taken of the matter by the great majority of interpreters. The difference in the names, however, presents a difficulty which to not a few has appeared insuperable, and from which escape has been sought in various ways. Some, as Scaliger, Hottinger, Mill, believing that Ahasuerus and Artaxerxes in Ezra iv. 6, 7, mean Xerxes and Artaxerxes Longimanus, suppose also that Darius in chapters iv. 24, vi. 1, &c., means the successor of the latter, viz., Darius Nothus. But the identification of the Darius with the well-known Darius Hystaspes is sustained by so overwhelming evidence (see DARIUS), that this opinion may be at once and without hesitation rejected. Others, as Howes (see *Pictorial Bible* on Ezra iv.), Bley (*Jour. Sac. Literature*, July 1866), and many Germans,—as Kleinert, Schultz, Hengstenberg, Auberlen, Vaihinger, Bertheau, Keil, &c.,—believe that the paragraph, Ezra iv. 6–23, forms an interpolation or episode, in which the chronicler has summed up the attempts of the adversaries of Judah to hinder the building of the temple, as well as what they did for the obstructing of the building of the city under Xerxes and Artaxerxes, in order to bring together in a compendious way all their machinations against the Jews (see Keil, *ad loc.*) It is impossible, however, to reconcile this view satisfactorily with the language of the narrative, especially of ver. 24, the plain meaning of which is that the interruption in the work of the house of God caused by the decree of the king named Artaxerxes continued until, and hence was previous to, the second year of king Darius. Some German expositors, indeed, as Herzfeld (*Gesch. d. Volkes Isr.* i. 303), Merx, Schrader, &c., admit the irreconcilability, and, believing that the two kings in question were Xerxes and his son, maintain that the compiler of the book of Ezra was guilty of a mistake in referring the documents cited to the period preceding, instead of to the period subsequent to, the reign of Darius. But, apart from all questions about inspiration, this must be condemned as an illegitimate procedure. Our only original witness to the events connected with the return of the Jewish exiles is the book of Ezra, and it is not permissible to alter its testimony, or to set it aside as erroneous, because it presents some appearances of discrepancy with what is otherwise ascertained. It is to be added that the Apocryphal 1st Esdras, in the version which it gives of the same events, refers them and the king Artaxerxes to the period intervening between Cyrus and Darius (Esdras ii. 16–30, v. 72, 73), and that Josephus also in so far agrees that he assigns the events to the same period, though making no mention of Artaxerxes, and naming Cambyses as the king by whom the work at Jerusalem was hindered (*Ant. Jud.*, xi. 2).

Retaining, therefore, the more common view, and identifying the Ahasuerus and Artaxerxes of Ezra iv. with Cambyses and the pseudo-Smerdis, it remains to be considered if the difference in the names presents any insuperable, or even any serious, objection. Confining the discussion to the subject of the present article (for the other name see AHASUERUS), it has been already abundantly evinced that Artaxerxes is a regal name, and was assumed by all who are certainly known to have borne it, in addition to their private and personal designation, on their accession to the regal power. There is no difficulty in supposing that the Magian Gomates, when, in the absence of Cambyses on his Egyptian expedition, he personated Bardiya or Smerdis, the younger son of Cyrus, and usurped the throne, assumed also, like the later usurper Bessus, this as his official name, under which, of course, the public decrees of his administration would be couched, and which would naturally be most current among those who, like the Jews, belonged to the foreign subjects of the Persian monarchy (*cf.* Tyrwhitt, *Esther and Ahasuerus*, p. 333). Nor are we destitute of express though somewhat obscure testimony to the fact. Two other names are found applied in the classical writers to the pseudo-Smerdis. He is called Tanyoxares by Xenophon (*Cyrop.*, viii. 7) and by Ctesias (*Pers.*, 8–13), and Oropastes by Justin (i. 9). The latter, as Ewald (*Gesch. Israels*, iv. p. 118) suggests, may well be supposed to be a corruption derived from Ortosastes, which is an exact reproduction of the Hebrew form of the name Artaxerxes (*cf.* the rendering Ἀρθασασθά in the LXX., Ezra iv. 7, &c.) In regard to this identification two additional and final remarks are to be made. On the one hand, it is unreasonable to allege, as Keil and others do, by way of objection, that the reign of the pseudo-Smerdis was too short (only seven months) to allow of representations being made to his court, and an answer returned in reference to affairs at Jerusalem. It is to be taken into account that the enemies of the Jews had begun their machinations in the time of his predecessor, and their agents were doubtless present in the Persian capital when the new king ascended the throne, ready to avail themselves of the new opportunity. On the other hand, all that is known of the policy of the usurper is in excellent harmony with the part ascribed to him by the sacred writer. Belonging to the Magian tribe, and ruling, probably, in the interest of Median as opposed to Persian supremacy, he naturally set himself to subvert the policy of Cyrus; and we have express and indisputable testimony, in the elaborate inscription at Behistun engraved by the authority of his successor Darius, that his procedure, especially in regard to religious interests, was of the nature of a revolution, which the son of Hystaspes glories in having arrested and reversed (*cf.* Rawlinson's *Anc. Monarchies*, iv. p. 397).

In the Sassanian dynasty there are three royal personages bearing the name now in question:—(1.) The founder of the dynasty is called Artaxerxes, or Ardeshir, surnamed Babegan, from the name of his father Babek. He was probably tributary king of Persia under the Parthian rule, and he revolted against Artabanus, king of Parthia, about 220 A.D. Artabanus was defeated and slain in a great battle in the plain of Hormuz, and Artaxerxes succeeded in establishing the ascendency of Persia, and his own position as independent sovereign in 226 A.D. (see Malcolm, *op. cit.* i. p. 89; Rawlinson, *Sixth Oriental Monarchy*, p. 365, *f.*) (2.) Another Artaxerxes, belonging to the dynasty of the Sassanides, reigned for four years, 381–385 A.D.; and (3.) immediately before the Mahometan conquest, an infant prince was raised to the throne by the same name, and nominally occupied it for five months, 629 A.D. For further details regarding these monarchs see PERSIA. (W. TU.)

ARTEDI, PETER, an eminent naturalist, was born in the province of Angermania, in Sweden, on the 22d February 1705. His parents were poor, but found means to give him a liberal education, and with this view sent him to the college of Hernosand. Intending to become a clergyman, he went, in 1724, to study theology at Upsal; but he turned his attention to medicine from the strong bent of his mind for the study of natural history, in which science he made rapid progress, and soon rose to considerable eminence, particularly in the department of ichthyology, the classification of which he remodelled upon philosophical principles. This arrangement afterwards became popular over Europe. In 1728 his celebrated countryman Linnæus arrived in Upsal, and a lasting friendship was formed between the two. In 1732 both left Upsal, Artedi for England, and Linnæus for Lapland; but before parting, they reciprocally bequeathed to each other their manuscripts and books in the event of death. In 1735, however, they met again at Leyden, where Artedi was introduced to Seba, and was employed in preparing for the press the third volume of that eminent naturalist's *Thesaurus*, which chiefly related to fishes. He intended, as soon as that work was finished, to return to his native country, and publish the results of his own labours; but as he was returning home from Seba's house on the evening of the 27th September 1735, the night being dark, he fell into the canal and was drowned. According to agreement, his manuscripts came into the hands of Linnæus, and his *Bibliotheca Ichthyologica* and *Philosophia Ichthyologica*, together with a life of the author, were published at Leyden in the year 1738.

ARTEMIDORUS, a native of Ephesus, flourished during the reign of Marcus Aurelius. He called himself The Daldian, from Daldis, or Daldis, a small town in Lydia, the birth-place of his mother, in order to distinguish himself from Artemidorus, the geographer, who was likewise a native of Ephesus. The work by which he is known, Ὀνειροκριτικά, the Interpretation of Dreams, is said to have been written by command of Apollo Mystes, who had granted to the author the power of divination. The treatise, which contains some valuable notices on ancient customs and modes of thought, is divided into five books: the first and second, addressed to Cassius Maximus, treat generally of divination by dreams; the third and fourth, addressed to his son, discuss some minor parts of the theory; and the fifth consists of a collection of prophetic dreams which had been realised. Artemidorus boasts of the trouble expended on this work; he read all the authors on the subject, travelled widely, and corresponded or conversed with all who had made dreams their study. He is also said to have written on Auguries and Chiromancy, but these treatises are not extant. The best editions of his work are those of Reiff, with notes, 2 vols. Leip. 1805, and of Hercher, Leip. 1864. There are several English translations of it.

ARTEMIS [DIANA], in *Greek Mythology*, twin sister of Apollo, but born a day before him, as it was said at Athens for the sake of explaining the fact of the 6th of each month being sacred to her, while the 7th was his day. It might seem, too, that their mother, Leto, had borne them in two different places, since the birth-place of Apollo was Delos, while that of his sister is called Ortygia. But the word Ortygia, meaning strictly, a "haunt of swallows," applies still to Delos, and may well have been a synonym for that island. In this, its original sense, it does not apply either to the island of Ortygia at Syracuse, or to the spot so named near Ephesus, which were the two principal competitors for the honour of having been the birth-place of the goddess. Besides, she slew Orion in Ortygia, and that incident is connected with the mythology of Delos. Consistently with her relation to Apollo, she was conceived as sharing his aspect and attributes, her occupations and even her beauty tending rather to what would be appropriate for males. Both were endowed with perpetual youth, and this, if it did not originally help to suggest the idea of their being twins, is consistent with a universal feeling as regards that relationship. Like him she is armed with bow and arrows, which, jointly with him, she used against offending mortals as in the case of the Niobides, or of Laodamia, and the wife of Eëtion (*Iliad*, vi. 205, 428), she slaying women—he, men. At other times, with no sign of anger, her arrows brought soft death, such as Penelope desired (*Odyssey*, xviii. 201, xx. 62, 80). But, unlike Apollo's, the bow in her hands was chiefly employed, as a borrowed weapon might be, for the amusement of the chase. And here a broad line must be drawn between two sides of her character. On the one hand she is a sister of Apollo, and shares several of his functions, even taking part on occasion in his favourite music and dance. But in this respect her actions seem sometimes forced, as if grafted upon her in comparatively later times, as indeed seems also her name = ἀρτεμής, "spotless," as applied to a virgin. On the other hand she had what appears to be a more primitive name, Oupis or Opis, and a wide variety of functions, which are not only obviously suggested by the real and supposed influence of the moon on nature, but also approximate often closely enough to the functions of Apollo to have led to the identification of the two deities as brother and sister. The name Opis is taken to refer to the light of the moon. With that luminary she was distinctly associated, but not as guiding its movement,—a task which devolved on Selene (Luna), just as the course of the sun was directed by Helios, not by Apollo. To regard the goddess of the moon as sister of the god of the sun was natural, but it was an observation of a secondary kind, and founded only on the appearance and movement of those orbs. Primitive observations would refer to the sensations immediately awakened by the moonlight. In general terms Artemis, the moon goddess, was styled φωσφόρος or σελασφόρος, and carried, besides bow and arrows, a torch, here only with the idea of spreading light, and not as when, under the name of *hegemone*, she carried a torch to light the way for travellers, as in the typical instance of Demeter searching for Persephone. At Athens she had an annual festival, *Munychia*, on the 16th of April, for which cakes were made in the form of a full moon stuck over with lights. But, in particular, the spread of vegetation from the dew under a peaceful moonlight was ascribed to her influence. Her presence was felt near springs, streams, bays, on the sea, and in marshy places, whence she bore the titles of ποταμία, λιμναία, λιμνᾶτις. In lifting the veil of night she revealed to the imagination the world of wild animals, among which she was an intrepid and unwearied huntress, and over which she exercised the care of a goddess. Her favourite animal was the deer, whence she obtained in Olympia and Elis the title of ἐλαφία or ἐλαφιαία. Because Agamemnon had killed a deer sacred to her she detained the Greek fleet in Aulis, and required the sacrifice of his daughter Iphigenia. But while deer, goats, rams, and wild animals were generally regarded as dependent on her control, certain animals were specially associated with her in particular districts of Greece, as was the wild boar in Ætolia and elsewhere, and the bear in Arcadia, and in her worship as Artemis Brauronia, and Munychia at Athens. When a wild boar appeared ravaging a district, as did the Calydonian boar, it was sent by Artemis in anger. The boar, however, was not an instrument of her moods, but rather, it would seem, a symbol of the awakening every spring of the hunting season after the sleep of winter. "Bears" (ἄρκτοι) was the name sometimes applied at Athens to young girls who there, as throughout the rest of Greece, were under her special protection, in token of which it was usual for them to dedicate to her a lock of hair, a trinket, or some plaything. Boys also were under her care. With the symbol of a bear she was worshipped among the Arcadians, or "bear people," who claimed her as the primeval mother of their race, till, through the increasing prominence of her virginal character, that honour devolved upon Callisto, whose name is an obvious variation of καλλίστη, the title of Artemis, and her transformation into a bear an invention for the purpose. Arcadia was her chief hunting-ground, and more numerous were her sanctuaries there than elsewhere in Greece. As *Artemis agrotera*, a title under which she was worshipped in Attica, she was conceived not only as goddess of the chase, but also as in some way providing the wild impetus with which men rush into battle. Hence the 500 goats annually sacrificed at Athens, to commemorate the battle of Marathon, were sacrificed to her. It was customary with the Spartans to sacrifice a goat before closing with an enemy (Xenophon, *Hellen.*, iv. 2, 20). Possibly, also, the curious dance with which the maidens of Caryae (Caryatides), in the valley of the Eurotas, celebrated her festival had reference to her part in war. Her care over children was recognised in Laconia and Messenia under the name of κορυθαλία, to whose temple, by the stream Tiasa, nurses brought their charges at the festival of the Tithenidia, *i.e.*, festival of nurses. As λοχία or λοχεία she divided the worship of Ilithyia by her helping presence at childbirth. With marriage her care almost ceased, and hence it has been supposed that the dresses which women dedicated to her were such as they had worn as virgins, and were intended to express piety for her past protection. In reference to this, apparently, she was styled χιτώνη or χιτωνία. Youth, innocence, modesty, and a good name were thought to find high favour with her, and as an illustration of this was often told, in works of art and in the tragedies of Sophocles and Euripides, the story of Hippolytus. Her own purity was unsullied (ἁγνή, Æschylus, *Agamem.*, 135; αἰὲν ἀδμήτα, Sophocles, *Electr.*, 1239). Actæon, the huntsman, she caused to be devoured by his own hounds, because he had seen her bathing. She slew Orion because of his pressing advances to Aurora. She transformed Daphne into a laurel to preserve her from pursuit. Meadows in their spring verdure and flowers, fields with the seeds springing, and the gay seasons of rural life, gave occasion for thoughts of her overseeing care. She was hailed by rustic choruses, all manner of rejoicings, and, in particular, on a hill at the back of Mount Taygetus with songs known as καλαβοίδια. In Arcadia she was called *hymnia*. At the mouth of the Alpheus she was worshipped as Ἀλφειωνία or Ἀλφειοῦσα, the common belief being enlivened with the story of how she defeated the god of that river in his passion for her nymph Arethusa, by leading the spring Arethusa underground away to the island of Ortygia at Syracuse.

So far the various phases of her character are such as were more or less generally accepted in the times of literature and art. But there had also survived certain peculiarities in her worship from apparently very early times, though the fact of their being found only in certain localities renders it impossible to know whether they had been originally only local peculiarities or universally admitted. Of this kind was the Tauric Artemis, peculiar at first to the Crimea and the shores of the Black Sea. From the Crimea, Orestes, it was said, brought the ancient image of the goddess to Sparta, and with it her worship, the chief characteristic of which was the sacrifice of human beings which it required. At Sparta these sacrifices were afterwards commuted by Lycurgus for the ceremony of flogging youths at her altar, but not till this barbarous phase of her worship had spread to several places in Greece, Asia Minor, and Italy. Her title at Sparta was *Orthia* or *Orthosia*. Again, originally peculiar to Crete was *Artemis Britomartis*, or *Dictynna*, the latter name being interpreted by the legend that Minos had loved and pursued her till she leapt into the sea, and was saved by being caught in a fisherman's net. In this character she was chiefly the goddess of seafarers, and as such was widely worshipped on the islands and coasts of the Mediterranean. But nowhere was the worship of Artemis so non-Hellenic in character as among the Greeks at Ephesus. It would seem as if the Greek colonists there had found among the native Carians and Leleges a form of the moon goddess, which, though widely different from their own, had the advantage of an image that had fallen from heaven (*diopetes*), and an established hold on the people with whom the colonists had to deal. Like theirs she was a goddess with power over wild animals, and identified with their productivity, as appears from her being represented with many breasts,—a characteristic of animals, and not necessarily to be understood as expressing her interest in maternity in the usual sense, which would have been strongly opposed to the Greek feeling towards their virgin goddess. Her worship was surrounded by hierodulæ and eunuchs. She was the goddess of the warlike Amazons, whose fondness of the chase presented another point of contact between the Asiatic and the Greek goddess. But however much of the Greek element may in time have become grafted upon her, Diana of Ephesus was only in rare instances accepted by the Greeks outside of Asia Minor. The wealth and splendour of the temple made Ephesus a powerful attraction for devotees in the neighbourhood. A figure of her similar to that at Ephesus existed near Magnesia on the Meander, where from the name of the spot she was called Λευκοφρυηνή.

The usual figure of the Ephesian Artemis, as preserved in works of art, is in the form of a female with many breasts, from the waist to the feet resembling a pillar, narrowing downwards, and sculptured all round with rows of animals. In archaic works, as on the chest of Cypselus of Corinth, she appeared winged, and holding a lion with each hand. As to the original image, believed to have fallen from heaven, it is not impossible that it had been made to take the place of a meteorite. But the Greek Artemis was usually represented as a huntress with bow and quiver, in face very like Apollo, her drapery flowing to her feet, or, more frequently, girt high for speed. She is accompanied often by a deer or a dog. Perhaps the finest existing statue of her is the Diana of Versailles On the coins of Arcadia, Ætolia, Crete, and Sicily, are to be seen varied and beautiful representations of her head as conceived by the Greek artists in the best times. (A. S. M.)

ARTEMISIA, daughter of Lygdamis, succeeded her husband in the kingdom of Halicarnassus, which was a dependency of the Persian empire. She took part in person in the expedition of Xerxes against the Greeks, and fitted out five ships, with which she distinguished herself in the sea-fight near Salamis, 480 B.C. When closely pursued by the Athenians she escaped by the stratagem of attacking one of the Persian vessels, whereupon the Athenians concluded that she was an ally, and gave up the pursuit. By her advice Xerxes did not attempt another battle, but at once retired from Greece. A story of her, in all probability entirely without foundation, is preserved by Photius. She is said to have loved a young man named Dardanus, of Abydos, and, enraged at his neglect of her, to have put out his eyes while he was asleep. The gods, as a punishment for this, ordered her, by an oracle, to take the famous but rather mythical *lover's leap* from the Leucadian promontory.

ARTEMISIA, the sister and wife of Mausolus, king of Caria, immortalised herself by the honours which she paid to the memory of her husband. She built for him, in Halicarnassus, a very magnificent tomb, called the *Mausoleum*, which was one of the seven wonders of the world, and from which the name of Mausoleum was afterwards given to all tombs remarkable for their grandeur; but she died of regret and sorrow before it was finished. She appointed panegyrics to be made in honour of him, and proposed prizes of great value for the best oratorical and tragic compositions. She also erected a monument, or trophy, in Rhodes to commemorate her conquest of that island. When the Rhodians regained their freedom they built round this trophy so as to render it inaccessible, whence it was known as the ἄβατον. She died about 350 B.C.

ARTESIAN WELLS, the name applied to water-springs rising above the surface of the ground by natural hydrostatic pressure, on boring a small hole down through a series of strata to a water-carrying bed enclosed between two impervious layers. In Europe this mode of well-boring was first practised in the French province of Artois, whence the name Artesian is derived. At Aire, in that province, there is a well from which the water has continued steadily to flow to a height of 11 feet above the ground for more than a century; and there is, within the old Carthusian convent at Lillers, another which dates from the 12th century, and which still flows. But unmistakable traces of much more ancient bored springs appear in Lombardy, in Asia Minor, in Persia, in China, in Egypt, in Algeria, and even in the great desert of Sahara.

In ordinary wells the water does not rise, but remains at the bottom of the trough dug for it in the soil, and to raise it we must use special apparatus or pumps. In Artesian wells, on the other hand, the water rises from a considerable depth to the surface of the ground, and usually spouts up to a greater or less height above it. The theoretical explanation of the phenomenon is easily understood.

The secondary and tertiary geological formations, such as those underneath London and Paris, often present the appearance of immense basins, the boundary or rim of the basin having been formed by an upheaval of the subjacent strata. In these formations it often happens that a porous stratum, consisting of sand, sandstone, chalk, or other calcareous matter, is included between two impermeable layers of clay, so as to form a flat porous U tube, continuous from side to side of the valley, the outcrop on the surrounding hills forming the mouth of the tube. The rain filtering down through the porous layer to the bottom of the basin forms there a subterranean pool, which with the liquid or semi-liquid column pressing upon it constitutes a sort of huge natural hydrostatic bellows. Sometimes the pressure on the superincumbent crust is so great as to cause an upheaval or disturbance of the valley, and there can be little doubt that many earthquakes, that are manifestly not of volcanic origin, are due to this simple cause.

It is obvious, then, that when a hole is bored down through the upper impermeable layer to the surface of the lake, the water will be forced up by the natural law of water seeking its level, to a height above the surface of the valley greater or less according to the elevation of the level in the feeding column, thus forming a natural fountain on precisely the same principle as that of most artificial fountains, where the water supply comes from a considerable height above the jet.

In the Tertiary formations, the porous layers are not so thick as in the Secondary, and consequently the occurrence of underground lakes is not on so grand a scale, but there being a more frequent alternation of these sandy beds, we find a greater number of them, and often a series of natural fountains may be obtained in the same valley, proceeding from water-bearing strata at different depths, and rising to different heights.

It does not follow that all the essentials for an Artesian well are present, though two impermeable strata with a porous one between may crop out round a basin. There must be, in the first place, *continuity* of the permeable bed for the uninterrupted passage of the water; and there must be, on the other hand, no flaw or breach in either of the confining layers by which the water might escape. To one or other of these causes is due the failure of many attempts to find Artesian wells where from appearances they might be expected. It has occasionally happened that on deepening the bore, with the hope of increasing the flow of water, it has ceased altogether, doubtless from the lower confining layer being pierced, and the water allowed to escape by another outlet. The subterranean pool is frequently of small extent, and of the nature of a channel rather than of a broad sheet of water; and the existence of one spring is no guarantee that another will be found by merely boring to the same depth in its neighbourhood. Several such failures are recorded by Arago in his notices on Artesian wells in the *Annuaire du Bur. des Long.* (1835, &c.), and referred by him to the circulation of the subterranean waters in irregular trenches between impermeable masses. The preliminary theoretical determination of the existence of these Artesian conditions is in itself a difficult matter, and can be arrived at only by a thorough acquaintance with the geological disposition of the district. Still more difficult, as can readily be imagined, is the practical execution of the boring of a hole of a few inches diameter to the depth of hundreds of feet. The keeping of the bore quite vertical, the ready elevation of the loosened rubbish, the prevention of the breakage of the boring rods at great depths, are some of the difficulties that beset the operation, and have tried the ingenuity of engineers.

The mechanical appliances employed in boring deep wells are not essentially different from those used in the sinking of mining shafts; and it may be remarked that the expense and tediousness of Artesian boring at the beginning of this century are to be ascribed not so much to the want of steam engines, as to the awkward mode of using the boring tool. In the old method a continuous boring bar was made use of, the steel boring tool or chisel being fixed to iron rods, which were screwed together in lengths of 10 to 15 feet. This, with a strong cross handle at the top, formed a sort of large gimlet, and was turned by two men, the tool being raised and suddenly dropped, as required, by a third man at the end of a lever, which was connected by a rope or chain with the gimlet-head. Most of the accidents, which formerly rendered well-sinking a hazardous task, were due to breakages of the borer or boring bar by the sudden fall which it was necessary to give the too in pecking through a hard stratum. The modern mode of boring is but an adaptation of steam power to a simple method practised for ages by the Chinese. They bore their deep wells by a steel head worked up and down by means of a cord suspended from a lever—a wooden pipe being used to guide the borer and keep the hole perfectly vertical. Free falling tools, worked by steam power, are now employed when bore-holes of large diameter have to be executed, the weight of the tool giving sufficient percussion to pierce the hardest rock. In the enormous Artesian boring, of $5\frac{1}{2}$ feet diameter, begun, in 1866, at La Chapelle, in Paris, a boring tool of about 4 tons weight was employed. It was raised by steam power, and allowed to fall freely from twenty to twenty-five times a minute, a twist of $\frac{1}{15}$th of a turn being given after each stroke. (See *Engineering*, vol. viii. pp 401, 413.) The borer is withdrawn at intervals, and the rubbish removed by means of a cylindrical augur with a valve at the bottom. Permanent pipes of cast or wrought iron must be fixed in the bore-hole to keep it open; and if the operations are through clay or sand, the pipes must follow the progress of the chisel as closely as possible.

One of the most remarkable examples of the patience and skill required to surmount the difficulties of deep boring is the Artesian well at Grenelle, in the vicinity of Paris. The operation of boring extended from 1834 to 1841; after a depth of 1254 feet had been reached (May 1837), a length of 270 feet of the boring rods suddenly broke off and fell to the bottom of the hole, and nearly fifteen months' constant labour was required to pick it up again. Discouraged by the delay, the French Government was to have abandoned the project after a depth of 1500 feet had been reached without any satisfactory result; but the urgent representations of Arago prevailed on them to prosecute the work And it was fortunate, for an additional depth of about 300 feet proved the correctness of Arago's theory. On the 26th February 1841, at a depth of 1798 feet, the boring rods suddenly sank a few yards. The subterranean water-bearing stratum had been reached, and within a few hours a vast column of water spouted up at the rate of 600 gallons per minute, and at a temperature of nearly 82° Fahr., furnishing a valuable source of supply for a suburb of Paris where it was greatly wanted. Prior to this no Artesian boring had reached even 1000 feet; and that of Grenelle was the deepest executed till the completion (12th August 1850) of the salt-spring at Kissingen, in Bavaria, which throws up a column of water to the height of 58 feet from a depth of $1878\frac{1}{2}$ feet. The most remarkable feature of this spring is that the projecting force is due, not to hydrostatic pressure, but to that of carbonic acid gas generated at the junction of the gypsum with the magnesian limestone, about 1680 feet down. Modern mechanical improvements have enabled engineers to exceed these Artesian dimensions considerably, and at a greatly diminished cost. The well at Passy, near Paris, which is supplied from the same water-bearing stratum as that of Grenelle, was bored by the Saxon engineer Kind in a very short time, having been begun on 15th September 1855, and carried to a depth of over 1700 feet by March 1857. Its total depth is now about 1923 feet, with the enormous diameter of 2 feet 4 inches at the bottom; and it throws up a continuous stream of water at the rate of 5,582,000 gallons per day to a height of 54 feet above the ground. Among other deep wells sunk in the Paris basin subsequently to those of Grenelle and Passy, the following may be mentioned. A gigantic bore, 5 feet 7 inches in diameter, was begun in January 1866 at La Chapelle, and by November 1869 had reached a depth of 1811 feet, the intention of the engineers being to extend it to a depth of 2950 feet. The mechanical processes employed are detailed in pp. 401 and 413 of vol. viii. (1869)

of *Engineering*. A bore of 19 inches diameter was carried down to a depth of 1570 feet in about two and a half years (1864–7), for the purpose of obtaining a water supply for the sugar refinery of M. Say in Paris; and the same engineer who executed this work (M. Dru), began in 1866 an Artesian boring of the huge diameter of 6½ feet at the part of Paris named *Butte aux Cailles*, to be carried down to a depth of 2600 to 2900 feet. (See *Engineering*, vol. iii. p. 605.) Besides these monster wells, there are in the Paris basin a great many others, varying from 300 to 400 feet in depth, and from 2 to 8 inches in the diameter of the bore-hole.

The Tertiary chalk strata over which London stands have been riddled with Artesian borings for the sake of pure water supply. The source of the New River (which was opened in 1613) is one of the chalk springs, at Chadwell, near Ware; this alone yields London a twenty-fourth part of its water supply, some 4½ million gallons a day. Many of the large London breweries obtain the water employed in the manufacture of their beer from Artesian wells over 300 feet deep. The Kentish Town water-works have a well 900 feet deep, which penetrates the chalk bed some 580 feet. Artesian wells also supply water to the Bank of England, the fountains at Trafalgar Square, the Mint, Pentonville Prison, Colney Hatch Asylum, Shoreditch Workhouse, the North Western Railway Station, Holloway Prison, &c. On the duke of Northumberland's property at Sion House there is a chalk well which descends 620 feet, and spouts the water up about 4 feet above the surface. At Merton in Surrey, at Brighton, at Southampton, all along the east coast of Lincolnshire, and in the low district between the chalk wolds near Louth and the Wash, Artesian borings have long been known, and go by the name of *blow-wells* among the people of the district. It is worthy of notice that the general level to which the water rises in the London district has been very sensibly lowered by the immense number of perforations that have been made; and in several wells where the water formerly rose to the surface, it now stands considerably below it, and requires to be pumped up.

None of the Artesian borings in England approach the depths frequent on the Continent and in America. The average depth of the water-bearing stratum around Paris is six times that of the London chalk beds; and in some parts of Germany and of America, wells have been sunk to even double the depth of the Parisian wells of Grenelle and Passy. At Chicago there are two wells, one 700 feet and the other 1000 feet deep, with a diameter of 5 inches, which supply the city with 800,000 gallons of water daily. At the town of St Louis, in the State of Missouri, an Artesian boring was carried down for 3147 feet, but as only brine was obtained, it was ordered by Government to be stopped in September 1868, when the depth was approaching three-quarters of a mile. The deepest boring in the world is at Sperenberg, twenty miles from Berlin, having been sunk for the purpose of obtaining a supply of rock salt. A bore-hole of 16 feet diameter was carried down to the depth of 280 feet, where the salt bed began; after a further descent of 680 feet was attained, the bore was reduced to 13 inches diameter, and then continued till the extraordinary depth of 4194 feet was reached, without having pierced through the salt deposit, which has thus the enormous thickness of at least 3907 feet.

The following are some of the other most important Artesian sinkings that have been made. At Louisville, in Kentucky, a bore of 3 inches was carried to a depth of 2086 feet between April 1857 and the summer of 1858, when a supply of water almost as plentiful as that of Grenelle was obtained. At Charleston, South Carolina, there is a well 1250 feet deep, which was begun in 1848, and which discharges water some 10 feet above the surface at the rate of 1200 gallons an hour. In 1858 a well at Neusalwerk, near Minden, had reached the depth of 2288 feet. At Bourne, Lincolnshire, there is a well 95 feet deep, which yields over half a million gallons of water per day, the pressure being sufficient to supply the town and force the water to the tops of the highest houses. There is one, on the property of the Continental Hotel, in Philadelphia, over 200 feet deep, and 8 inches in diameter, which yields 50,000 gallons a day. Two Artesian wells at Croydon supply a million gallons of water per day; and Brighton draws over a million gallons from Artesian sinkings. There is a well at Bages, near Perpignan, which gives 330 gallons per minute; and one at Tours, which jets about 6 feet above ground, and gives 237 gallons per minute.

The boring of wells in the great desert of Sahara is a very ancient industry; and some oases are supplied with water wholly from Artesian wells. The average depth of these is from 160 to 200 feet, and the upper strata have only to be pierced to give a constant stream. With their primitive methods of boring, the Arabs often labour for years before they reach the wished-for pool; and with only palm wood as a casing, they have great difficulty in keeping the bore-hole from closing up by the drifting of the sand, and they require to scour them out periodically. Since 1858 an immense number of perforations have been made by French engineers, and the fertilising effect upon the sandy desert plains is already making itself apparent. Villages are built and palm trees are growing where formerly there was but waste and solitude. (See *Geological Magazine*, vol. i. p. 31.) The importance of deep wells in such cases cannot be over-estimated.

Artesian wells have been made to supply warm water, for keeping hospitals, &c., at a constant temperature. Invariably the temperature of water from great depths is higher than that at the surface, this being due to some unknown source of heat in the interior of the globe. The temperature of the water in the well at Grenelle is 82° Fahr., and that of Passy the same, showing that they have a common source. Kissingen well has a temperature of 66° Fahr., that of St Louis one of 73°·4 Fahr., that of Louisville 76½° Fahr., and that of Charleston 87° Fahr. The average rate of increase of temperature is 1° for a descent of from 40 to 55 feet. In Würtemberg the water of Artesian wells is employed to maintain in large manufactories a constant temperature of 47° when it is freezing outside. Artesian waters have also been employed to reduce the extreme variations of cold in fish-ponds, which are so fatal to their finny inhabitants.

See Héricart de Thury, *Considérations sur la cause du Jaillissement des Eaux des Puits-forés*, Paris, 1829; Bruckmann, *Ueber Artesische Brunnen*, Heilb., 1833; *Arago*, "Notices Scientifiques," *Annuaire du Bureau des Long.*, 1834; *Engineering*, vols. ii. iii. and viii.; *Transactions of the Academy of St Louis*, vol. i. No. 1; American *Jour. of Science and Art*, 1859; Beardmore's *Manual of Hydrology*; Notice by General Desvaux in the *Annales de Mines*, 1858; Burnell's *Hydraulic Engineering* (Weale's Series); *Les Puits artesiens des oasis méridionales de l'Algérie*, 2d edition, 12mo, 1861, by Berbrugger.

ARTEVELDE, Jacob van, a celebrated Flemish popular leader in the 14th century, was a brewer in Ghent. His enormous wealth, great eloquence, and general talent for administration, easily made him the most prominent and powerful man on the side of the citizens in their struggle against the encroachments of Count Louis of Flanders. The people of Ghent gave him the command of their forces, and he banished from the town all the nobles and adherents of the count. In 1335 he made a commercial treaty with Edward III. of England, and with the aid of some English troops expelled Louis from Flanders. Ten years later, in 1345, after having persuaded Edward to assume the title of king of France, and induced the Flemings to support the claim, he thought to cement the alliance by making the Black Prince count of Flanders. This proposal was badly received by a large body of the people of Ghent, who were dissatisfied with their leader's somewhat arbitrary government. A popular tumult broke out with its usual impulsiveness, and Artevelde was slain.

ARTEVELDE, PHILIP VAN, son of the above, lived in retirement till 1381. Some years before that date enmity had again arisen between Count Louis of Flanders and the somewhat turbulent citizens of Ghent, who, under one Hyons, had expelled the count's adherents, plundered his house, and slain several of his officers. Hyons died in 1379, and in 1381 the citizens, under Peter van der Bosch (Dubois), were closely blockaded by the count. In this emergency Van der Bosch proposed that the son of the great Artevelde should be invited to take the direction of affairs. Philip accepted, at once entered on public life, and by some strong measures secured his power. The inhabitants of Bruges had at this time allied themselves with the count, and Artevelde resolved to punish them. He led out his forces quietly, and utterly defeated the army of the count, who escaped with difficulty. Bruges was plundered, and submitted to Artevelde. Next year the French, taking up the cause of Louis, invaded Flanders, and at Rosbecque completely routed the forces of Ghent. Many thousands were slain, and among them Artevelde himself. The brief but stirring life of this popular leader is admirably treated in Sir Henry Taylor's drama, *Philip van Artevelde.*

ARTHROPODA. The Aristotelian distinction of *Malacostraca*, or Crustaceans, and *Entoma*, or Insects, has been referred to by Agassiz as in reality more precise than Linnæus's last classification (1766), in which his Crustaceans form part of the Apterous group of insects. But whereas the Greek naturalist recognised the notchings which indicate annuli, *somites*, or body-rings, in *Coleoptera* and the other groups to which the class-name Insect is now restricted, and in Worms, under which he comprehended insect larvæ, several true Annelids, and intestinal worms (Scolecida), he failed to appreciate this as a feature common to the *Malacostraca* or *Scleroderma*, which he named on account of the character of their integument. Linnæus, on the other hand, saw that annulation was the most prominent common feature, and his *Insecta*, therefore, were a good natural group so long as embryology could throw no light on the affinities of the Cirripeds and parasitic Crustaceans—these two groups forming, together with the intestinal worms, molluscs, zoophytes, and lithophytes, the class *Vermes*. Cuvier (1829) includes in the third branch of his scheme, *Animalia articulata*, Annelids, Crustaceans, Arachnids, and Insects (the Myriapods being an order of this class). Latreille (1796) proposed a scheme in which the orders of the Insects (as now restricted) formed equivalent groups with the Crustaceans, Arachnids, and Myriapods, which now first appear as a distinct group, though still united with a section of the Crustaceans. Latreille further, in 1801, recognised the Cirripeds as intermediate between his *Insecta* and the Molluscs. Lamarck gave the value of classes to the Insects, the Arachnids (including therein the *Thysanura* and *Myriapoda*), the Crustaceans, and the Cirripeds. But he has no province answering to the Cuvierian *Articulata*, since these orders are, with Annelids, Conchifers (= Lamellibranchs), and Molluscs (= *Odontophora*), members of the "sensitive animals," the Lernæans and other parasitic Crustaceans being an order of the *Vermes*, and therefore apathetic animals. De Blainville, still relying chiefly on external form, recognises four types in the sub-kingdom of the bilateral animals:—(*Artiomorpha* or *Artiozoaria*), of which the first is *Osteozoaria* (Vertebrates). The second *Entomozoaria* (Articulates) includes: Class 1. HEXAPODA, *Insecta proprie sic dicta*; 2. OCTOPODA, *Arachnida*; 3. DECAPODA, *Crustacea decapoda and Limulus*; 4. HETEROPODA, *Squilla, Entomostraca, Epizoa*; 5. TETRADECAPODA, *Amphipoda and Isopoda*, 6. MYRIAPODA; 7. CHÆTOPODA, *Annelides*; 8. APODA, *Hirudo, Cestoidea, Ascaris.* The third type, *Malentozoaria*, is intermediate between the Articulates and Molluscs, and embraces two classes: *Nematopoda*, Cirripeds; and *Polyplaxiphora*, the Chitons. The classification of which this forms a part is a compromise between the method of Cuvier, based on the recognition of distinct plans, and that of Ehrenberg, who sketched each group as departing from the common plan of the animal kingdom only by excess of development in one or other direction. The *Articulata*, viz., *Insecta*, *Arachnoidea*, *Crustacea* (the Cirripeds and Epizoa being included), *Annulata*, and *Somatotoma* (the two latter making up all that are now known as Annelids), he distinguished from Molluscs by the isolation of their ganglia and their succession, those of the Molluscs being dispersed. Owen's *Homogangliata*, as equivalent to *Articulata*, is the expression of the same difference: his *Insecta* embrace two sub-orders, *Myriapoda* and *Hexapoda*, and the *Annellata* are placed between the Epizoa and Cirripeds. Milne-Edwards (1855) divides the *Entomozoaria* or *Annellata* into two groups,—(1.) *Arthropoda*, including Insects, Myriapods, Arachnids, and Crustaceans; and (2.) *Vermes*, including Annelids, Helminths, Turbellarians, Cestodes, and Rotifers. Siebold and Stannius (1845) made the Arthropods a primary division co-ordinate with *Vermes*, and united the Myriapods with the Crustaceans. Leuckart's *Arthropoda* comprise two classes,—*Crustacea* and *Insecta*; the latter combining the orders, *Myriapoda*, *Arachnida*, and *Hexapoda*. Fitzinger's *Arthrozoa*, or eminently motor animals, Crustaceans, Arachnoids, and Insects, contrast with the *Dermatozoa* or Molluscs, which are eminently sensitive. Von Baer's *Articulata* correspond to the Cuvierian group under the same designation, and like it represent a type of organisation, the longitudinal or bilaterally symmetrical, the organs being arranged with reference to the axial alimentary canal. The embryological system of Van Beneden (1855) rests upon the position of the vitellus relatively to the surface of the embryo, the Articulates being designated by him *Epicotyledones* or *Epivitellians*, the vitellus being received into the embryo on the dorsal or upper surface, while the vertebrates receive the yelk on the ventral or lower surface, and are therefore *Hypocotyledones* or *Hypovitellians*. As will be pointed out afterwards, this nomenclature is unfortunate, since the surfaces thus contrasted are identical, both being the hæmal aspects of the body. It may further be remarked that the term *Articulata* is manifestly one which should be abandoned, since it is made to represent very different things, being used by Cuvier, Ehrenberg, and Owen to include the Annelids,—by Van Beneden, Vogt, and some more recent writers, to their exclusion. Neither is *Arthrozoa*, the Greek equivalent of *Articulata*, more commendable, Burmeister and Fitzinger using it with the same difference. But *Arthropoda* has varied only in the rank assigned to it, not in the area it represents, thus Milne-Edwards makes it a sub-division of the *Annellata*, Van Beneden, Siebold and Stannius, and Leuckart, a primary division of the animal kingdom. But as a general designation for those animals which are made up of nearly equivalent somatomes or somites is needed, Macleay's term *Annulosa* is, perhaps, the best, since it has never been used for two incommensurate groups. Leach, and later (1825) Latreille, proposed *Condylopoda* as the name of the group for which *Arthropoda* was afterwards devised. Custom has overborne the rule of priority, and the later is now the more common name. The classifications hitherto mentioned rest solely on an anatomical basis, those of Von Baer and Van Beneden dealing only with the observed facts of development. Haeckel, applying all that was known of embryology to the construction of the pedigree of the groups, made (1866) the *Articulata* one of the five great trunks of the genealogical tree. The Articulate phylum embraced the Infusoria and intestinal worms, as well as the Annelids, along with the *Arthropoda* as restricted above. The *Arthropoda* further formed two groups :—*Carides*, the branchiate Arthropods or Crustaceans; and *Tracheata*, the Arachnids, Myriapods, and Insects, which breathe by tracheæ. The term Articulate disappears from Haeckel's latest classification, in which a redistribution of the phyla is set forth. From assumed ancestors destitute of body-cavity (*Acœlomi*) descend those *Vermes* with body-cavity, of whose plan *Echinodermata*, *Arthropoda*, *Mollusca*, and *Vertebrata* show special modifications. In 1870 Gegenbaur gave a general table, in which the *Vermes* included *Tunicata* and *Annulata*. The former led towards the *Mollusca;* the latter was the starting point of *Arthropoda*, *Vertebrata*, and *Echinodermata;* of the Arthropods there are four classes,—Crustaceans, Arachnids, Myriapods, and Insects. Amidst all the varying opinions as to the value of the group, the importance of the limb-structure has been recognised since Latreille dwelt upon the articulations by which the parts of these appendages are connected.

The *Arthropoda* agree in the characteristic already mentioned, the articulations of their limbs, whence the class-name is derived. The body presents various degrees of complexity. In the caterpillar, the *metamera*, *somites*, *somatomes*, or *annuli*, owe their mobility to differences in thickness of the integument. In the Myriapods the numerous similar somites are flexed on each other by the overlap of the chitin-thickened portions of cuticle which protect the upper and lower surface of each division. The somites are more or less effaced in the abdomen of insects and spiders; head and thorax in crabs and spiders have their composite origin concealed. But the external signs of division of the body no longer correspond, as in Annelids, to the distribution of the internal organs, which, with a partial exception in the case of the nervous system, are now unities contributing to the well-being of the whole. Homonomy, the absence of segmentation, or the equivalence of the divisions of the body, among the Annelids, has been contrasted with the heteronomy, or segmentation of the arthropod body. The difference, however, is only one of degree, since both the cephalic and caudal extremities, at least of the higher Annelids, are true segments, *i.e.*, fused somites which, in addition to fusion, have undergone some amount of specialisation. In the four classes of Arthropods the head is a constant segment. It consists of præ-oral and post-oral somites, the ganglia of which are represented by the supra- and sub-œsophageal masses. The number of somites, as represented by appendages, is not the same in the four classes, and as the variation affects the præ-oral appendages supplied from the supra œsophageal ganglion the difference is of great importance. In the Crustaceans the somites of this segment are, according to Huxley,—

App.—	Eyes,	Antennæ,	Antennules,	Mandibles,	Maxillæ,	Maxillæ.
Som.—	1.	2.	3.	4.	5.	6.

The *Podophthalmata* present the eyes as modifications of processes identical with those which become ambulatory limbs. In the rest the eyes are sessile. In Myriapods, Arachnids, and Insects, the eyes are sessile, and the præ-oral appendages are reduced to one pair of antennæ, whose innervation is from the supra-œsophageal ganglion. Apart from the value to be assigned to descent in the search for homologies among these classes, it is a question of fact whether the eyes are præ-oral or lateral to the oral aperture. The cephalic lobes carry the organs of sight probably in the earliest types of development at the angle of bifurcation, the position of the single eye of Ostracods. In more complex forms the eyes appear more or less towards the outer margin of the lobes; and in insects where the cephalic arch is high, these organs may appear to correspond not to the most anterior, but to a posterior part of the cephalic sterna, just as sensory organs appear, the gustatory at the base of the outer, the auditory at the base of the inner antennæ in the higher Crustaceans. By shortening of the development process the change of position may be obscured, and the eyes, primitively belonging to the extremity of the embryonal body, may from the first appear connected with more posterior somites. The identification of homologous parts of the præ-oral region in the four classes rests on the opinion held as to the origin of the classes. If the Crustaceans are regarded as the stock of the Arthropods, the homologies must be recognisable. If, on the other hand, all four are divergencies from a common stock, then the absolute identity of the parts must hold a second place in comparison with a general conformity to the common plan. The identification of the eyes with a particular pair of appendages necessitates the assumption that these sense organs, when sessile, are so by non-development of their supports. The converse supposition is more admissible, that the eyes are supported on stalks as the result of an adaptive modification. Further, among the Crustaceans we find hints of the primitive composite character of the Arthropod. The auditory sacs of *Mysis* are at the caudal extremity of the body, the respiratory organs of Isopods are in the same position, and the genital orifices vary in different genera, and even in the sexes of the same species. Analogous (perhaps no more) is the distribution among Molluscs of the eye-spots which fringe the mantle of *Pecten*, are pedunculate in the snail, and, with the otolithic sacs, are in close proximity to the nerve centres of cuttlefishes. If this view is accepted, the close comparison of the limbs of Arthropods loses much of its importance, and it becomes more interesting to endeavour to trace the primitive form from which the divergences have occurred. Among Crustaceans the Nauplius is the earliest recognisable form,—"an unsegmented ovate body, a median frontal eye, and three pairs of natatory feet, of which the anterior are simple, and the other two biramose" (F. Müller). The third pair of appendages is replaced by the mandibles, the oval body is divided by a transverse fold, and the Nauplius head and tail thus marked off have the mid-body of the adult developed by intercalation between them. Appendages are developed before segmentation is indicated in the free living Nauplius; but in some this stage is overpassed in the egg, the evidence of its existence being the presence of a thin exuviated membrane which is not egg membrane, nor can it be termed amnion, without overstraining that term which is properly used in the higher vertebrate embryology. In Insects the vermiform stage is rapidly passed through, the priority of segmentation to the development of appendages being indicated in the *Trichoptera*, according to Zaddach, and in Aphis, according to Huxley. If we go to the Rotifers, there are in that group types which are comparable with the Nauplius of Crustaceans, and with the vermiform larvæ of Insects, as O. Schmidt and Lubbock (*Origin and Metamorphoses of Insects*) have shown. *Pedalion mira* (Hudson) has a very close resemblance to the Nauplius, *Lindia* to the vermiform grub of Dipterous insects. The resemblance is not impaired by the comparison suggested by Ray Lankester between the Molluscs and Rotifers. Huxley calls the Molluscs "little more than oligomerous modifications of the polychætous Annelids" (*Nature*, December 10, 1874); and in this article it is attempted to show what are the simplest forms presenting common features with the Arthropods. The hexapod Insect has been compared by Haeckel, F. Müller, and others to the Zoëæ of Malacostracous Crustaceans, a group in one member only of which, *Peneus*, has a Nauplius stage been detected. The Zoëa and the Insect possess alike three pairs of limbs for locomotion, and three for ingestion of food. The abdomen in both is without appendages, and the mandibles are without palps. Admitting the resemblances, there is a prior question to be settled in the case of Insects, Myriapods, and Arachnids. Are the temporary embryonal investments of these animals, the cellular and the structureless membranes, to be compared with the blastodermic moultings of Crustaceans, with that membrane whose presence in the Amphipods is accepted by some observers, as the last trace of the Nauplius stage? In the Acarids Claparède found the inner layer to invest the embryo after the outer gave way, and Metschnikoff recognises the deutovum in *Platygaster* also. The identification with the Nauplius is strongly denied by the last-named observer; but there is still room for further investigation, since embryologists of high reputation differ so entirely on the matter of fact, irrespective of phylogenetic theories. Should the identification be accepted, the Arthropods would, as a group, agree in having a Nauplius stage, different in detail in each class; the second, or Zoëa stage, would differ still more in each, and the homologies of the parts would thus become obscured in details, the identity of the general plan being clearly recognisable. All the Arthropods agree in having the terminal portion of the intestinal canal derived from the outer, the middle portion from the inner embryonic layer. Lastly, the Arthropods, in common with the Molluscs and Annelids, have their body-cavity, or perivisceral space, formed by the splitting of the mesoblast, or derivative layer formed between the outer and inner layer (epiblast and hypoblast, and ectoderm and endoderm). In Insects, in the higher Arachnids, and Crustaceans, yelk segmentation is partial; in Myriapods, and the lower Arachnids, and Crustaceans, it is total; but as in Insects, for example, the unsegmented yelk undergoes at a later period a division into polygonal masses, the difference, though of value in classification, is not of primary importance. The relation of the branchiate Arthropods, the Crustaceans, to the other three tracheate classes, has been discussed chiefly from a phylogenetic point of view. The priority of aquatic to terrestrial forms is assumed, and the derivation of the latter from the former is traced in various ways. The somites or metamera of the Arthropod retain, more than the nervous system which is derived from the epiblast, and still more than the alimentary canal and its appendages, the annulose characteristic that each represents a unit; each may, and many do, give rise to appendages originally similar, but afterwards modified for special functions. Hence the same limbs are tactile in Crustaceans, prehensile in Arachnids, ambulatory in some Crustaceans, accessories of mastication in others, locomotive in some, respiratory in others. In Insects the abdomen of the adult is destitute of appendages, but many larvæ are provided with tracheal gills, that is, external processes in which air-canals ramify, and in which a large quantity of blood is received within the cavity of the thin-walled dilatable process. These processes are destitute of external apertures, the tracheal system is in them closed. Such structures are found but rarely to co-exist with the open condition of this tracheal system. But *Pteronarcys*, one of the Orthopterous order, is remarkable for this conjunction, the branchial processes of the adult overhanging the stigmata of the tracheæ. Considerable variety exists in the position of the gills. The larvæ of *Perla* have three thoracic pairs of gills, and are terminal of the abdomen. In other cases they are confined to the abdomen. Now, it is to be noted that these gill projections are not at first tracheal; in *Chloea* the tracheæ appear after another moult, and they are then vibratile. Further, they are developed from the upper surface of the body. Now, in the Annelids the limbs are typically double pairs projected from the sides of the body, the parapodia consist of two branches, notopodium and neuropodium, and the gills when present are modifications of the notopodium. In the Crustaceans this bipartite condition is indicated by the exopodial and endopodial divisions of the limbs. In the adult insect this duplicity has disappeared, unless we recognise in the position of the gill tracheæ the equivalent of the branchiferous notopodium. Gegenbaur and Lubbock regard the wings as tracheal gills transferred from locomotive organs in water to locomotive functions in air. Gegenbaur thinks that the dropping off of the gills determines the opening of the tracheal system by the stigmata or pores. Further, he assigns to the closed tracheal system a function similar to that of the swim-bladder of fishes, structures primarily useful in flotation, subordinately respiratory in function.

Natural as may seem the assemblage included under *Arthropoda*, there is no group in which adaptive modifications have introduced so much diversity of anatomical and physiological relations. Metamorphoses, the changes of form which changes of external conditions have promoted, are met with of very various amount. The progress of the embryo from the first appearance of the blastoderm up to sexual maturity of the adult may be direct, without metamorphosis, or may be retarded by changes of form and habit, rendering the young animal capable of sustaining life under very various conditions. In any one of these stages, even in the adult, multiplication may be provided for by a process of budding, the bud from which the new form emerges being in essence undistinguishable from the ovum for whose further development impregnation is necessary. These metamorphoses are probably of late origin in the history of the group, their perpetuation being due to change in their surroundings. Their relations may be "falsified by the struggle for existence," the details of the developmental history of the family (phylogenesis) may be crowded into a short space in the development of the individual (Ontogenesis). The description of these variations belongs to the particular treatment of the Crustaceans, Myriapods, Arachnids, and Insects. (J. Y.)

ARTHUR, or ARTUS, a hero of the Welsh Tales, the Chronicles of Geoffrey of Monmouth, and the Romances of the Round Table. His exploits, even the most fabulous, passed with historians, before the days of historical criticism; subsequently a reaction led to the figure of Arthur being regarded as nothing but a Celtic myth. The truth, so far as it is possible to arrive at it, lies between these two extremes. There was a real Arthur, one of the last Celtic chiefs in Great Britain; but there is no single trait of his real character and exploits which legends, working according to laws to be presently discussed, have not remodelled and transfigured or disfigured; while the scarcity of documents makes it impossible to reconstruct a coherent historical picture. Thus the work of comparison between the historical and the legendary personages, such as has been performed for Charlemagne by MM. Gaston Paris and Léon Gautier, is impossible in the case of Arthur. We can only study the legend and analyse its elements.

There is an error, not so popular as it once was, which supposes that myths and legends are arbitrary creations, and does not recognise them as having an origin in regular causes, and therefore a rational history, before the period when they are crystallised into their final legendary form, or are merged in the current of a literature in that later and artificial stage when it disinters and refashions old materials. Before Arthur took his final French form in the Romances of the Round Table, he was a Celtic hero in the Breton, and more specifically still in the yet earlier Welsh, legends. And behind these is the original Arthur, of whom we must be content with such impressions as we can gather from his contemporaries, Myrdhinn and Lywar'ch.

Lywar'ch, a bard and king, born about 480, was one of the companions of the valiant chief, Urien of Reghed, in Cumberland, upon whose death he composed a pathetic lament. He survived the death of his twenty-four sons in the last struggles against the Saxon, and in his old age, banished and a cripple, he wrote from his hiding-place a mournful hymn on his own and his country's decay, in which lovers of the poetry of despair have admired this verse worthy of Job:—"See yonder leaf driven by the wind; woe for him who has the like lot! it is old, though born within the year." But the bard-king had only despaired after a life-long struggle, and in like manner the bard-prophet Myrdhinn had long sung in praise of peace before he went mad with grief, on the night of the battle of Arderidd, where the northern and southern Celts slaughtered each other to the profit of the Saxons. Before this fratricidal struggle (the beginning of the 6th century) Myrdhinn had cherished the dream of the resurrection of an ancient chief, whom he called Lemenitz:—

"My prophetic soul foretells it; discord shall reign among the British tribes until the federation which shall be formed by the chief of heroes, Lemenitz, when he comes back to the world. Like the dawn he will arise from his mysterious retreat."

By this chief of heroes, destined to bring back union, the bard meant his king and friend, Aurelianus Ambrosius, and after his death Arthur, his valiant successor, and Myrdhinn's own pupil. The battle of Arderidd came to dissipate the last of these illusions. One of the contending hosts consisted of northern Celts, bent upon imposing on all of their race yet unconquered in Great Britain the authority of Howell of Scotland, the brother of that Gildas who soon afterwards became a convert at once to Christianity and to Saxon interests. The other host, that of the southern Celts, was led by Aurelianus Ambrosius, whose favourite bard was Myrdhinn. After the final destruction of the Celtic power, the destiny of Myrdhinn is to reappear in legend with the Latinised name of Merlin. Aurelianus Ambrosius and Arthur, the two Celtic chiefs to whom the bard had been so loyal, undergo a like resurrection; but their lives and exploits are confounded, according to the accumulative method of legend, with each other and with those of Vortigern, king of Kent. The Arthur of the legend more than realises all the prophecies of Merlin; and these prophecies in the process of oral repetition, and in travelling further from the place and the time of their origin, themselves were altered to an ampler tenor. They underwent one great degree of change in crossing the Channel, and another and greater in passing from the soil and speech of Brittany into those of France. With the tenor of the prophecies grow the proportions of the hero. The poetic Arthur pacifies the Celts, quells the Saxons, and ends by establishing a reign of justice upon earth. It is a hard saying, but true, that the key to all this is a certain sentiment which is the mark of conquered races. The Celtic genius after its defeat in arms would have revenge in songs. What happened was this. The Celtic chief, Vortigern, summoned to his help the Saxon chief Hengist. Now, let it be noted that, in the annals of the Saxon kingdom of Kent, the fourth king in succession from Hengist is the Saxon Ethelbert. Turning to the legend, it will be found that the corresponding fourth king in succession from Vortigern is the British Arthur. For in legend the treachery of Vortigern must not be allowed to bear fruit, the Celts after many a struggle must be left conquerors. The honour of giving the last blow to the Saxon invasion in Kent, West Wales, and elsewhere, is assigned in the legend to Arthur. And why to Arthur? Because of the ancient prophecies of the resurrection of the fabled Lemenitz, with whom later times identified him, and above all, because the whole legendary structure hinged upon the impressive portraiture of Merlin, whose historical prototype had, in fact, been the devoted follower of the historical Arthur and Aurelianus Ambrosius. But this edifice of fable, under which the Celts strove to hide from themselves the real ruin of their race, was not built up in a day. The conquered people repeated and enlarged upon the prophecies of Merlin; and with these grew the figure of Arthur, enriched by every noble trait which could be borrowed from the stories of the bravest chief., and made to accord with the prophecies. Round the main personage soon revolved other ideal types, and little by little was founded the harmonious hierarchy of King Arthur and his knights, such as it now remains in romance, and such as never existed in reality. The tales were then carried into France, for just as in England the Irish bards were held in higher esteem than the Welsh, in France the Breton lays were preferred to the songs of the *trouvères*. While this work of infiltration was going on, Geoffrey of Monmouth set down, in 1130 and 1147, the Arthurian legend in his *Historia Britonum*, and, emboldened by the popularity of this work, published afterwards a poem entitled *Vita Merlini*, which lent the authority of Latin to the tissue of fabulous successes. Robert Wace translated the chain of legends into old French, and Richard de Borron added his *Saint Graal*, which serves in some sort as a theological preamble to the Romances of the Round Table. At that time the poems of the Carlovingian era had lost their hold on popular favour, as much from the unreality of their heroes,—*Charlemagne à la barbe florie*, *Roland*, and *La violente Blanchefleur*,—as because the dominant sentiment pervading these poems, as binding faith and loyalty between vassal and lord, had ceased to find an echo in the hearts and life of the people. An attempt was made to replace the Carlovingian Cycle by another formed from the various songs taught by Breton minstrels to *trouvères* and troubadours; for Charlemagne was substituted the far more poetical type of Arthur. *Languor*, *fatality*, *pleasure*, were all personified in Lancelot, Tristan, Gaurin, &c., and the Romances of the Round Table took the shape in which they now remain. Nevertheless, those who have traced the legend to its source, and for whom the ancient Celtic foundation is still visible, will regret in reading even the graceful paraphrases of Christian de Troyes, or the sweet and simple poems of Marie de France, their departure from the original types.

The recent discoveries of Messrs Owen Jones and Hersart de la Villemarqué in Welsh literature show us how much the romances lost in elevation of sentiment and depth of thought as they varied from the Celtic model. To give an example of this revarnishing and its effect in concealing the primitive foundation, we may cite Tristan, who, in the original legend, drinks the philtre to obtain by it all knowledge, and his madness and despair that ensue are the madness and despair of one fatally gifted with universal insight; whilst in the French romance the philtre becomes a vulgar love draught. This was only a preliminary step to the false sentiment of modern French *romanticists*, who have since, in their exaltation of the passions, dispensed with philtres altogether. In the same way Merlin, in the Welsh texts, is mad with grief on beholding a fratricidal war, and his madness, according to the old Celtic idea, endows him with the power of a seer and magician over all nature. In the romances his frenzy and magical power have no worthier cause than his love for Vivian.

The figure of Arthur, on the contrary, seems to gain in dignity by the migrations of the legend. In the Welsh tale of *Owain and Gherain* (Ivain et Erec, with Christian de Troyes), we see him, it is true, holding his court during

Easter and Pentecost at Caerleon on the Usk, but as a little exalted monarch, a *roi-bonhomme*, asleep on his throne, while the chiefs of his following relate at their ease all their adventures. Here we find preserved the idea of the individual independence of all the Celtic chiefs, whose king, only *primus inter pares*, must necessarily have been as little of a sovereign as possible. After the legend has passed into France Arthur becomes a sort of rival Charlemagne, holding supreme and boundless sway, though never as a real feudal emperor (they were tired of that in France), but rather as a Marcus Aurelius,—a monarch, half philosopher, ruling chiefly by his wisdom and subtlety, and still more a judge than a general over his people. The type is one which belongs essentially to the Celtic mind, more akin to the Greek than any other, and naturally as far removed from the Roman as from the Saxon turn of thought.

Among the writers of the 17th and 18th centuries the historical existence of Arthur was, with a few rare exceptions, denied, and the Arthurian legend regarded purely as an invention of the worthy chronicler, Geoffrey of Monmouth. Pinkerton bestows a moment's notice on "the king whose exploits fill all the poetry of the Middle Ages, and whose very existence is doubtful," and then passes on. The difficulty of establishing the filiation of Arthur perplexed Milton, who says, "As to Arthur, more renowned in songs and romances than in true stories, who he was, and whether any such reigned in Britain, has been doubted heretofore, and may again with good reason. No less is in doubt who was his father; and as we doubted of his parentage, so may we also of his puissance." Guinguené settled everything by the unwarranted explanation, that English romancers had invented an Arthur out of jealousy of the French Charlemagne. English writers of Guinguené's calibre in mythical science replied, that Arthur was a French invention of Richard or Elie de Borron, or of the Anglo-Norman Mapes, basing the assertion on an expression found in Geoffrey of Monmouth. Ampère, deficient here in his usual penetration, throws entire discredit on the good faith of Marie de France, who speaks of having seen and handled the original Celtic MS. Fauriel, and with him the other French *savans*, would fain have attributed the Arthurian legend to the troubadours rather than acknowledge its Welsh origin. He asked for the tests which have since been discovered by Mr Owen Jones and commented on by M. Hersart de la Villemarqué with perhaps indiscreet zeal. Sir Walter Scott's excellent historical instinct had already exhibited a part of the truth in his edition of Thomas of Ercildoune's Rhymes. We may now, therefore, venture on being more positive than Southey, and less sceptical than Mr Thomas Wright, the two modern editors of the translation which Sir Thomas Malory made in 1634 of the five Romances of the Round Table (he "compiled the booke oute of certaine bookes of Frensshe, and reduced it into Englysshe"), and we may follow almost step by step the development of the legend, and of the various Arthurs, from the British Arthur of history to the mythical Arthur of Cambrian and Breton tradition, and lastly to the French Arthur, the rival of Charlemagne.

We shall conclude by noticing the main features of the character of Arthur, and indicating their origin.

Historic Facts.—The general belief regarding Arthur has been that he was a leader of the Celtic tribes of the west of England against the Saxons. It is recorded that, about the middle of the 5th century, Kent, after suffering from famine and pestilence, was invaded by the Picts and Scots, while at the same time another struggle, longer and more keen, was taking place in West Britain against another Saxon invasion. The longer and braver resistance of the Western Celts is partly set down to the merit of their leaders, Aurelianus Ambrosius and Arthur. The men of Kent, however, after a vain appeal to Ælius, prefect of the Gauls, were induced by Vortigern, their most important chief, not only to make peace with the Saxons, but to invoke their aid against the Picts and Scots. Hengist was appealed to, and the looked-for Saxon alliance became the Saxon invasion and conquest of Kent, after Hengist, heretofore a *Heretogen*, became a king. Whilst his immediate descendants were establishing themselves in succession to him, the contest in the plain of Arderidd took place, which occasioned Myrdhinn's frenzy. Arthur was slain in the battle called by historians the victory of Mountbaden near Bath, 520 A.D.

[The historical Arthur is now regarded by many as having been a 6th century leader, *Guledig*, or "Dux Bellorum" of the northern Cymry of Cumbria and Strathclyde against the encroaching Saxons of the east coast (Bernicia), and the Picts and Scots from beyond the Forth and Clyde. For such would appear to be the, at least, approximately certain result of recent researches, in opposition both to the scepticism of the 17th and 18th centuries as to the existence of an historical Arthur, and to the popular notion of him as a West-of-England king, or king of Wales, or Cornwall. This conclusion had, however, been more or less distinctly suggested by Chalmers, by Sir Walter Scott, by a writer in the *Gentleman's Magazine* (1842), by Mr Nash, and by Dr Burton. Yet this result of special recent researches is still so far from being generally known and accepted, that it may be desirable briefly to indicate the arguments in support of it.

First, then, we have the facts of the northern extension and conflicts of the Cymry in those five centuries, from the 6th to the 10th, which may be distinguished as the Premediæval Period. For these facts our first authorities are the only premediæval British historians, Gildas and Nennius—the *Historia* and *Epistola* of the one having been composed in the 6th, and the earliest of the works that go under the name of the other in the 7th century. Now, in the former there is, at least, nothing to favour that popular notion as to Arthur which is derived from the mediæval chronicles; for the words in the Durham MS., "Qui prope Sabrinum ostium habetur," are now acknowledged to be an interpolation of the 13th century. And the latter is most naturally interpreted as positively affirming that Arthur's conflicts were with the Saxons of Bernicia (Northumberland and the Lothians). It has been contended that this could not be meant, because the Teutonic settlers in the north were Angles. But, in answer to this, it can now be affirmed that the earlier Teutonic settlers in the north were Frisians, a tribe of Saxons; and that the northern settlement of the Angles did not take place till 547, after the time of Arthur. Besides, the bards of the 6th century, to whom are attributed those historical poems, which do not, however, appear to have taken their earliest consistent shape farther back than the 7th century, and which have been recently edited by Mr Skene under the title of the *Four Ancient Books of Wales*,—these Cymric bards—Merlin, Taliessin, Aneurin, and Llywarch Hen—are all connected with the north; of a large proportion of their poems the scenery and events lie in the north; these poems are, in fact, the literature of the Cymric inhabitants of Cumbria and Strathclyde before these kingdoms were subjugated by the Saxon king, Edmund of Wessex, and by him ceded to the Gaelic king, Malcolm king of Scots, in 946; the warriors, whose deeds are celebrated in these poems, were "Gwyr y Gogledd," or men of the north; and the historical Arthur, who figures in five of them, is no southern king, but a Guledig, whose twelve battles are in the north. And, finally, in evidence of the former northern extension of the Cymry, it is as Bretts and Welsh that the inhabitants of Cumbria and Strathclyde are referred to by the contemporary Saxon chroniclers, and in the charters and proclamations of the Scottish kings, David I., Malcolm IV., and William the Lion. So late, indeed, as 1305, we find a recognition of the Cymry as a distinct element of the population of southern Scotland, in the enactment that "the usages of the Bretts shall be abolished and no more used." And it is to Welsh that we must still look for the etymology of the names of the great natural features of that district of southern Scotland which would appear to have been the scene of the battles of the historical Arthur. From Welsh the names Tweed, Teviot, Clyde, Nith, and Annan, and the numerous Esks, Edens, and Levens, &c., are all derived. From Welsh, also, we explain Cheviot, and the names of the border hills. And where the eminences of southern Scotland are not *hills*, *fells*, *laws*, or *knowes*, they are *pens*, as in Wales or Cornwall.

But if, as these various facts (and particularly the connection in which Arthur is mentioned in contemporary, or approximately contemporary, histories and historical poems) lead us to believe, Arthur was a leader of those northern Cymry afterwards absorbed in the population of southern Scotland and the English border, then, in this district, we ought certainly to find localities which can be more or less clearly identified with those mentioned in the earliest historical notices of Arthur, and localities also which, in their names or the traditions associated with them, commemorate his story. Now, it has been shown that such localities are not only found in the district thus defined, but are found there in such numbers as can nowhere else be paralleled. And a very important verification is thus obtained of what, from the scantiness of the earliest sources, might, if thus unsupported, be regarded as a mere hypothesis rather than a theory, with respect to the scene of the battles of the historical Arthur.

Scotland, however, is but the northern extremity of a long line of country in which Arthurian localities are found. What we may call the Arthur-land extends from the Forth and Clyde, or rather from the Grampians, in Scotland, to the Loire in France, and includes (besides the south of Scotland and the north of England) Wales, Somersetshire, Cornwall, and Brittany. It is certain that the scene of the battles of the historical Arthur of the 6th century could have been but a comparatively small area of this vast territory. There must, therefore, have been a migration of Arthurian traditions from the south to the north, or from the north to the south. And if, on quite independent grounds, we find it more probable that such migration of tradition was from the north to the south, rather than from the south to the north, it is evident that we shall have a still further verification of the hypothesis suggested by our examination of the earliest historical records. Now, considering these facts,—Cymric migrations from, but not to, the north; the northern descents of some of the southern dynasties; the upburst of Cymric literature (which belongs in the main to the mediæval period) contemporaneously with the last struggles for, and final loss of, national independence; and the satisfaction, too great to be regardful of historical truth, which a conquered people would have in locally commemorating former victories and heroes of their race,—we cannot but see conditions in the highest degree favourable to the importation from the north of the Arthurian traditions of Wales, the south-west of England, and the north-west of France. On the other hand, we not only find no conditions favourable to the importation of Arthurian traditions from the south into the north, but conditions that would have been positively inimical to the preservation of such traditions, and conditions, therefore, that would seem to make it impossible to explain the existence of Arthurian localities in the north, except on the hypothesis of the north having been the scene of actual Arthurian events. Such conditions are to be found in these facts:—the absorption of the northern Cymry by a kindred race with whom they had never, save temporarily, been at war, viz., the Scots, a brother of whose king they had themselves voluntarily elected to the throne in 918, previously to their being regularly incorporated with the Scottish nationality after the treaty of 946 between Malcolm II. and their Saxon foe, Edmund of Wessex, the preparation for this political incorporation in the 10th century by an ecclesiastical incorporation in the 8th century, through the subversion of the native Cymric Church by the opponent Irish or Columban Church of the Scots with its Gaelic language, whence followed the dying out of the Cymric language, and, finally, the possession by the Scots, with whom the northern Cymry were thus incorporated, of a traditional and poetic literature of their own, which must certainly have greatly opposed the introduction, after their incorporation of the Cymry, of Cymric poetry and tradition, and been highly unfavourable to its preservation, if it had any other than a native historical origin. But yet, further, it is to be noted that Arthurian localities are, speaking generally, found in Scotland only where, in the 6th century, there was a Cymric population, that that part of Scotland in which Arthurian localities are, speaking generally, *not* found, coincides with the ancient kingdoms of the Picts and Scots, and is dotted all over with localities belonging to the other great cycle of Celtic tradition, the Fenian, Fingalian, or Ossianic, and that, while Fingalian localities are not found at all in the Arthurian district, Arthurian localities are found in the Fingalian district, or in the ancient territory of the Picts, only in cases in which their being found in that territory is a strong indication of their having originated in such actual historical facts as they commemorate. (J. S. S.-G.)]

Additions to Historic Facts and Introduction of Mythological Elements.—From the Saxon invasions resulted two emigrations closely succeeding each other of Britons into French Brittany; and the impenetrable forests and mountains of Wales afforded a refuge where the more recent fugitives from Wessex or the north mingled with the earlier exiles from Kent, and hence the subsequent confusion of historic facts. Vortigern of Kent became in the legend the kinsman of Ambrosius of Wessex, the gaps in the history were filled up by mythic reminiscences, and to Arthur was assigned a celestial and miraculous parentage from Uthyr Pendragon, that is to say, Head of the Dragon. Under the form of a cloud this Celtic Jupiter became the father of Arthur, who in the same mythological order gave his name to two constellations, Arthur's chariot, i.e., the Great Bear, and Arthur's lyre. But the word for cloud in Welsh was *Gorlasar* Now, whilst the legend was carried from place to place acquiring new force, the Celtic world had made a stand against Roman and Teutonic ideas; there was, as in Greece, a tendency to explain the earlier myths, no longer understood, into the gross elements of adultery and incest bastardy was not censured, &c. Thus the Uthyr Pendragon of the Romances of the Round Table is a real Jupiter The cloud becomes a man, *Gorloes;* and there is an Alcmene, Ygerne. In short, when Molière has, with more genius than morality, diverted so many generations by his *Amphitryon*, he is striking an old Celtic and Welsh chord. Then Arthur is another Hercules. An advantage, from a national point of view, gained to the legend by Arthur's celestial and pagan origin, is that he becomes by it at once above and akin to all the Celtic chiefs. All the chiefs become his brethren; their sons, who flock to fight under his banner, his *beaux neveux*,—though one, indeed, among them is the traitor Medrod of the Welsh legends, Mordred of the romances. So in dream was founded besides the Round Table which never existed, the Celtic family, which had existed only to destroy itself.

Gradual Formation of the existing character of Arthur in the French Romances.—We have noticed the *bonhomie* which was the chief characteristic of the early Cambrian Arthur. The Arthur born of the recollections and resentments of exile has a more terrible shape. In Brittany, the land of exile, was elaborated this type of a national avenger,—a more moral David (Arthur slays his giant), a Solomon without his scepticism (Arthur was a great author of proverbs). In exile this figure of a Celtic Messiah was graven with some of its most indelible traits. Arthur's own device is very far removed from the gospel; he out-Herods Herod, and, franker than the Jesuitical cruelty of the twelve tables or of Shylock, he goes beyond the *lex talionis;* "a heart for an eye, a head for an arm," he says. Alain de Lille relates, in his commentaries and explanations on the prophecies of Merlin, that in his day any one who, drinking with the Bretons, would tell them that Arthur was dead and never to return, was in danger of being stoned. "Like the dawn, he will arise from his mysterious retreat."

To return to the Arthur of the Round Table, nothing in the romances is touched with more generous sentiment than his invariable affection for Ken (Kay of the Welsh legends), his cunning but clownish, friendly yet treacherous seneschal. For the infant Arthur had been confided by Merlin to Antor, and believed himself his son, while Ken, the real son of Antor gives place to Arthur, is neglected, and all his evil qualities are derived from the wicked nurse to whom he had been given away from his mother; so Arthur was bound to be patient and kind to Ken in after life, and forgive him many times for being "fol et vilain et fel."

We shall not describe the trials to which Arthur submits, those of the sword and of the anvil, for instance, nor the essay in royalty he makes without taking the title of king, though the idea of being made a king, not only by election, but even after examination, is remarkable. Nor shall we relate how, in disguise, aided by his friends Ban and Bohor, he rescues Leogadan from the "Saisnes" (Saxons) and Danes; in disguise, as Merlin explains to Leogadan, who had thrown himself at the feet of his deliverer to entreat to know his name—because thus, without naming himself, should a hero, who is the son of a king, seek out and win his wife. So Arthur woos and weds Guenever, Leogadan's daughter, the Gwenhwyvar of the Welsh tales. The Welsh would have their Arthur cross the Channel to succour their kindred allies in Brittany; the Bretons, in the same way, sent their Arthur into Great Britain, hence confusions which explain each other. One reproach, which has been made at all times, by Mr P. Paris, as by William of Newburgh, to the revengeful instinct which was the soul of the Arthurian legend, is its monstrous vanity, which has depicted Arthur as an opponent and conqueror of the Romans. William of Newburgh has said, "the Britons were little to be feared as warriors, little to be trusted as citizens;" and this passage curiously resembles one in the legend where a Roman knight, before the battle of Langres, is made to exclaim, "Behold, truly the Britons—slow in action, ready in menace!" Whence has arisen this battle of Langres, where Arthur, allied with Claudas, king of the "Terre Déserte," conquers the Romans and destroys their empire. Strange to say, the fictitious battle of Langres has an authentic foundation in history, being but an echo in tradition of the obstinate and successful resistance to the Romans carried on by the Celts of the vast district called the *Tractus Armoricanus,*—a resistance out-lasting, indeed, the Roman power, till Clovis turned it to account and destroyed it; and of Clovis, the treacherous ally of the Armorican Celts, the portrait is easily recognised in the Claudas of the romance.

Rome has been cursed in history more often than she is named in Camille's imprecation in Corneille's play, and we need not wonder at the legend, wherein Arthur calls together a confederation of Greeks, Africans, Spaniards, Parthians, Medes, Libyans, Egyptians, Babylonians, Phrygians, &c., in fact, all nations, against Rome. The legendary hero falls at last, in all his glory and in the midst of his reign of justice, on the field of Camlan. But he is not deserted by that fairy world with whom Shakespeare's soul delighted to dwell; magically transported into the Isle of Avalon, his body is cured of its wounds, and his soul sleeps, while rests his enchanted sword Excalibur, till that day comes when he shall rise again from his mysterious retreat. But that day must dawn for all nations at once, as in the veins of all peoples of Europe is hidden some Celtic blood. On the other hand, progress is barred and darkness dwells where the Celtic race remains unmixed. So it is the destiny of some peoples, while buried for ever as a temporal power, because of their irreparable faults, to live on gloriously for the good of all, but only as an idea, an instruction, a legend. (J. A.)

Authorities: Turner's *History of Anglo-Saxons;* Leland's *Assertio Arthuri; The British History, translated into English from the Latin of Jeffrey of Monmouth,* by Aaron Thompson (London, 1718); *Myvyrian Archaiology of Wales;* Paulin Paris's edition of the *Romans de la Table Ronde: Saint Graal, Merlin, Lancelot;* Hersart de la Villemarqué's *Myrdhinn ou l'Enchanteur Merlin* (Paris, 1862, 8vo); *Les Romans de la Table Ronde,* Paris, 1860, 12mo; *La Mort d'Arthure,* edited by Sir Th. Malory in 1634; Southey's edition (1817, 4to); Thomas Wright's edition (1856, 8vo); Gildas, *Historia;* Nennius, *Historia Britonum;* Skene, *Four Ancient Books of Wales* (1868), *Book of the Dean of Lismore,* and *Chronicles of the Picts and Scots;* and Stuart-Glennie, *Journey through Arthurian Scotland* (1867), and *Arthurian Localities* (1869).

ARTICHOKE. The common artichoke, *Cynara Scolymus,* is a plant belonging to the Natural Order *Compositæ,* having some resemblance to a large thistle. It has long been esteemed as a culinary vegetable; the parts chiefly employed being the immature receptacle or floret disk, with the lower part of the surrounding leaf-scales, which are known as "artichoke bottoms." In Italy the receptacles, dried, are largely used in soups; those of the cultivated plant as *Carciofo domestico,* and of the wild variety as *Carciofo spinoso.* The Jerusalem artichoke, *Helianthus tuberosus,* is a distinct plant belonging to the same order, cultivated for its root-tubers, which somewhat resemble potatoes, for which they have been proposed as a substitute. It closely resembles the sunflower, and its popular name is a corruption of the Italian *Girasole Articocco,* the sunflower artichoke.

ARTICLES, The Thirty-Nine, of the Church of England, contain the public standard of religious belief adopted by that body. They were drawn up by Archbishop Parker, sanctioned by Convocation in 1562, and published by royal authority in the following year. The general principles of this body of doctrine, and the form into which it was thrown, had been gradually developed during the previous attempts to establish a standard of faith in England. Soon after the authority of the Pope had been thrown off by the English Church, there began to appear wide differences of opinion with regard to the extent of reformation required. One party, the conservative, held by the old practices of the Church of Rome; another, the moderate reformers, desired to abolish these practices on account of the abuses to which they were liable; while the various sects of the Anabaptists were eager for radical reformation both of doctrine and of practice. Religious turbulence and strife prevailed to such an extent that, in 1536, a set of Ten Articles was published by royal authority, intended, as was expressly stated, to "stablyshe Christen quietnes and unitie among us, and to avoid contentious opinions." A considerable share in the composition of this code was taken by Henry himself. The articles were evidently intended as a compromise; they contained much that was afterwards rejected by the church, and do not seem to have given general satisfaction. They were partially, though not authoritatively, superseded by the publication, in 1537, of the *Institution of a Christian Man.* For two or three years before this negotiations had been carried on with the Continental reformers, and proposals had been made for a general conference at which some universal articles of faith might be considered. The conference took place but did not attain the end desired, for Henry, at first favourably disposed, was swayed by the influence of the anti-reformation party; and Cranmer, while able to come to agreement with the German deputation so far as points of doctrine were concerned, saw clearly that it would be a hopeless task to try to abolish all the ancient ceremonies. The increasing influence of the conservative party led to the passing, by Convocation and Parliament, in 1539, of Henry's SIX ARTICLES, the "bloody statute," or "whip with six strings," as they were then called, from the cruel persecutions to which they gave rise. These articles enforced belief in transubstantiation, declared that communion in both kinds was unnecessary, that the marriage of priests was unlawful, that vows of chastity or widowhood were absolutely binding, that private masses and auricular confession were expedient and necessary. The severity of these doctrines was mitigated by the third authorised formulary of Henry's reign, *The Necessary Doctrine and Erudition for any Christian Man*, called the "King's Book," and published in 1543. The conference with the Germans, though not entirely successful, had not been without fruit. Among Cranmer's papers has been found a set of Thirteen Articles bearing evident traces of the Continental ideas, and highly interesting on account of the influence it exercised on the later formularies. Many of these articles are drawn directly from the Augsburg Confession, and there seems no doubt that they thus formed an intermediate step between that Confession and the FORTY-TWO ARTICLES of Edward. These were drawn up by Cranmer in obedience to the command of the king and privy council, who, in 1551, ordered the archbishop to "frame a book of articles of religion, for the preserving and maintaining peace and unity of doctrine in this church, that, being finished, they might be set forth by public authority." Great care was taken in their preparation; the first draft was sent round to the bishops, then revised by Cranmer, submitted to Cheke and Cecil, and to the six royal chaplains, and finally laid before the council. In 1553 the mandate enjoining subscription to them was granted by the king, but the articles had already been printed in English. In the same year they were published in Latin, and appended to a short catechism of Christian doctrine. It has been much disputed whether these articles were sanctioned by Convocation, or were only circulated by order of council; on the whole, the balance of probability seems to be in favour of the supposition that they had received ecclesiastical sanction (Hardwick, *History of the Articles*, 106–112).

During the reign of Mary these articles were suppressed, but, on the accession of Elizabeth and the elevation of Parker to the see of Canterbury, attention was again directed to the framing of some standard body of truth. A series of Eleven Articles was drawn up in 1559, and was in use for some time; it had not, however, full authority, though it was enforced in Ireland until 1615. In 1562 the houses of Convocation were summoned, and Parker laid before them a revised copy of the Forty-Two Articles. In the work of revision he had been assisted by Bishops Grindal, Horn, and Fox. The changes introduced by them were, for the most part, Lutheran in tendency, and were probably influenced by the Würtemberg Confession of 1551. Articles v., xii., xxix., and xxx. of the present set were newly introduced; x., xvi., xix. (part being transferred to the present vii.), and xli. of the old series were omitted. Seventeen other articles were modified by partial omission, alteration, or substitution. Convocation further struck out Articles xxxix., xl., and xlii.; made considerable alterations in iii. and xxviii., and some slight changes in viii., xv., xxii., xxix., and xxxiii. A Latin manuscript of Parker's, containing a list of signatures, might be supposed to give the final state of the document, but it differs from the extract taken in 1637 by Laud's order from the registers, both in regard to the signatures, and in the omission of the first clause of Article xx. The articles, now thirty-nine in number, were submitted to the queen, who is said to have read and examined them. After nearly a year's delay they were published in Latin. In this edition the disputed clause of Article xx. is found, and Article xxix. is wholly omitted. In the English version, printed in the same year, the clause of Article xx. is wanting. In all editions after 1571, Article xxix. is inserted, and, with one exception, the same is true of the clause in Article xx. A law (13 Eliz. c. 12) was passed in 1571, ordaining that the clergy "should subscribe to all the articles which only concern the confession of a true Christian faith, and the doctrine of the sacraments." Convocation of the same year inserted Article xxix., made a few slight changes, added a list of the Apocryphal books, and thus gave the articles their present form. The only serious attempt at alteration was made in 1595, when the Primate, Whitgift, accepted a series of articles proposed by Dr Whitaker of Cambridge. These, generally known as the *Lambeth Articles*, were strongly Calvinistic in tone. They did not receive sanction, and were immediately suppressed. At a later date (1604) it was again sought to introduce them, but the attempt was unsuccessful. The canons of 1604 enforced subscription, while the general relation of the articles to the church was defined by the royal declaration of 1628 (now prefixed to them), which enjoins the settlement of disputed points by Convocation, the acceptation of the articles in their plain and full bearing, and the interpretation of them in their literal and grammatical sense.

The articles are not intended to be a complete system of theology, but only enumerate certain truths of such primary importance that any one denying them is thereby excluded from the church. They do not, however, furnish merely a negative test; they were framed not only for the avoidance of diversity of opinion, but for the establishment of consent regarding true religion. Accordingly, they treat in order of the main points of theological doctrine, and may be classified thus:—(1.) Articles i.–v., the doctrine of the Trinity; (2.) Articles vi.–viii., the rule of faith or sources of our knowledge of religious matters; (3.) Articles ix.–xviii., the doctrines which concern the Christian as an individual, *i.e.*, sin, redemption, and their cognate notions; (4.) Articles xix.–xxxix., the necessary relations of Christians as members of a religious community, including the general theory of the church, and the doctrine of the sacraments. The Church of Ireland continued to use the Eleven Articles until 1615, when a more elaborate code was drawn up by Ussher. This, in 1635, was superseded by the Thirty-Nine Articles, which were then adopted by the Irish Church. The Episcopal Church in Scotland accepted the articles in 1804, and in America the church subscribed to them in 1801, excluding, however, the Athanasian Creed.

See Abp. Laurence, *Bampton Lectures*, 1804, new ed. 1853; Lamb, *Historical Account of the Thirty-Nine Articles*, 1835; Hardwick, *History of the Articles of Religion*, 1859.

ARTICULATA, the name given by Cuvier to his third great division of the animal kingdom. *Arthropoda* is the designation now generally adopted, which includes the *Crustacea, Arachnida, Myriapoda*, and *Insecta*, but excludes the *Annelida*, which Cuvier classed with these among the *Articulata*. See ARTHROPODA.

ARTILLERY

THE modern term *Artillery* is used in two senses,—firstly, to designate the *matériel* of artillery, *i.e.*, the guns, &c.; secondly, the *personnel* and organisation by which the power of this arm is wielded. The word itself is derived by some from "arcus," a bow; by others from "ars telaria," signifying bows, arrows, and all implements of projectile warfare. The earliest forms of artillery were the "engines invented by cunning men to shoot arrows and great stones," of which we read in the Old Testament; these developed, with the progress of military art, into the more elaborate machines used by the Romans under the names of *catapulta*, *balista*, battering-ram, &c.; and under various forms and names this "mechanical artillery" continued in use, until the discovery of a propelling agent so powerful as to supersede all others and revolutionise both the implements and the art of war.

The history of artillery proper may be said to date from the discovery of gunpowder. This is popularly attributed to the two monks, Roger Bacon and Bartholdus Schiraz, about the end of the 13th century (see GUNPOWDER); but there is ample evidence that substances of somewhat similar composition and powers had been known and used for purposes of war in the East at far earlier times. The Chinese seem to have been the first discoverers of explosive compounds as engines of war, and to have used them for several centuries before the Christian era; and their "thunder of the earth," produced by filling a huge bombshell with some such compound, and exploding it at the proper moment, is spoken of as early as the 3d or 4th centuries of our era. According to Father Amyot, stone mortars, projecting stone balls, were used by them in the 8th century; and although they were first instructed in the scientific casting of cannon by missionaries in the 17th century, there is evidence of large cannon and wall pieces of rough construction having been in use as early as the 12th century. The inhabitants of India seem to have possessed fire-arms of some sort as early as the time of Alexander; but the information is too meagre to admit of more than the merest speculation as to their nature. The celebrated Greek fire, of which we have ample accounts, was usually in a liquid form, and vomited through long copper tubes, with which the bows of vessels of war were provided, or projected in fire-balls, or by means of arrows and javelins around which flax was twisted. It was used by the Romans of the Eastern empire with much effect, especially at the defences of Constantinople (668–675 and 716–718 A.D.), and the secret of its manufacture was preserved with a superstitious care for nearly 400 years; but it afterwards passed into the hands of the Mahometans, and was much used by them in their wars with the Christians. The Moors first introduced fire-arms in western Europe; according to Condé, they used artillery against Saragossa in 1118 A.D., and a little later they defended Niebla by means of machines which threw darts and stones through the agency of fire.

The application of gunpowder to projectile warfare, and the use of cannon, became general in Europe during the 14th century. Mention is made, however, of isolated instances of their employment at earlier periods, especially among the Moors. Artillery is also said to have been used by Henry III. of England during the rebellion of the Duke of Gloucester in 1267, and by the Spaniards against Cordova in 1280 and against Gibraltar in 1306. But it is held by those well qualified to judge, that the first unquestionable testimony of the employment of cannon is in 1338 under Edward III. of England. The substitution of the new engine for the old mechanical artillery was gradual, and was not effected without opposition; and in the 13th and early part of the 14th centuries, we still find various machines, such as the trebuchet, onazer, scorpion, and espringal, whose action was dependent on the elasticity of twisted cords, used to hurl stones, Greek fire, &c.

The earliest trace of an artillery organisation, such as now plays so important a part in all great armies, is found in the middle of the 14th century. In 1344 Edward III. formed an artillery train and an ordnance establishment, numbering 340 men; but of these only twelve were termed artillerymen and gunners, the remainder consisting of waggoners, engineers, and artificers of various kinds. The ordnance establishment at the siege of Harfleur, in 1415, included twenty-five master gunners and fifty "servitour gunners." The gunner of those days seems to have been the captain of the gun, and to have had general charge of the guns and stores, with the especial duty of laying and firing the piece in action. The manufacturing establishments, now maintained on so gigantic a scale, do not seem to have sprung up till considerably later. Piobert states that gun-foundries were established in France in 1377; but we have no trace of them in Germany till 1440, and record of them is wanting in England until 1521.

The guns of the 14th century were of the rudest make, cumbrous and inefficient, and though an advance on the earlier machines, and useful in sieges, still played but little part in battles. Whether Edward III. used them at Creci or not (a point which has been much debated), it may safely be affirmed that they had but little to do with the result of that day. Progress, however, began to show itself in the 15th century; the "bombards" were replaced by brass guns, and the cumbrous beds, upon which the earlier ordnance were transported, gave way to rude artillery carriages on wheels; and iron was substituted for stone in the manufacture of projectiles. The first step towards a better organisation and some tactical system appears to have been made towards the end of the 15th century by Charles VIII. of France, who used a numerous artillery in his Italian campaigns; and Louis XII. largely owed his successes in Italy to this arm. Francis I. still further increased its mobility, adopting a lighter construction for field-guns, and having them drawn by the best description of horses; and in the defeat of the Swiss in 1515, "the French artillery played a new and distinguished part, not only by protecting the centre of the army from the charges of the Swiss phalanxes, and causing them excessive loss, but also by rapidly taking up such positions from time to time during the battle as enabled the guns to play upon the flanks of the attacking columns."[1] In England also considerable attention was bestowed on ordnance matters during this period, though the progress was not so great. In 1456 it is stated that a commission was issued to John Judd, as *master-general of the ordnance;* and in 1483 (Richard III.), Rauf Bigod was appointed master of the ordnance, an office which continued down to 1852. These early masters of the ordnance personally commanded the artillery in expeditions and wars, besides being responsible for the general administration of the *personnel* and *matériel* of such artillery as then existed. Henry VII. and Henry VIII. did much to advance the progress of artillery. Tartaglia[2] gives tables of the different cannon in use about this time. The heavy pieces, *i.e., culverins*, &c., were drawn by oxen, and corresponded to those now in use for

[1] *Observations on Fire-Arms*, Chesney, 1852.

[2] *Three Books of Colloquies concerning the Art of Shooting.*

siege or position purposes, while the field guns appear to have been the 2, 4, 6½, and 8 pounders,—*falcons, falconets*, and *sakers*. No permanent artillery trains existed at this time; the *personnel* was obtained by withdrawing gunners from garrisons, and supplementing them with men hired for the occasion, and the cattle required for transport were also hired. The artillery train on service included the ammunition waggons, pontoons, and a large proportion of artificers, besides the men actually required to serve the gun, corresponding nearly to the artillery park of the present day, and had its position assigned in camp and on the march. "On the march the train was preceded by an advanced guard of light cavalry to protect it. The first portion of this troop carried hatchets and saws; the second, instruments and implements for the construction of machines; the third, sledge-hammers, iron wedges, and pickaxes; finally, the last were provided with pioneers' implements. After these came carriages loaded with guns, capstans, levers, and other like machines; these were followed by the light pieces, by the heavy siege guns, by ammunition waggons, by pontoons and the necessary men for them, by the artillery artificers, and, lastly, by the baggage."[1]

16th century. The 16th century was not marked by any great advance in artillery science, though the number of guns which accompanied an army had increased considerably—as many as 1600 gunners, cannoneers, armourers, and clerks of the ordnance, being attached to Lord Mountjoy's army in Ireland in 1599. The artillery tactics were simple; the guns usually deployed in advance of the troops and fired a few rounds, but from their want of mobility could neither accompany an advance nor protect a retreat, and were generally captured on the first advance of the enemy. Greater progress, however, was made in the attack and defence of fortresses by artillery. Vertical fire was used to a considerable extent, and seems to have been conducted by artificers while the "cannoneers" served the guns. In

17th century. England but little advance was made even in the 17th century, and the commencement of the Great Rebellion found the artillery of England in a very feeble and backward state. Two books by artillerymen of those days[2] give us much information on its condition, and a very complete account of the "Field Artillery of the Great Rebellion" is furnished by Captain H. W. L. Hime, R.A.[3] The guns chiefly used were the light pieces known as "minion," "saker," and "demi-culverin," *i.e.*, 3-pounder, 5-pounder, and 9-pounder respectively. The heavier pieces being used in sieges and garrisons, and ranging from the "whole culverin," or 15-pounder, to the "Canon Royall," or 63-pounder. The carriages were cumbrous. "They were formed of two large cheeks or brackets, whose general outline was much the same as the brackets of our own bracket-trails, connected together by four transoms." The transport of the ammunition was in carts or wheelbarrows, or on men's backs. The gunners walked beside the gun, and, as in later times, their pace was a measure of the mobility of the field artillery. Cartridges, when used, were made of paper or canvas, but an iron ladle was preferred. The following words of command show the gun-drill of those days:—

1. Put back your piece.
2. Order your piece to load.
3. Search your piece.
4. Sponge your piece.
5. Fill your ladle.
6. Put in your powder.
7. Empty your ladle.
8. Put up your powder.
9. Thrust home your wad.
10. Regard your shot.
11. Put home your shot gently.
12. Thrust home your last wad with three strokes.
13. Gauge your piece.

As to the draught, twenty-three horses were required for a cannon on good ground, fifteen or seventeen for the demi-cannon, and nine for a culverin. The proportion of guns to men was 1 per 1000. The artillery general was a greater man in those days than in more modern times, as we find that "the generall of the artillery hath alwayes a part of the charge, and when the chief generall is absent, he is to command all the army." The "gentlemen of the artillery" seem to answer to our present majors, and the duties of the "gunners" were much the same as those now performed by lieutenants. In the Scotch invasion of 1640, leather guns were used with effect against the English in the passage of the Scots over the river Tyne. When Charles I. took the field in 1642, the earl of Peterborough, as parliamentary general of artillery, had a large train under his orders, but such was its want of mobility, that he was obliged to leave his guns behind him for a time. It came up, however, at last, and was used at the battle of Edgehill, 23d October 1642. In 1643, at Braddoch Doun, an instance occurred of the use of field artillery first masked by cavalry; and at Roundway Lord Wilmot handled his guns so well that he prepared the way for his cavalry, and finally was able to seize the enemy's guns and turn them against him. At other affairs, however, the artillery seems to have been comparatively useless, and the presence of twenty-five guns on the Royalist side at Marston Moor was neutralised by Cromwell's flank attack; and in no battles of this war did the artillery assume the importance it had already attained on the Continent.

The first half of this century forms an era in the history of this arm in Europe. Henry IV. of France was among the first to recognise its coming importance, and occupied himself diligently with improving it. His minister, Sully, was named master-general, and during the last ten years of his reign (1600–1610), he may be said to have created an artillery. More than 400 guns were turned out, including a number of field-pieces. Maurice of Nassau also helped to develop the use of this arm. But it was under the great Swedish warrior Gustavus Adolphus that artillery first began to take its true position on the battle-field. Gustavus Adolphus. Recognising the necessity for the mobility of field artillery, he introduced "*Kalter*" guns, "consisting of a thin cylinder of beaten copper screwed into a brass breech, whose chamber was strengthened by four bands of iron, the tube itself being covered with layers of mastic, over which cords were rolled firmly round its whole length and equalised by a layer of plaster, a coating of leather, boiled and varnished, completing the piece."[4] This primitive field artillery was drawn and served by two men, and was first used in his Polish war. The guns could naturally bear but a small charge; the great point gained was *mobility*, all guns heavier than 12-pounders being separated from field artillery. In his German campaigns he used iron 4-pounder guns, weighing about 5¼ cwt., and drawn by two horses. Rapidity of fire was obtained by the use of cartridges instead of the old method of ladling the powder. Gustavus attached two of these guns to each regiment, and placed them under the orders of the colonel. Gustavus Adolphus may therefore be said to be the father of the battalion system of guns,—a system which had its advantages in those days of imperfect organisation, but, like many other things, was carried down to a late date when the necessity for the system had entirely disappeared. But he also appreciated the value of concentration of fire, and frequently massed his guns in strong batteries at the centre and flanks. He appears to have been fully alive to the necessity of having both a heavy and light artillery, and it was his practice to retire his heavy guns, protecting a

[1] Owen's *Modern Artillery*.

[2] *The Gunner*, by Robert Norton, one of His Majesty's gunners and engineers, 1628; *The Gunner's Glasse*, by William Eldred, master-gunner of Dover Castle, 1646.

[3] *Proceedings of the Royal Artillery Institution*, vol. vi.

[4] Cheney's *Observations on Fire-Arms*, 1852.

retreat by the field artillery. It was in the celebrated Thirty Years' War that his artillery showed the advantages which it could win when handled properly. The artillery of the Imperialists was as cumbrous as that of their Swedish adversaries was mobile. Tilly's guns were chiefly 24-pounders, each requiring twenty transport horses and twelve horses for the waggons, while the service of the guns was primitive and defective, and they could hardly even be moved during the course of an action. The first battle of Leipsic was fought the 7th September 1631, between the allied Swedes and Saxons under Gustavus Adolphus and the Imperialists under Tilly. The Imperialist artillery was badly disposed on a range of hills in rear of their position, so that any forward movement would effectually mask the fire of the guns. Gustavus, on the other hand, advanced his guns more, and covered his front with 100 guns, which he was able to use with considerable effect. The next action in which the use of the artillery is remarkable was the passage of the Lech, a tributary of the Danube. Tilly had taken up a position on the right bank of the river between Augsburg and Rain, and awaited attack. On the night of the 3d April 1632 the Swedish army threw up earth-works, upon which were mounted seventy-two pieces of artillery. Gustavus, taking advantage of the re-entering bend of the river, brought such a converging fire upon the Imperialists that he forced them to retire and gained the passage of the stream. At the battle of Lützen, 6th November 1632, Wallenstein had taken advantage of certain eminences and rising ground in his position to post his guns in batteries of from four to fourteen pieces, while Gustavus placed powerful batteries on the wings and centre of his line. The battle closed the glorious career of this great warrior, who was struck down in the hour of victory. During his life he had done much to forward the science of artillery. He had increased its mobility and rapidity of fire, and raised the proportion of guns to over six per 1000 men; and though he may be said to have been the originator of the battalion system, with its attendant evils of dispersion of guns, he checked this evil by keeping in hand a considerable reserve.

Further progress was made in construction and organisation during the latter part of the century. In England the laboratory at Woolwich was established in 1672, and a great reorganisation of the artillery took place in 1682 under the master-general, Lord Dartmouth. About that time we read, that at the Hounslow camp "brass 3-pounders, under gentlemen of the ordnance, were escorted to their places by the grenadiers of the various regiments," an example of the tactical system of "battalion guns" already spoken of. The train of artillery with which James II. prepared to meet the invasion of 1688 was a considerable one; details of it will be found at page 53 of Duncan's *History of the Royal Artillery*. William III. (1689) introduced foreign artillery, and undertook the reorganisation of the *personnel*. He formed the first regimental establishment. Howitzers, mortars, and hand-grenades were introduced during this period, being used principally by the Dutch and English. In France the improvements under Louis XIV. seem to have been made chiefly in siege artillery. Heavy guns of position were much used, and there appears to have been a disposition to regard batteries of this kind, covered by epaulements, as in field fortifications, as the natural rôle of artillery. Louis XIV., however, was the first to give a permanent foundation to the new arm. In 1671 he raised a regiment of royal fusiliers as artillerymen, composed of gunners and workmen. Schools of instruction were established, and the arm recognised as a special branch. Improvements were also effected in the *matériel*. The calibres were reduced in number and made uniform, and those then adopted have remained unaltered up to the present day, some having been rifled. Carriages were improved. "Siege and field carriages had heavy bracket-trails, but were provided with limbers having a straight pintail on the top, like an old service siege limber."[1] Platform waggons were used to transport guns; *wrought-iron* field carriages and mortar carriages were used; and the carriage for coast batteries was little dissimilar to the standing gun-carriage of the present day.

The 18th century was fruitful in artillery progress. In England it saw the Royal Regiment of Artillery permanently established, and rapid strides made on the Continent in every branch of the arm. The Duke of Marlborough was appointed master-general of the ordnance on the accession of Queen Anne, in 1702, and in the same year war was declared with Germany and the States-General. We have but scanty record of the handling of his artillery by this great general; but at Blenheim it is said a strong battery, posted on the allied right wing, greatly assisted by its enfilade fire; and at Malplaquet, Marlborough deployed forty guns in the centre of his position. The artillery trains were considerably increased. In 1706 forty-six guns and sixty mortars formed the artillery of a force of 11,000 men, the mortars being used mounted upon travelling carriages. The history of the "Royal Regiment of Artillery" commences from the 26th May 1716, when the artillery which had so long existed was formed into two permanent companies of Royal Artillery. In 1727 the organisation was expanded into four complete companies, commanded by a colonel, lieut.-colonel, and a major, and in 1740 two more companies were added. A company consisted of 5 officers, 4 fire-workers, 18 non-commissioned officers and bombardiers, 30 gunners and cadet gunners, 48 matrosses and cadet matrosses, and 2 drummers. Albert Borgard was the first colonel. By birth a Dane, he served first in the Danish army and afterwards in the Prussian service, and subsequently entered that of England. He was adjutant of the short-lived regiment formed by William III., and died in 1751 at the age of 92. In 1741 the Royal Military Academy was instituted at Woolwich for the instruction of cadets, and of officers and men of the artillery. The cadets were accommodated in buildings at the Warren, and it was not till 1806 that the new academy was opened at the foot of Shooter's Hill. In 1748 a company of Royal Artillery went to the East Indies and took part in the siege of Pondicherry, subsequently forming the nucleus of the Indian artilleries. In 1755 four additional companies were raised for service in the East Indies, and in 1757 the regiment had increased to twenty-four companies. A Royal Irish Artillery corps was also formed, which gradually increased from a small nucleus to a strength of twenty companies, and was amalgamated with the Royal Artillery in 1801. About this period (the middle of 18th century) the guns in use consisted of 24-pounders, 12-pounders, 6-pounders, and 3-pounders. The guns were divided into brigades, corresponding to the present batteries, of four, five, and six guns respectively, and began to be separated into "heavy" and "light" brigades. Each field gun was drawn by four horses, the two leaders being ridden by artillerymen, and had 100 rounds of shot and 30 rounds of grape. Three companies of the Royal Artillery took part in the battle of Minden in 1759, and were handled with great success; and even in those days the English artillery won praise from foreign critics. Decker says,[2] "The English artillery was distinguished by its lightness, its elegance, and the good quality of its materials. In the battle of Marburg (1760), although the English artillery

18th century. England.

[1] Owen's *Modern Artillery*.

[2] *Battles and Principal Combats of the Seven Years' War.*

was not horsed, it followed Lord Granby's cavalry at a trot, and was always ready to engage." "The English artillery," says Tempelhof, "could not have been better served; it followed the enemy with such vivacity, and maintained its fire so well, that it was impossible for the latter to re-form." In the great blockade and siege of Gibraltar (1779–83), the gallantry and devotion of the garrison artillery were conspicuous.

Before passing on to the era formed by the great war against Napoleon, it is necessary to trace the progress made by this arm on the Continent.

Prussia. The Prussian artillery was very backward at the beginning of this century. In 1688 the Brandenburg (Prussian) artillery numbered only 300 men; and at the death of Frederick-William I., in 1740, there was only one battalion of field artillery of six companies, and one of garrison artillery of four companies. Nor did Frederick the Great at first place much value upon its services. But experience soon convinced him of the necessity for creating an efficient and mobile field artillery. His first efforts in this direction were not successful; and though the Prussian artillery contributed much to Frederick's victory at Rossbach, it was usually no match for the excellent and well-handled Austrian artillery. But the gradual destruction of his veteran infantry obliged him to devote more attention to this arm, he considerably raised the proportion of guns, and in 1759 he formed the first horse artillery, consisting of a battery of ten light 6-pounders (afterwards changed to six 6-pounders) and two 7-pounder howitzers. Frederick placed great value on howitzers, and made much use of them against entrenched positions, and at the close of the war, after experiments on a large scale, ordered forty heavy howitzers to be attached to each army corps. Frederick seems to have made the mistake during the Seven Years' War of trying to bring heavy artillery into the field, instead of trying to lighten his artillery generally. But he gave a great impetus to the progress of artillery. He raised the proportion of guns from $2\frac{1}{2}$ and 3 per 1000 men in the Silesian wars to 5 or 6 per 1000 at the end of the Seven Years' War. He created a horse artillery which in rapidity of movement could rival cavalry; and commenced the formation of a real field artillery by the adoption of a number of light pieces and howitzers, while the heavier guns were relegated to parks for siege and position purposes. And his wars brought forward three important tactical principles in the employment of artillery,—the establishment of smaller batteries at important points in the line of battle in lieu of the old formations at the centre and flanks, opening the battle and protecting the deployment of columns by light guns, and changing the position of batteries according to the course of the action.

Russia and Austria, though they produced no great military leader like Frederick, were ahead of Prussia in the
Russia. development of this particular arm. In Russia its importance had always been recognised, and large numbers of guns employed, while each dragoon regiment had three "licornes" or howitzers attached, with mounted gunners, forming a
Austria. species of horse artillery. In Austria, though the tactical employment of the artillery was often defective, its general excellence was pre-eminent, and it was ably organised under Prince Lichtenstein, the chief of artillery. But it
France. was in France that the experience of Frederick's wars was best utilised, and the great strides to a more perfect system were made. At the commencement of the century French artillery had made but little progress. The carriages and waggons were driven by waggoners on foot, and on the field of battle the guns were dragged about by ropes or remained stationary. Hollow projectiles had made their appearance, and lead tarred balls arranged round an axis and kept together by a net, and termed *grape*, were employed. But the ammunition generally was of a rough and primitive description. Towards the middle of the century some improvements were made. Field guns and carriages were lightened, and the guns separated into brigades. Siege cartridges were introduced, the ladle being abolished, and shot with wooden bottoms or *sabots* invented. But it was under General Gribeauval, in 1765, that the great reforms in the French artillery were commenced. This officer had been sent to Austria during the Seven Years' War, and had held an artillery command under Prince Lichtenstein. Struck with the improvements effected in Austria, he strove, on his return, to build up a complete system both of *personnel* and *matériel*, creating a distinct *matériel* for field, siege, garrison, and coast artillery. Alive to the vital importance of mobility for field artillery, he dismissed from the park all pieces of greater calibre than 12-pounders; and reduced the length (necessary for the service of guns in embrasures and behind parapets) and weight of those retained. He also reduced the charge and the windage. His reforms were resisted, and for a time successfully; but in 1776 he became first inspector-general of artillery, and was able to carry through the improvements which will ever cause his name to be celebrated. For many years artillery had been separated into regimental or battalion guns, artillery of position, garrison, and siege artillery, the position guns being distributed in large batteries on the flanks or in front of a position, and the siege artillery collected in a park or train. The field artillery of the new system included 4-pounder regimental guns, and for the park 8 and 12 pounders, with 6-inch howitzers. The ammunition was improved by the introduction of "case" or canisters of sheet-iron holding cast-iron balls, the old grape and case being abolished.

The carriages were constructed on a uniform model, strengthened with iron, the limber-wheels heightened, and the draught diminished. Iron axletrees were introduced, straight pintails on the top of the limbers, and poles took the place of shafts. Boxes on the carriage held part of the ammunition. Travelling trunnion poles were introduced. The horses were harnessed in pairs, instead of in file as formerly, and the *prolong* of rope was introduced to unite the trail of the gun and the limber in slow retiring movements. A new ammunition waggon, carrying fixed ammunition, was also invented. The service of the guns was improved by the introduction of cross-headed elevating screws and tangent scales,—the later experiments exploding the old false ideas with regard to the absolute flatness of the path of a projectile. The manner in which the teams were driven remained much the same; but the bricole was introduced, a collar with rope and hook, to which the gunners and foot soldiers harnessed themselves. For siege and garrison service Gribeauval adopted the 16-pounder and 12-pounder guns, 8-inch howitzer, and 10-inch mortar; the 12, 10, and 8-inch gomer mortars being introduced in 1785. Siege only differed from field carriages in having shafts in lieu of poles. Gribeauval introduced for garrison service a carriage with wheels in front and a truck in rear, while for coast service traversing platforms were adopted, having a bolt in front and a truck in rear running upon a circular racer. The great step made was in a uniform construction being adopted for all *matériel*, and the parts susceptible made interchangeable.

In 1765 the *personnel* of the French artillery was reorganised. The field artillery with an army was divided into regimental guns and corps or reserve artillery. This latter portion was subdivided into divisions of eight guns of the same calibre. A company of artillery was also attached to each brigade of four battalions. The battery or division was thus made the tactical unit, with guns, munitions, and gunners complete, the horses and drivers being added at a later date. The French horse artillery dates from 1791. Horsemen and gunners were combined, each class learning the work of the other. Companies were attached to a battery of six guns, and in 1793, when the divisional organisation was adopted, artillery was attached to divisions in proportionate strength, and regimental guns were abandoned and entirely suppressed by Napoleon in 1796. The reforms of Gribeauval bore fruit in the wars of the republic. The tables of construction which had been drawn up secured a uniformity of manufacture, the reduction of the weight of the gun gave mobility to the field artillery, and enabled it to be used with the greatest effect in the new tactics which Napoleon introduced; and the last step in the complete organisation of field artillery was made in 1800, when the establishment of a driver corps of soldiers put an end to the old system of horsing by contract.

War of the French Revolution.

At the commencement of our wars on the Continent in 1793, the British artillery was in anything but an efficient condition. The guns were dispersed among the infantry, they were horsed in single train, the ammunition was packed in rough deal boxes, the ammunition waggons were cumbrous and ill-constructed, the drivers were mere carters on foot with long whips, and the whole equipment was scarcely able to break from a foot pace.[1] Prior to the Peninsular war, however, the exertions of an able officer, Major Spearman, had done much to bring about an improved state of things. Horse artillery had been introduced in 1793, and the driver corps established in 1794. The battalion or regimental guns were abolished in 1802, and field batteries or "brigades" of six guns were formed, horse artillery batteries being styled troops. Military drivers were introduced, the horses teamed in pairs, the drivers being mounted on the off-horses, while eight gunners were carried on the limbers and waggons. The equipment was lightened and simplified, the ammunition was properly packed, and a correct system of manœuvres was introduced. The invention of shrapnel shell by Major Shrapnel in 1803, and the transformation of the rocket from a mere signal to a destructive engine by Sir W. Congreve in 1806, also added to artillery power.

The composition of a troop of horse artillery from 1805 to 1807 was about as follows:—

	Men.					Animals.	Carriages.
	Officers.	N. C. Officers.	Gunners.	Drivers.	Artificers.		
Horse Artillery	5	14	85	60	...	164 horses	19
Driver Corps	...	1	...	20	3	36 mules	...

The composition of a field "brigade" between 1808 and 1816 was as follows:—

	Men.					Animals.	Carriages.
	Officers.	N. C. Officers.	Gunners.	Drivers.	Artificers.		
Company of Artillery	5	17	123	...	...	160 horses	19
Driver Corps	1	9	...	96	10	10 mules	...

The troops of horse artillery were armed with five guns (6 or 9 pounders) and one $5\frac{1}{2}$-inch howitzer. The field brigades were likewise armed with five guns and one howitzer, the guns ranging from light 6-pounders to 12-pounders. At Waterloo there were four different armaments for field brigades. The "driver corps," raised in 1794, consisted of a few subaltern officers, with non-commissioned officers, artificers, drivers, and horses. The corps was divided into troops, the addition of one of which to a company of foot artillery converted it into a field "brigade." The horse artillery possessed both drivers and horses, and required very limited assistance from the driver corps.

Although the British artillery distinguished itself on many occasions during the Peninsular war[2] and at Waterloo, and French officers were loud in its praise, the field artillery still suffered from the great evil, want of mobility. Matters, however, had somewhat improved by the end of the war. Great augmentations had also taken place during the war, and in 1815 the Royal Artillery numbered 23,085 of all ranks. After the peace it was again reduced, and horse artillery troops and field brigades were placed on a skeleton establishment of two guns each. In 1822 the driver corps was abolished, and the men and horses distributed among the field battalions, men being enlisted as "gunners and drivers." This system did not work well, owing to the difficulty of finding men who could combine such dissimilar duties. During the Peninsular war field guns and waggons were drawn by six and four horses respectively; but in 1820 a committee recommended eight horses for heavy field guns, and six for light guns and waggons; and after considerable opposition this was ultimately adopted. For some years the artillery, in common with the other branches of the British army, was kept down to the lowest state, but in 1848 the troops of horse artillery were increased to four pieces, and in 1852 they and the field batteries were raised to six guns. The field and horse artillery was increased to twenty batteries, giving a total of 120 guns. Shortly before the Crimean war a further increase of several battalions took place; but notwithstanding these various augmentations, both field and garrison artillery were entirely insufficient during the siege. At this time the field artillery consisted of "position batteries" of three 18-pounders and one 8-inch howitzer, or of four 12-pounders and two 32-pounder howitzers; of "field batteries" of four 9-pounders and two 24-pounder howitzers, and of "horse artillery troops" of four 6-pounders and two 12-pounder howitzers. In 1858 drivers, specially enlisted and trained, were permanently attached to each field battery. In 1859 the Royal Regiment of Artillery, which had increased to fifteen battalions of field and garrison artillery and one brigade of horse artillery was reorganised and divided into horse, field, and garrison brigades—each an administrative unit complete in itself with its own staff, and in 1862 the Indian artillery was amalgamated with the Royal Artillery, and the total strength of establishment was five horse and twenty five field and garrison brigades.

Progress of British artillery since 1815.

Important changes also took place in the *matériel* about this period. The advantages of rifling had been long known, but it was not practically applied to ordnance until 1846. Rifled guns were first used by the British artillery at the siege of Sebastopol, but with no great effect, owing to defective construction. A few years later the introduction of the Armstrong breech-loading rifled gun (first used in the China campaign of 1860) caused a great alteration in the equipment of the British artillery. The 7-inch gun of 82 cwt. was introduced for garrison service and even for siege purposes; 40-pounders, on block trail travelling carriages, for batteries of position, while 20-pounders were intended for the same or heavy field batteries; the

[1] *British Gunner.*

[2] For an interesting summary of the employment of artillery in the Peninsular War, see a paper by Captain Hime, R.A., No. 5, vol. viii., *Proceedings of R.A. Institution*, 1873.

12-pounder of 8 cwt. being for the armament of field, and the 9-pounder of 6 cwt. for horse artillery. The field carriages were provided with a gun-metal "saddle" worked by a lever and hand-wheel for traversing, and ball-and-socket elevating screw. The limbers and ammunition waggons were constructed of an improved pattern, and the whole equipment showed a great advance in efficiency; 124 rounds per gun were carried on the gun carriage and ammunition waggon, and a further "reserve" in a second line of waggons. The system of attaching small arm ammunition waggons to field artillery was abolished, and in future separate "ammunition columns" will convey this as well as reserve ammunition for artillery. The Armstrong system, which was but little tested in the field, has since 1873 been almost entirely superseded by muzzle-loading rifled guns, which will be described further on.

France. In France a new era for artillery opened with the wars of the consulate and the empire. The *matériel* underwent no great alteration, the 6-pounder being substituted for the 8 and 4-pounders for horse and divisional artillery, and a 24-pounder howitzer introduced. But beyond all other changes, we may note the increased tactical employment of artillery under the great artillery officer, Napoleon I. It is to his wars that we first look for instances of the important effects produced by this arm, in that concentration of fire which in those days was only produced by massing guns.[1] After the peace of 1815 the system of Gribeauval, which had served its time, was further improved upon. The *matériel* adopted in 1827 consisted of 12-pounder and 8-pounder guns, and 6-inch and 24-pounder howitzers. A six gun battery was composed of either four 12-pounders and two 6-inch howitzers, or four 8-pounders and two 24-pounder howitzers. The carriages and ammunition waggons were also improved, so that the detachments could be mounted on them, and the mobility thus much increased. A new mountain artillery equipment was also adopted; a powerful 12-pounder howitzer, but weighing only 220 lbs., was introduced, the carriage and ammunition boxes being carried on mules; and this equipment proved very serviceable in the Algerian campaigns. In 1852 Napoleon III., when president of the Republic, did much to simplify the *matériel*, and introduced a 12-pounder shell gun, intended to fire solid shot or shrapnel shell. Louis Napoleon had always made artillery a special subject of study; and the great work on artillery commenced and mainly carried out by him is a standard work on the subject. In 1858 rifled guns, 12-pounders and 4-pounders, were adopted in the French service, and used with great effect against the Austrians in the Italian campaign of the following year. Since the war of 1870-71, where the French artillery proved itself markedly inferior both in numbers, power, and handling to that of their adversaries, the French have been actively engaged in carrying on experiments, with a view to the introduction of a superior weapon, and have further increased their force of artillery by 120 batteries.

Prussia. At the commencement of the 19th century the Prussian artillery was rather powerful than mobile, the field artillery counting 216 12-pounders, 96 heavy 6-pounders, and only 120 light 6-pounders. After the disasters of 1806–7 this defect was remedied; and in 1816, when a further reorganisation took place, the ninety-six guns allotted to each army corps were in the proportion of three heavy to eight light. The horse artillery numbered twenty batteries in 1809, and twenty-seven in 1816, and for many years formed the bulk of the reserve artillery. The *personnel* of the Prussian artillery has developed enormously during the 19th century. In 1808 it formed three brigades, each consisting of six field and two horse artillery batteries. In 1814 it was increased to nine brigades, each composed of twelve field and three horse artillery batteries, besides a proportion of garrison artillery and artificers, and corresponding to one of the permanent army corps of the Prussian army. It was with this organisation but slightly modified that Prussia undertook the wars of 1864 and 1866. In the latter war the Prussian artillery did not shine so much as its Austrian adversary; and deficiencies were brought to light which were carefully remedied in the few years of peace which followed. In 1867 an addition was made of three Prussian and one Saxon regiment of field artillery, with four divisions of garrison artillery, consequent on the incorporation of Schleswig-Holstein, Hanover, Nassau, &c., and the formation of three new army corps from these provinces. It was with this establishment that the war of 1870–71 commenced. The South German forces contributed four regiments of Bavarian artillery and twenty-eight batteries of Würtemberg, Baden, and Hessian artillery; and altogether seventeen regiments of field and nine of garrison artillery took part, or were effective for service, in that war. In 1872 the German artillery was reorganised, the field artillery of each army corps being augmented to seventeen batteries, and divided into two regiments.

Austria. Similar progress was made by the other great European powers during this century. The Austrian artillery has always been pre-eminent both in the excellence of its *matériel* and in tactical handling on the field. In 1859 rifled guns were introduced; and in 1861 gun-cotton was substituted for gunpowder, but was soon afterwards abandoned. In the unsuccessful war of 1866 her artillery especially distinguished itself by its gallantry and devotion, and showed itself decidedly superior to that of her adversary. A considerable development of her artillery has taken place within the last few years, which will be treated of further on. Russia, which specially distinguished itself in the Napoleonic wars by the power and good service of her artillery, has continued to devote the same attention to it. In 1861 she adopted the French system of rifled guns, but after the German war of 1866 she abandoned it for the breech-loading system of Prussia, and has armed her field artillery mainly from the manufactory of Krupp at Essen. Of late years Russia has shown the greatest activity in all matters connected with artillery; the re-equipment of her siege, garrison, and coast artillery has been energetically proceeded with, and her fortresses re-armed; more than 1000 rifled guns having been supplied and mounted in the years 1869-70. Her field artillery has also been increased from three to four batteries per division, and thirty-eight batteries of mitrailleuses added. Russia.

Indian artillery. To complete this historical portion of the subject some brief notice is necessary of the Indian artillery, which springing from the Royal Artillery in 1748 returned to it again in 1862, after a varied but glorious career. The company of Royal Artillery sent to the East Indies in 1748 formed the nucleus from which three companies of regular artillery, one for each presidency, were raised in 1749. Five more companies were sent out between that and 1756; and on the reorganisation of the Indian army by Clive in 1765, the greater part of the Royal Artillery then serving there volunteered for, and was incorporated with, the Indian army, thus forming the basis upon which were formed the three corps of Bengal, Madras, and Bombay artillery. Its early days were passed in difficulties and comparative obscurity; it was recruited largely from the navy or merchant service, and many of the terms still in use, such as "lascar" (native assistant-gunner), were drawn from that service. Its officers, as a rule, were utterly without technical training. By degrees, however, educated officers were obtained from the Royal Artillery, and both *matériel*

[1] See below under "Tactics."

and organisation were improved, the changes following those adopted in England though somewhat tardily. Up to the end of the 18th century, however, bullocks were alone used for artillery draught, attached to the carriages by yokes and traces of raw hide; and in the earlier wars the ammunition was carried on the heads of lascars. The artillery developed rapidly, as our Indian possessions and Indian armies increased, and bore a constantly increasing share in our triumphs in that country. Early in the 19th century it numbered three horse brigades, and seven European and three native battalions. In 1845 the Afghan and Gwalior campaigns led to improvements in this branch; and in the Sikh wars the artillery was at last placed in its proper position. In 1857 it had attained its maximum strength, and numbered no less than sixty-five European and sixty-six native troops and batteries, with a total of 524 field guns. Its last and most brilliant services as a separate body were rendered in the great Sepoy mutiny, and in 1862 it was amalgamated with the Royal Artillery.

Organisation, Administration, and Matériel.

Modern artillery is broadly divided into field, siege, and garrison; and field artillery, again, is divided into mountain, horse, field (or foot),[1] and position artillery. The battery is essentially the unit of artillery organisation, both tactical and administrative; and brigades or regiments are formed by combining a number of batteries for convenience of administration.

Field artillery. A battery of field artillery comprises three elements: viz., *matériel*—guns, carriages, ammunition, and stores; *personnel*—officers and non-commissioned officers, gunners to serve, drivers to groom and drive, and artificers; and *transport*—horses, mules, elephants, oxen, &c. The number of guns in a battery varies from four to eight. Mountain and position batteries have usually four or six, field and horse batteries six or eight guns each. In England, France, and Prussia, there are six guns to a field or horse battery; while Russian and Austrian batteries have eight guns. The latter number seems to possess decided advantages. It admits of more convenient division; and the half-battery of four guns is a small but convenient battery for any particular service. In England, where the battery is divided into three divisions of two guns each, the centre division has to be divided to form half-batteries. Moreover, the larger the unit consistent with tactical considerations, the fewer will be the relative number of non-fighting carriages, such as forges, &c.

Usually the guns in a battery are all of one class, but sometimes what are termed *mixed* batteries are formed. Thus, until recently a field battery consisted of five guns and one howitzer, or four guns and two howitzers. These mixed batteries were supposed to have an advantage over those of guns alone, in that they commanded every kind of fire, and were adapted to every variety of circumstance. There was, however, a serious objection in the fact, that the differences between the gun and howitzer were so great in range and employment, that the fire of one must usually be comparatively neutralised; and the universal use of shell guns has now practically abolished mixed batteries.

The carriages which accompany a battery include (besides gun-carriages and limbers) ammunition waggons, store and provision carts or waggons, and forge waggons. The number of ammunition waggons depends upon the amount of ammunition which it is considered necessary for a battery to take with it in action—an important question, upon which there is considerable diversity of opinion. The greater the amount of ammunition a battery carries with it, the more independent it is; on the other hand, every additional waggon makes the battery more cumbrous, and lengthens out the column of march,—a serious consideration at all times, and especially in the case of artillery moving with the advanced guard of an army. The proportion of ammunition to be carried must be based on past experience. At the battle of Lützen, 1813, the French fired 220 rounds per gun, and on this they based their estimate. But in all the great battles of the Franco-German war of 1870–71 the maximum expenditure was 94 rounds per gun; at Vionville and at many of the great engagements not more than half this average was reached. The accumulation of waggons leads to batteries leaving a large part of their ammunition waggons at some convenient point under shelter when going into action; and the tendency now is to reduce the amount of ammunition with the battery in order to obtain the greatest possible mobility, and provide against any failure of ammunition by a more efficient system of ammunition columns. In former days batteries were further hampered by having to carry the reserve of small-arm ammunition for the infantry and cavalry. This system was said to be advantageous, in that the infantry knew at once where they could obtain their ammunition, but its disadvantages were numerous, as it seriously encumbered the artillery; and, moreover, with the new tactics of long-ranging guns, the artillery, instead of closely accompanying the infantry, will often remain at a considerable distance in rear, while the infantry is advancing. The reserve of small-arm ammunition is therefore now carried by special ammunition columns.

The distinction between horse and field or foot artillery is another question at present engaging attention. Horse artillery was created to compete with cavalry in rapidity of motion, and for this purpose every man was mounted; while field batteries were supposed to accompany the infantry, and their pace under ordinary circumstances to be limited to that of a man on foot. Under the new conditions of improved fire-arms, the dash of horse artillery has no longer its former value, while more mobility and more independence of action is required for the field batteries. It is therefore held by many that there should be only two classes of artillery: horse, or very mobile field artillery, and position batteries of heavy guns.

The organisation and interior economy of a battery is much the same in all field artillery. In England the command is held by a major. Upon the commanding officer depends to a great extent the efficiency of the battery in peace and in war. He should be not only well versed in stable management and the ordinary routine of his duties, but he should be acquainted with the *matériel* with which he has to deal, and be a practical gunner; and further, besides the tactics of his own arm, he should understand the combined tactics of the other arms in order to appreciate intelligently what is required of artillery in modern warfare. The second in command is a captain. The battery is divided into three divisions of two guns each, each under a subaltern officer, who is responsible for everything connected with his division,—men, horses, guns, carriages, ammunition, and stores. Each division, again, consists of two subdivisions, each comprising one gun and ammunition waggon, with its quota of men and horses; and at the head of each is the No. 1 of the gun detachment,—usually a sergeant,—who is immediately responsible to the divisional officer for his subdivision. The No. 1 is technically the head of the gun detachment of nine gunners, and his duties in the field are to lay and command the gun.

Rockets and *Mitrailleurs* are generally associated with

[1] The term *field* artillery has a general and a particular sense. In the former it applies to all kinds of artillery which accompany an army on the field of battle; in the latter it is confined to that branch (in some armies called *foot* artillery) which is supposed ordinarily to move with infantry, as distinguished from the lighter *horse* artillery and the heavier *position* artillery.

field artillery in organisation, but will be found treated of under their own titles. Rockets were applied to warlike purposes by Sir W. Congreve about 1804. They were used in 1809 in the Walcheren expedition, and with great success at Leipsic in 1813, but have since fallen somewhat into discredit on account of the danger of the service and their inaccuracy of flight. They are, however, still used for mountain and forest warfare against savage tribes, as in Abyssinia, in 1868, and in Ashantee, in 1874; and are very valuable for this purpose, from their extreme portability and their moral effect. The rockets now used are Hale's; they have no stick. They are carried in special rocket carriages when required. The rocket troop of horse artillery did excellent service in its day, but has long been abolished; for some time a rocket section was attached to every battery, but this has also been done away with. Mitrailleurs are extensively used by some of the Continental powers, especially the French and Russians, but have not yet been adopted as part of the British field artillery. The Germans oppose them on the ground that they are not equal to the guns, which they to a certain extent supersede. A Russian infantry division has one, and a French division one battery of mitrailleurs attached to it.

Siege and garrison artillery.

Siege and Garrison Artillery.—Siege and garrison artillery have not usually the complete and permanent organisation that distinguishes field artillery. In India and some other countries permanent siege trains are maintained; but usually the *matériel* is kept in store, and the *personnel* and transport are supplied from other sources according to requirement. In garrison artillery, the guns mounted on fortresses and batteries, or stored in arsenals for the purpose, furnish the *matériel*, and the battalions or companies of garrison artillery the *personnel*.

England.

In giving a brief account of the artillery services of different nations at the present time, we begin with that of Great Britain.

Mountain batteries.

(*a.*) *Mountain Batteries* have for many years past been used in India, where the details have from time to time been changed by the light of experience. In England no batteries of this kind are maintained, though the *matériel* would be forthcoming and the *personnel* would be supplied from the garrison artillery. In 1868 two batteries were organised for the Abyssinian expedition, each composed of six 7-pounder M.L.R.[1] guns, with steel carriages, ammunition boxes, rockets, forge, &c. The gun now adopted is a 7-pounder steel M.L.R. gun, of 3 in. calibre and 200 ℔ weight. The carriages are entirely of iron, the axletree consisting of a stout bar of wrought-iron, the brackets, of single plate, being housed directly across it. The projectiles are common shell, double shell, sharpnel, and case; the double shell is fired at high angles, with a reduced charge, and a modified form of vertical fire is thus secured, which is very useful in hill campaigns. In Abyssinia the guns were carried on the backs of mules, transversely supported on iron saddles or cradles. It is generally considered more expedient, however, to carry the guns lengthwise. The carriage is distributed between two mules, one carrying the bed and trail, and the other the wheels. The ammunition is carried in boxes, a pair to each mule. Mules are also provided for a small forge, tools, stores, &c.

In India mountain batteries are of two kinds; European and native, both officered from the Royal Artillery. There are two European batteries stationed in the Himalayas. The detail of each is 6 officers, 23 non-commissioned officers and trumpeters, 1 collar maker, 70 gunners; total, 100 Europeans, with 119 native drivers, besides a native establishment of muleteers for baggage mules, grass cutters, artificers, &c., and 182 mules. There are two native mountain batteries in Bengal, and two in Scinde; and it is intended to increase the mountain batteries of India by turning certain native field batteries attached to the local Panjab Frontier Force into mountain batteries.

Horse batteries.

(*b.*) *Horse Batteries.*—Horse artillery batteries differ from field batteries in possessing a lighter equipment, and in having the detachments of gunners to serve the guns mounted on horses. They are armed with six 9-pounder M.L.R. guns of wrought-iron, with tempered steel tube weighing 6 cwt.[2] The *personnel* of a horse artillery battery at home is as follows:—

	Peace Establishment.	War Establishment.
Officers	5	5
N.-C. Officers and Trumpeters	20	22
Artificers	7	10
Gunners	70	70
Drivers	56	70
Horses (exclusive of officers' chargers) riding	54	62
Horses (exclusive of officers' chargers) draught	78	102

In India a battery has, further, a large non-combatant native establishment, as 23 subordinate medical and hospital attendants, and no less than 339 artificers and followers of various kinds.

The detail of guns and carriages is as follows,—6 guns and carriages, 6 ammunition waggons, 1 forge, 1 store, 1 general service waggon, and 1 store cart. The construction of our carriages is very solid, excessively so in the opinion of many, as mobility is sacrificed to gain strength; but this is partly caused by the fact that English carriages must be so constructed as to endure all extremes of climate. The gun-carriage for horse (and field) artillery is of wrought-iron.

The ammunition waggons are built on a framework of wrought-iron, with wrought-iron perches and wooden ammunition boxes. The projectiles are common and shrapnel shell, and case shot. Each limber has two boxes, and the body of the ammunition waggon four; each box contains a centre compartment, with 18 filled cartridges, two compartments front and rear, each with 6 shrapnel shells, and two side compartments containing 3 common shells and fuses in proportion. The ammunition carried is 4 case shot in the axletree boxes of the gun-carriage, 12 common shell, 24 shrapnel in the limber of the gun, and 36 common shell and 72 shrapnel in the ammunition waggons. A total of 148 rounds is thus carried by each gun with its ammunition waggon.

The stores for horse and field batteries are numerous, consisting of camp equipment, entrenching tools, harness and saddlery, artificers' tools, ordnance stores, and miscellaneous articles, the details of which will be found in the regulation hand-books and equipment tables. These are packed and carried on the different carriages of the battery. Thus the gun-limber carries drag-ropes and axe in front, and other implements, such as spade, shovel, pick-axe, at the side of the boxes, or underneath. A centre box on the limber contains time and percussion fuzes and friction tubes. On the lids of the boxes inside are carried various fuze implements, and a camp kettle and two leather buckets are carried under the limber-boxes. Traversing handspikes and sponges are carried on the gun-carriage itself, and in the axletree boxes, besides the case shot, linch-pins, drag-washers, gun-spikes, &c.

The waggon is packed much in the same way, but two camp kettles are carried under the body, and a spare wheel in front, three picket posts are carried on each side of the body, and under each alternate waggon of the battery a spare shaft or axletree. The tents are packed between the

[1] The abbreviations M.L.R. and B.L.R., for "muzzle loading rifled" and "breech loading rifled" respectively, are used in the technical description of guns.

[2] In India a few batteries are still armed with guns of old patterns.

ammunition boxes, and the many other stores distributed in various ways throughout the battery.

Each carriage in a horse artillery battery has six horses, except the general service waggon and store cart, which have only four. The horses are teamed in pairs,—lead, centre, and wheel,—the drivers mounted on the near horses. The off horse of the wheel is in the shafts. Much controversy has been raised as to the respective merits of "shafts" or "pole;" the latter was in use in India for many years, and is still generally used by Continental powers. The balance of advantage seems to lie on the side of shafts, but it requires a very powerful horse for the off wheeler, on whom so much is thrown. The harness is strong and fairly simple. The off horses have pads upon which the valises containing the drivers' kits are carried. Picket ropes and posts are carried on the waggons, and each mounted man has a head rope and a forage cord, which may be used as a heel rope, a peg and leather shackle being carried for it.

(*c.*) *Field Batteries* differ from horse artillery in that they have a heavier armament, and the gunners are not mounted. The guns now in use are—(1) 9-pounder M.L.R. gun of $8\frac{1}{2}$ cwt., (2) 12-pounder B.L.R. Armstrong gun of 8 cwt., (3) 16-pounder M.L.R. gun of 12 cwt. No. 2 has, however, been superseded in England, and will erelong become obsolete in India also, where the whole of the field artillery is being armed with the 9-pounder M.L.R. The 16-pounder is a most powerful gun, probably the most powerful field gun in Europe, but is heavier than the corresponding guns in Continental armies, and some consider that its weight is inconsistent with sufficient mobility.

The *personnel* of a field battery is as follows:—

	Peace Establishment.	War Establishment.	Indian Establishment.
Officers	5	5	5
N.-C. Officers	19	20	20
Artificers	7	9	5
Gunners and Trumpeters	68	87	78
Drivers	61	73	54
Horses	88	154	110

The peace establishment, however, is variable. In India a field battery has, further, a native establishment of hospital attendants, lascars, grass-cutters, artificers, &c., and amounting in all to 247.

A field battery has 6 guns and carriages, 6 ammunition waggons, 1 forge, 1 store, and 1 general service waggon—total, 15. In war time the 6 ammunition waggons (known as the second line of waggons) form the nucleus of the ammunition reserve. In India the second line of waggons are kept in readiness in the arsenals, and when taken into the field are drawn by bullocks. The gun-carriages are of wrought-iron, similar in construction to those of horse artillery. The obstacle to the rapid movement of field artillery has always been, that no means were provided for carrying *with* the gun the gunners required to serve it, as the limber could at most only accommodate three men. In India the constant necessity for rapid movement had caused the adoption of axletree seats, by which two more gunners could be mounted, one on each side of the gun, and saddles were also provided for the lead and centre horses of the gun team, so that, with the mounted non-commissioned officer, seven men would be at hand to serve the gun, independently of those mounted on the waggons. The axletree seats are generally used on the Continent, and have recently been adopted in England for field batteries.

The projectiles for the M.L.R. guns are common shell, shrapnel, and case; the first used against earthworks, buildings, &c., the second against troops, and the third at close quarters. The fuzes used are percussion and wood time fuzes. The amount of ammunition carried with the 9-pounder M.L.R. gun, and manner of carrying it, are the same as in the horse artillery. With the 16-pounder M.L.R. field batteries, the arrangement of the ammunition and the packing of the boxes and stores are similar, but the number of rounds carried is less. The near limber box of both gun and waggon contains 7 common and 5 shrapnel shells, the off one 5 common and 7 sharpnel, while the front waggon boxes contain each 5 common and 7 shrapnel shells, and the rear boxes 12 shrapnel; so that, with four rounds of case in the axletree boxes, the gun and waggon carry 34 common shell, 62 shrapnel, and 4 case, or 100 rounds altogether. In India the ammunition stores, &c., are similarly packed, but the camp equipment being larger is separately carried on camels provided for the purpose.

Field artillery has been *carried* on elephants in India, and cradles or saddles are kept up there for the purpose in case of need; and has also been transported by *sleighs*, as in Canada. The sleigh is a platform placed on runners 16 inches high and 3 feet broad. A description of the sleigh-carriages and the exercise with them is given in the *Hand-book for Field Service*.

Position batteries.

(*d.*) *Position Batteries*,—a heavy field artillery, capable of movement, but not required to move fast, or to change position frequently, and used in the defence of special important points on a battle-field, entrenchments, &c. No manned batteries of this description are kept up in England, but the *matériel* is kept in store, and the *personnel* would be furnished from the garrison and field artillery. The guns at present used are 40-pounder B.L.R. Armstrong guns, 40-pounder M.L.R., and 25-pounder M.L.R. guns. The carriages are of angle iron, with bracket trails, and of great strength; the projectiles are common and shrapnel shell, and case. The detail for a battery is as follows,—4 guns and carriages, 4 ammunition waggons, 1 forge, 1 general service, 1 platform, 1 store waggon, and 1 store cart. The guns are drawn by 12 horses, harnessed four abreast; and as it is intended that the horses shall be furnished from the country if possible, the batteries have been specially fitted for the attachment of farmers' horses.

In India position artillery is maintained in the form of "heavy field batteries," some being armed with 40-pounder Armstrong guns and 8-inch mortars, others still with the old smooth-bore guns. The guns are dragged by elephants, two for each gun, one in the shafts and the other as leader; the mortars and ammunition waggons by oxen. Elephants are dangerous under fire, and, therefore, their place is then taken by bullocks, of which ten pair are required for a gun.

Siege artillery.

(*e.*) *Siege Artillery.*—There is no special organisation of siege artillery in England in time of peace. The *matériel* is kept in store, and the *personnel* and transport are furnished according to the requirements of the particular service. The new M.L.R. wrought-iron guns, 40 and 64-pounders of 35 and 64 cwt. respectively, will probably form part of any future siege train, and with these will be associated 10-inch and 8-inch M.L.R. howitzers, and $5\frac{1}{2}$ inch and 10-inch mortars, or, perhaps, a rifled mortar. The *personnel* would be supplied from the garrison artillery, a battery of which at war strength would form a siege train battery. The transport might be specially furnished or supplied from the country in which operations were to be conducted.

The proportions of guns, &c., in a British siege train would be approximately—

55	64-pounder M.L.R. guns.
20	40-pounder " "
30	8-inch M.L.R. howitzers.
105	

To these would probably be added rifled and smooth bore mortars according to circumstances.

The proportion of ammunition must vary with the nature of the siege, but as a standard a detail has been fixed, which is given at length in the *Revised Army Regulations of* 1870.

The number of men required is calculated for three reliefs, or 30 men per gun, 15 per large mortar, and 9 per small mortar, with a reserve. A brigade of garrison artillery on war strength, numbering 51 officers, 135 non-commissioned officers and trumpeters, and 800 gunners, is held to be sufficient to man a siege train of 35 pieces.

The carriages employed are gun-carriages and limbers, howitzer and mortar-carriages, platform waggons, general service waggon, siege waggon, store waggon, sling waggon and cart, hand and trench carts. The carriages are generally of the block trail pattern, and, except that they are stronger, are similar in construction to the travelling carriages for field service. The new siege limber is of universal pattern, and similar to the field limber in construction. The mortar-carriages consist of a bed with an axletree mounted on two wheels, and with a perch for limbering up to a limber for travelling. The platform waggon is composed of a fore and hind carriage, with a platform over them for carrying guns and mortars. The general service waggon consists of a fore and hind carriage with body over them, covered with waterproof canvas. The siege waggon is merely the general service waggon strengthened and fitted so as to transport shot and shell. The store waggon consists of a body and limber, and will contain spare stores and materials, and necessary tools. The sling waggon is composed of a body and limber, and fitted with windlass arrangement so that guns can be slung up underneath. In the heavier pieces iron sling waggons are used. Considerable improvements will probably be made in siege carriages so as to admit of the abolition of embrasures and of the gun being fired over the parapet.

In India siege trains are kept in readiness in arsenals, and the transport, which is composed of bullocks, is to a large extent also maintained. These siege trains have been hitherto composed of old smooth-bore guns, but these will be replaced by rifled guns. There are 16 such trains, with a total of 400 or 500 pieces. The *personnel* would be supplied from the garrison artillery and the native establishment in the arsenals.

The duties of the siege trains, the position of parks and batteries, &c., rather relate to the conduct of sieges, and do not therefore fall within the scope of the present article.

Garrison artillery.

(*f*.) *Garrison Artillery*.—The garrison battery consists only of *personnel*, the *matériel* used being part of the defences or fortress in which this branch of the artillery is employed. The establishment of a battery is as follows:—

	Peace.	War.	India.
Officers	4	4	5
N.-C. Officers	16	16	16
Gunners and Trumpeters	80 to 120	142	72

An Indian battery, further, has a native establishment of 30 hospital attendants, followers, &c. The care and preservation of the ordnance in fortresses and batteries, with all the complicated appliances and scientific constructions of modern artillery *matériel*, and of the carriages, stores, and ammunition, devolve upon the garrison artillery in peace time.

For fortress defence large numbers of smooth-bore 68, 32, and 24-pounders, and 8 and 10-inch shell guns, are still mounted. The general tendency, however, is to replace these with rifled guns of calibre suited to the importance and object of the work, while the mitrailleur or Gatling gun will probably be used in flanks and for the defence of ditches. Large numbers of 7-inch or 110-pounder B.L.R. Armstrong guns have been mounted since 1862. The M.L.R. guns are 7, 8, 9, 10, 11, and 12-inch, the latter weighing 35 tons. The projectiles of these are common, shrapnel, and Palliser shell, case, and Palliser cored shot, and attain the extraordinary weight of 690 lb. An 81-ton gun is now (1875) in process of construction, and is calculated to throw a shell of 1600 lb.

The old smooth-bore garrison carriages are of wood, with various arrangements and platforms for traversing. The new carriages for the large M.L.R. guns are of wrought-iron, with hydraulic buffer arrangements. The Moncrieff carriage and system, by which the gun is loaded and laid in a gun pit, raised by a counterweight, and released again, descending after firing by the regulated power of the recoil, will probably be extensively employed in coast defences; and it is probable that still further improvements will be made in the carriages for the immense ordnance now used.

General Organisation.—The whole of the British artillery forms one regiment, the "Royal Regiment of Artillery," numbering 1414 officers and 33,688 men, and distributed in 216 batteries of horse, field, and garrison artillery. For purposes of administration a unit higher than the battery is adopted, called the *brigade*. Each brigade has its own staff of colonel-commandant, 4 lieutenant-colonels, adjutant, quarter-master, &c. The batteries of the brigades are, as far as possible, kept in the same part of the country where the headquarters are serving. There are 6 brigades of horse artillery, 12 of field artillery, 13 of garrison artillery, and the "coast brigade;" their detail and distribution will be found in the account of the British army (see Army, p. 578). Besides the brigade organisation, there is another which may be termed the territorial system, or district commands, having reference especially to local duties, stationary *matériel*, such as guns mounted on forts and batteries, &c. These artillery districts correspond generally to the army districts, and have at their head a colonel on the staff, or other officer commanding the artillery district. In the United Kingdom there are also artillery sub-districts, under lieutenant-colonels, who are invested with the commands of the auxiliary and reserve force artillery of the sub-district. The highest administration of the Royal Artillery is conducted at the War Office, in the department of the Commander-in-Chief,—a deputy-adjutant-general of artillery, with assistants, being attached for that purpose to the adjutant-general's division. An inspector-general of artillery is charged with special artillery inspections in the United Kingdom, and also inspects the *matériel* and munitions of war in the hands of the artillery. The department of the director of artillery and stores at the War Office is a branch of the Ordnance Department (see Army, pp. 573, 582), and deals with all matters relating to armaments, stores, and munitions not in artillery charge, and superintends the manufacture of warlike stores and the scientific experiments which have to be constantly made. In India the administration is not dissimilar, a deputy-adjutant-general and inspector-general of artillery performing duties analogous to those of the similar officials in England, while the director of artillery is represented by an inspector-general of ordnance and magazines.

Although Woolwich is no longer the official headquarters of the artillery it is the chief artillery station, and continues to be that to which officers and men practically look as their headquarters. The mess and band of the regiment are permanently maintained there; and a large number of batteries, including the greater part of the depôt brigade, are always stationed there, and it further contains most of the great artillery establishments, both manufacturing and instructional.

For an account of the manufacturing establishment see Arsenal, p. 633, and for the scientific and educational establishments see Army, p. 586.

Proportion of guns to men.

Unlike Continental nations, England has no permanently organised army corps and divisions, and, consequently, no combinations of artillery with the other arms. Her colonial possessions, and the vast extent of her Indian empire, raise almost insurmountable obstacles to any organisation which shall fulfil equally the conditions of peace and war, and have necessitated a distribution of the artillery on principles other than those which obtain in the more facile systems of Continental armies. The proportion of guns to men at present existing is 2·45 per 1000 men; the grand total of guns for field service,—including field, mountain, and position batteries—being 784, while the total strength of troops, British and native, is 320,000. This proportion is somewhat under that now generally accepted, viz., 3 guns per 1000 men. The proportion of guns to men has varied with the circumstances of the age and country. During the 18th century the proportion was usually 3 per 1000, though Frederick at one time raised it to over 5 per 1000. In the earlier wars of the French Republic the allies increased the proportion unduly; and Napoleon, whose rapid tactics did not admit of his hampering his army with heavy trains, reduced it again. He advocated 2 guns per 1000 with old and tried troops, but 3 guns per 1000 with the usual composition of an army; and in his later campaigns, when his armies consisted almost entirely of recruits, he even exceeded this proportion. In the Crimean war, and in 1859, the Russians and Austrians increased this ratio considerably, but the great increase to the strength of armies which took place between 1866 and 1871 led to a comparative decrease of artillery, and the Germans have now rather less than 3 per 1000. It must be remembered, however, that the actual proportion on service is always in excess of the nominal one, often considerably so, as the guns are not reduced by the wear and tear of the campaign as the *personnel* of an army is; a battalion is soon reduced from 1000 to 500 men, but a battery always retains its six guns. In the great American war of 1861–65, the proportion of guns at first was nearly 6 per 1000, but towards the end was reduced to little over 1 per 1000, showing how the proportion is affected by the nature of the country which is the scene of operations.

Important questions connected with the organisation of the British artillery are now giving rise to discussion, and will probably be solved shortly; the two principal ones being the breaking up of the huge, overgrown "regiment" of artillery into smaller units, and the separation of the field from the garrison artillery. The appellation "regiment," for a force of 35,000 men and officers, is manifestly a misnomer, and the continuance of the present system is upheld principally on what may be termed "sentimental" grounds,—unwillingness to break old ties and uproot traditions, and fears that the *esprit-de-corps* of the service might suffer in the change. The separation of the field from the garrison artillery has often been advocated on the grounds of the essentially different nature of the two services, and the fact that the men and *matériel* are already separate, the officers alone being transferred from one branch to the other. The full discussion of the proposed changes does not fall within the province of this article.

France.

The organisation of the French artillery has been completely changed by recent regulations. Previous to the Franco-German war of 1870–71, it consisted of 1 horse artillery and 1 field artillery regiment of the guard, 4 horse artillery and 12 field artillery regiments of the line, with garrison artillery, making up 19 regiments. The horse artillery regiments consisted of 8 batteries of 6 guns each, and the field artillery regiments of 12 batteries. Only 8 out of the 12 were mobilised during war, 4 remaining as *batteries de sortie* for garrison service. The number of field guns available was 984. This number of guns could not be put in the field at once, as 58,000 men and 39,000 horses were required, while in peace time only 34,000 men and 16,000 horses were kept up. The guns in the service were a 9-pounder (shell) mountain gun of 2 cwt., 9-pounder of 6½ cwt. for field artillery (*canon de* 4), 16-pounder of 11½ cwt. (*canon de* 8), 25-pounder of 12 cwt. for position artillery (*canon de* 12), and 50-pounder of 40 cwt. (*canon de* 24) for siege purposes. These were of bronze, and rifled on the La Hitte system. In naval service B.L.R. guns of cast-iron, strengthened by rings, have been employed, ranging from 70 to 300-pounders. The field guns fired studded projectiles, shell, shrapnel, and case; and the heavy guns heavy elongated projectiles of similar kinds.

In accordance with the recent regulations, each of the 18 French army corps has a brigade of artillery attached to it, consisting of 2 regiments, 1 of divisional, the other of corps artillery. The divisional regiment consists of 8 field batteries and 1 depôt battery; the corps regiment, of 3 horse artillery batteries (1 of which is attached to the cavalry in time of war), 9 field batteries (1 of which is utilised for service in Algeria), and 1 depôt battery. Each brigade has besides 4 dismounted batteries for garrison service, and 4 companies of drivers for ammunition columns. An army corps has, therefore, 4 batteries attached to each of its divisions, and employs 10 batteries in addition as its corps or, as it was formerly called, reserve artillery. The war strength of each battery is 5 officers and 168 men. The field guns in use are the 15 and 10-pounder bronze B.L.R. Reffye guns (*canons de 5 et de 7*). (See GUNS AND GUNNERY.)

Germany.

The general organisation and distribution of the German artillery will be found under ARMY (p. 597). To each territorial army corps is attached a brigade of artillery, consisting of 2 regiments of field artillery and a regiment, or portion of a regiment, of garrison artillery. The first *field* regiment or corps artillery consists of 2 field divisions of 3 field batteries each, and one horse artillery division of 3 batteries. The second field regiment or divisional artillery consists of 2 divisions, each of 4 field batteries. The field guns are the 9-centimètre B.L.R. gun, firing a shell of 15½ ℔ weight, used by the field batteries, and the 8-centimètre B.L.R. gun, firing a projectile weighing 11 ℔, with which the horse artillery is armed. These guns are of cast steel, with polygrooved rifling and wedge breech action (*système de Krupp*). Each battery has 16 carriages, viz., 6 guns and carriages, 6 ammunition waggons, 3 provision and store waggons, and 1 forge waggon. The gun-carriages are double cheeked, and made of plate iron. The ammunition waggon carries one large box opening to the rear. The projectiles are a common shell of novel construction, case, and shrapnel—the latter only lately introduced. The following ammunition is carried per gun:—

Field artillery.

	Ammunition.	Gun Limber.	Waggon Limber.	Waggon Body.	Total per Gun.
8-cent. gun	Common Shell	24	24	32	80
	Shrapnel	12	12	16	40
	Case	3	2	...	5
	Total	39	38	48	125
9-cent. gun	Common Shell	20	20	30	70
	Shrapnel	10	10	15	35
	Case	3	2	...	5
	Total	33	32	45	110

The artillery ammunition columns have 25 waggons each, and provide a first reserve of about 125 rounds per gun. The infantry columns have 24 small-arm ammunition waggons.

The following table gives the *personnel* and transport of a battery or ammunition column on war establishment:—

	Batteries.			Ammunition Columns.	
	Horse.	Field.		Artillery.	Infantry.
		8-centm.	9-centm.		
Commanding officer	1	1	1	1	1
Subalterns	4	4	4	..	..
Officers of ammunition columns	...	...	...	2	2
Laboratory conductor (officer)	..	.	...	1	1
Quartermaster	1	1	1	1	1
Ensign (aspirant to rank of officer)	1	1	1	.	
Non-Commissioned officers	12	12	12	12	12
Trumpeters	2	2	2	2	2
Gunners	42	42	48	8	8
Drivers	49	60	60	23	26
Spare men	38	23	23	37	34
Corporals		..	.	3	3
Hospital orderly	1	1	1	1	1
Collarmakers and Saddlers	2	1	1	1	1
Soldiers of the transport train (including officers' servants)	5	5	5	80	84
Total	158	153	159	172	176
Horses: Officers'	15	7	7	4	4
Horses: Draught	92	92	92	132	140
Horses: Riding	100	16	16	22	22
Horses: Spare	6	8	10	8	8
Total	213	123	125	166	174

Siege artillery. For *siege* purposes the Germans use the 12-centimètre (4·68 inch) bronze gun, firing a 29-lb shell, and steel and bronze guns of 15 centimètres (6·85 inch) calibre, firing a 54-lb shell. The mortars used are the 8-inch rifled, and the smooth-bore 15-centimètre. The usual composition of a siege train is 400 guns, viz.:—

320 rifled guns:
- 40 of 9-cm. (bronze).
- 120 of 12-cm. (bronze).
- 120 of 15-cm. (steel), short
- 40 of 15-cm. (steel), long.

40 rifled 21-cm. mortars, 40 smooth-bore 15-cm. mortars,—

besides 150 rifled wall pieces.

A 21-cm. shell gun and a 28-cm. rifled mortar are likely to be added to this list soon. Each gun has 508 rounds of ammunition ready for immediate service.

The siege trains are 2 in number, and in time of war have 16 ammunition columns attached to each. These columns consist of 46 ammunition waggons, 6 open waggons, a forge, and some baggage and forage carts. Each waggon is adapted for draught for either 4 or 6 horses.

Garrison artillery. The *garrison* guns are the 12-centimètre gun in cast-iron and bronze, 15-centimètre, 23-centimètre (9-inch) cast-iron howitzer and heavy guns for garrison, coast, and naval purposes, ranging from 7-inch to 13-inch calibre. The Prussian artillery is breech-loading, and three systems are employed in the closing of the breech, viz., that of Wahrendorf, or the "piston" arrangement (*Kolbenverschluss*)—that of Kreiner, or the "wedge" system (*Keilverschluss*)—and the Krupp system, or cylindro-prismatic wedge (*Rundkeilverschluss*). The first dates from 1861; the second system has been applied to land guns since 1864; the third is, in slightly varying forms, applied to all the most recently manufactured guns. The siege carriages have a peculiar arrangement of iron supports on the cheeks, by means of which the gun is enabled to fire over the parapet. The foot or garrison artillery has recently been reorganised into 30 battalions, counting 122 batteries or companies. The number of regiments is 19, but the number of battalions in a regiment varies. The garrison artillery is separated from the field artillery, and is specially attached to the army territorial commands, and officers can only be transferred from one branch to the other by special permission.

Austria. The Austrian artillery is divided into field, garrison, and technical artillery.

Field artillery. The *field artillery* consists of 13 regiments, having their permanent headquarters in Prague, Olmütz, Komorn, Josephstadt, Pesth (2), Grätz, Vienna (2), Lemberg, Neustadt, Laibach, Temesvar. Each regiment comprises six 8-pounder and four 4-pounder field batteries, three 4-pounder horse batteries, one depôt battery, and five or six ammunition columns.

Three batteries are attached to each infantry division, and three form the corps artillery, one battery being detached to the cavalry. In peace time a battery has only four guns and two ammunition waggons horsed; on war footing they have eight guns and eight waggons each drawn by four horses in the 4-pounder field batteries, and by six horses in the others. The guns are 4 and 8-pounder bronze rifled guns, having calibres of 3 and 3·9 inches, and firing 8-lb and 14-lb shell respectively.

Steel B.L. guns of the Prussian type are, however, being gradually brought into the service, the M.L. system being definitely abandoned. The carriages are double cheeked or bracketed like the Prussian. A box to hold case is fixed on the trail about halfway between the breech of the gun and the point of the trail, and adapted to form a seat. The projectiles are common shell, shrapnel, incendiary shell, and case. As in the Prussian artillery, the percussion fuze is alone used with common shell, and time fuzes for shrapnel. The peace and war establishments of batteries and ammunition columns, and the number of rounds carried, are shown in the following tables:—

	Peace Establishment.					War Establishment.						
	4-pr. Batt.			Cadres.		4-pr. Batt.		Battery.		Ammun. Cols.		
	Field.	Horse.	8-pr. Batt.	Ammun. Cols.	Depôt.	Field.	Horse.	8-pr. Batt.	Depôt.	1, 2, 3.	4.	5.
Captains	1	1	1	1	1	1	1	1	2	8	8	8
Subalterns	3	3	8	5	5	8	3	3	4			
Cadet	1	1	1	...	...	1	1	1	...	...	...	...
Artificers	2	2	2	3	3	2	[illegible]	2	8	3	3	8
Sergeants	4	4	4	4	4	4	4	4	8	2	2	2
Corporals	6	6	6	5	5	8	8	8	16	6	6	6
Trumpeters	1	1	1	1	1	2	2	2	2	1	1	1
Conductors of carriages	14	14	14	...	10	16	16	16	20	8	8	8
Gunners	46	46	50	12	6	65	65	75	90	47	52	57
Drivers	25	31	31	...	...	60	80	80	70	93	108	113
Servants	4	4	4	6	6	4	4	4	6	3	3	8
Shoeing-smiths and farriers	1	1	1	...	...	3	3	8	3	8	8	8
Saddler and Collar maker	1	1	1	...	...	1	1	1	1	1	1	1
Total	109	115	119	37	41	170	190	200	230	170	190	200
Horses:— Officers'	19	19	19	...	...	19	19	19	19	10	10	10
Draught	16	24	24	...	...	84	120	120	84	124	154	172
Reserve	2	4	4	...	...	6	8	8	6	...	...	...
Spare riding	...	...	...	...	...	...	...	...	...	4	4	4
Spare draught	...	...	...	...	...	...	...	...	...	28	28	40

The 4-pounder batteries carry 156 rounds of ammunition per gun, the 8-pounder 128 rounds. The first ammunition reserve conveys in addition 74 rounds for each 4, and 82 for each 8-pounder. The total number of rounds for each gun is, therefore, 230 and 210 respectively.

In order to avoid dependence on foreign contractors attempts are being made to cast a *hard* bronze for field guns, and it is hoped that by employing this metal a portion of the new equipment may be furnished by the Austrian arsenals.

The war *matériel* necessary to place the batteries on a war footing is kept under charge of the field artillery, store horses being apportioned for it in the barracks of each regiment. By this system mobilisation is more quickly effected, and the *matériel* is better looked after than when stored in arsenals. Including the depôt batteries the Austrian artillery numbers 209 batteries, or 1672 horsed guns.

Garrison artillery. The *garrison artillery* consists of 12 battalions of 5 companies each (increased to 6 in war time), and one coast artillery regiment of three battalions. The garrison battalions further furnish 5 mountain batteries, increased to 6 in war time. The mountain batteries are armed with four 3-pounder rifled bronze guns, and carry 112 rounds per gun, viz., 72 common shell, 24 shrapnel, 16 case. For siege and garrison purposes the guns in use are B.L.R. 15 and 21-centimètre and 8-inch bronze guns; 8-inch and 6½-inch rifled mortars, breech-loading, have also been adopted.

Technical artillery. The *technical artillery* comprises a portion of the workmen charged with the construction and repair of guns in all arms, ammunition, artillery *matériel*, &c. The *personnel*, numbering 28 superior officers, 162 captains and lieutenants, and about 1600 men, is distributed in sixteen arsenals, established in the chief towns of the empire; in war time companies of artificers are detached from these to the parks of each army corps. Artillery officers have to serve by roster in the technical artillery.

The instruction of officers is conducted at the cadet school and at the Academy of Technical Artillery. On leaving this academy officers ordinarily pass into the garrison artillery, and after a year in this enter one of the regiments of artillery. After a second year they may be admitted, on application, to the advanced course of artillery, and after passing successful examinations are nominated as first lieutenants. Schools also exist in each regiment for the instruction of non-commissioned officers, one-year volunteers, and artillery cadets; and an autumn course of equitation, the most proficient at which are sent to the central school of equitation at Vienna, to be from thence appointed as riding-masters to the artillery regiments. For further details of Austrian artillery organisation see article ARMY, p. 606.

Russia. The Russian *matériel* is divided into mountain, field, siege and garrison, and coast artillery. The *mountain* gun is a 3-pounder bronze rifled gun of 224 ℔ weight, firing a 9-℔ projectile. For *field artillery* they use both cast steel and bronze B.L.R. guns, 4-pounder and 9-pounder, of 3·3-inch and 4-inch calibres, firing 12-℔ and 24-℔ shells (loaded). Mitrailleurs have also been introduced for field artillery, and with them the range-finder, invented by Captain Nolan, R.A. The *siege* and *garrison* guns are 12 and 24-pounders, throwing 30 and 63-℔ shells, 8-inch bronze and steel guns, and 6 and 8-inch rifled mortars. For coast purposes guns from 6-inch to 11-inch calibre are used. The Russians have also introduced a 50-ton gun, or 1200-pounder, but the future will prove its efficiency. Krupp of Essen has been largely employed by the Russian Government for the supply of steel guns, but these are now furnished by Russian factories.

The field carriages are of wood and iron, that for the mountain gun of iron; but the former are now to be made of greater stability, and the carriages for siege and garrison artillery have also been improved. The projectiles used are the charokh and shrapnel for the mountain and field guns, chilled shot being used with the heavier ordnance.

The artillery of the active army consists of 48 brigades of field and 8 brigades of horse artillery, besides siege trains, parks, and mobile arsenals.

The horse artillery brigades (bodyguard excepted) consist of 4 batteries of 6 guns each. A brigade of field artillery consists of 5 field batteries (3 heavy and 2 light) and 1 mitrailleuse battery. There are four descriptions of batteries,—(*a.*) 9-pounder field batteries, (*b.*) 4-pounder field and horse batteries, (*c.*) 3-pounder mountain batteries, (*d.*) mitrailleuse batteries. Each battery has eight guns, drawn by six horses in time of war.

The two-wheel ammunition carts formerly in use are being gradually replaced by four-wheeled waggons. The mitrailleuse batteries carry 6290 rounds. In the 9-pounder battery there are 24, and in the 4-pounder 16 ammunition waggons.

The great increase and development of the Russian army, which began in 1873, was accompanied by a corresponding increase in the artillery, each brigade being raised from 4 batteries, its former strength, to 6, and a further increase of 2 batteries is probable. When the changes in progress are completed, the Russian field artillery will number 300 batteries, or 2400 guns.

Tactics.

The tactics of artillery, combined with the other arms, will be dealt with in another place (see WAR). The present article treats only of drills, and the simpler or uncombined tactics of artillery. Drill, though commonly included under the head of tactics, is rather the elementary training and education required for the higher development, and varies according to the nature of the artillery. The drills and instruction for *horse artillery* are as follows:—(1.) Equitation or riding drill. (2.) Foot drills, as for cavalry. (3.) Sword drill. (4.) Field gun drills. This includes the actual service of the gun, the loading, laying, and firing, &c., positions of gunners and detachments under various conditions, limbering up, unlimbering, exercise with drag ropes, &c.; also, such exercises as dismounting gun and carriage, mounting gun and carriage, replacing a damaged wheel, exchanging gun and limber wheels, shifting shafts from double to single draught, and *vice versâ*, moving disabled ordnance, &c. For details the reader is referred to the *Manual of Artillery Exercises.* (5.) Battery exercise (sometimes called by the horse artillery "gun drill"). In the horse artillery each subdivision consists of gun and waggon, with two non-commissioned officers, and six or eight gunners, besides drivers. Two gunners are carried on the limbers. The rest are mounted, and are called the detachment, which is placed in front, rear, or on a flank of the gun, according to circumstances. Ammunition waggons of horse artillery do not manœuvre usually, but merely conform to the movements of the guns at a safe distance. A battery of six guns in line occupies 95 yards, each gun being 19 yards from the next. When a battery comes into action, each detachment dismounts, the limber gunners get off the gun-limber to the rear, the trail is unkeyed, the limbers drive on, and the gun is placed in position, and the Nos. 1 lay them during the loading. They are then fired independently, unless the commanding officer gives orders to the contrary. "Limbering up" is the converse operation. The details of drill will be found in the *Manual of Field Artillery Exercises.*

Horse artillery.

Field artillery. *Field Artillery.*—The drill of a field battery is almost the same as that of a battery of horse artillery. The space occupied by a battery and the intervals are the same. There are, however, no mounted detachments, and the waggons usually accompany the guns in manœuvring, though on the battle-field they are supposed to be kept at a safe distance, and if possible under cover. The gunners are carried on the limbers and waggons when the battery moves faster than a walk. The provision of gun axletree seats now enables a sufficient number of men for the service of the gun to be kept with it under all circumstances. The drill for mountain batteries is not laid down anywhere, but is conducted on the same general principles as that of a field battery. Ease and celerity in coming into action is the great object in that as in all field artillery drills. At the word "halt, action, front," ("rear," "right," "left"), as the case may be, the carriage is taken off the carriage-mules, the wheels taken off the wheel-mule, and run up to the carriage and put on. The gun has by this time been lifted off by gunners by means of a handspike in the muzzle and one under the cascable, and is put on to the carriage. The movements of a mountain battery in "column of route," *i.e.*, single file, in "columns of subdivisions," the ammunition mules being alongside the gun and carriage mules, or in "columns of divisions," subdivisions being side by side, two and two, are merely adaptations of the manœuvres of field artillery.

Siege artillery. *Siege Artillery.*—The drills for the service of siege guns are numerous. Travelling carriages being used, the drill employed is a medium between field and garrison gun drills, and comprises unlimbering, limbering up, shifting from travelling to firing trunnion holes and, *vice versa*, the loading, laying, firing, &c., the mode of "taking post" under cover and at the gun.

Mortar drill would also come into this section, and embraces the manner in which the travelling mortar-beds are unlimbered and placed on the ground, and the converse operations, the detachment taking post at the mortar, the preparation for action, the mode of laying the mortar, loading, firing, &c. The laying of platforms also forms an important part of the duties of siege artillery. "Knotting" and the use of ropes and tackles is an essential branch of the drill. A siege artilleryman must be instructed in all the materials and appliances used in moving ordnance. Chains, levers, handspikes, fulcrums, skids, planks, rollers, crab capstans, lifting jacks, &c., all enter into his work. He must also be acquainted with the numberless operations by which siege guns are moved when dismounted, the mode of mounting and dismounting them, while the drills for gyns, sling waggons, sling carts, sheers, &c., are particularly his province.

Garrison Artillery.—The drills for garrison artillery embrace all those which come under the head of *siege*, but, further, comprise all the drills and exercises with heavy ordnance, such as drills with heavy guns on standing carriages, traversing platforms, and Moncrieff carriages, and with the enormous 10-inch, 11-inch, and 12-inch guns, fitted with special mechanical contrivances for loading, traversing; mounting and dismounting of heavy ordnance; and all kinds of work with sheers and derricks. The garrison artillery are also trained in the ordinary duties of infantry, viz., carbine, company, and battalion drill. All artillerymen are further instructed in the laying of ordnance, judging distance, and in the various laboratory operations which gunners are required to know, the handling of all kinds of projectiles, fuzes, &c.

The uncombined tactics of artillery. *Field Artillery Manœuvres.*—In manœuvring batteries, no fixed right or left is acknowledged, but only the front to which the guns point when in action, or the horse's face when limbered up. The paces used are the walk, trot, and gallop, and, according to Taubert, the "trot" is the most important. With us field batteries are strictly enjoined not to move beyond a trot, but there are occasions on which it is necessary for a battery to move at its quickest possible pace; and in Germany this is recognised and acted upon. Field artillery has increased in mobility by the recent change in *matériel* and the provision of axletree seats, so that there is no longer danger of a gun coming into action without a sufficient number of gunners to work it. Batteries should, therefore, be exercised to manœuvre with waggons at a safe distance, taking advantage of cover, but conforming to the movements of the guns.

Columns of artillery are composed of batteries, half batteries, divisions, subdivisions, and columns of route. Taubert divides artillery columns into (1) the column of march, (2), the rendezvous column, (3) the column of manœuvre. 1. With us the first is usually the "column of route" or single file, each waggon following its own gun in a long string. In the German army the guns come first, and then the waggons. This has the great advantage of not hampering the line of march, and is peculiarly adapted to the use of artillery with a large advanced guard. Columns of divisions may be used on a very broad road. 2. Rendezvous columns are open columns with the guns at full interval, so as to admit of guns, &c., reversing or taking ground to right or left. 3. The column of manœuvre may, when cover exists, be formed at close interval, but never so under fire. A close formation enables batteries to get near an enemy unseen, and the commander has the force well in hand, but this advantage should not weigh with the necessity for opening out for fire at the earliest moment. The best formation on the battle-field is that which admits of the easiest deployment for action. The position of guns is always governed by the nature of the ground, and "every possible advantage should be taken of this without paying too much attention either to intervals or dressing." The construction of gun-pits and epaulements for the waggons should be an important part of drill.

Positions for artillery must naturally be dependent on the character of the ground, and the objects to be executed by the guns. But where a choice exists, we must be guided by principles which secure us the vantage ground. A flat trajectory for our guns is highly important in diminishing the safe space for the enemy, and with this view a very elevated position is to be avoided. Such position is also bad if percussion fuzes are used, and the soil which the enemy occupies is soft. On the other hand, artillery do not now change their positions so frequently as in times past, and are more constantly required to fire over the heads of their own infantry; and a position sufficiently elevated to give a good command of the country and search out the enemy's position is therefore more required than formerly. Shell firing against troops under cover will also enter largely into the use of artillery in future, and for this command is of importance. A point of first importance in selecting a position is the absence of cover for the enemy within range of infantry rifle fire; and the position should be such that advance or retreat is easy. The brow of a hill, where the guns can be partly, and the limbers and waggons entirely covered by being withdrawn, is generally advantageous. The ground should be neither heavy nor stony. A good deal of controversy has taken place about the dispersion or concentration of guns for fire. If the object, *i.e.*, concentration of fire, can be attained by dispersion of batteries, it may be better under certain circumstances of ground to separate than to collect the artillery in large masses; on the other hand, dispersed batteries are much more out of control, and unable to receive the directing impress of one mind, and usually the employment of large masses of artillery will have a greater moral effect. The one object, concentration of fire, must be attained. Artillery positions.

The most powerful and effective position in which artillery can be placed is that in which, acting on a flank, it enfilades or takes in flank the enemy's troops. A remarkable illustration of this was given by Frederick the Great at Rossbach. At the battle of Talavera, July 28, 1809, the British guns changed position to the right, advancing from the left flank, and brought a destructive fire to bear on the French columns attacking from the centre of their line. At the battle of Bautzen, May 21, 1813, Napoleon's great manœuvre, in sending Ney to attack the right rear of the allied position, was frustrated by the fire of 20 Prussian guns taking Ney's columns in flank on the march. The battle of the Alma, September 20, 1854, gives an example of the effect produced by the enfilade fire of a few guns. Two guns of Turner's battery boldly advanced to a knoll which had been left unguarded almost in the centre of the Russian position, took the Russian columns in flank, and with such effect as almost to decide the fortunes of the day.

It has been explained that, in the early days of artillery tactics, guns had occasionally been massed, but usually with no clear aims as to their functions; nor was this state of things altered until far into the Napoleonic era. It was at the camp of Boulogne in 1805 that a truer system of tactics was first practised, and it was at the battle of Friedland, on the 14th June 1807, that the first striking example of the effect of artillery when employed in masses was given. The Russians had crossed the river Alle and taken up position in front of the town of Friedland. Ney had been ordered by Napoleon to drive back the Russian left and occupy Friedland, but had met with a severe check, when the French artillery general Senarmont collected the divisional artillery of the 1st corps, and, dividing it into two batteries of 15 guns each, with a reserve of 6 guns, placed a battery on each side of the road from Eylau, and by a converging and destructive fire of case broke the Russian columns, defeated all attempts on their part to resume the offensive, and finally drove the Russian left into the narrow defile and re-entering bend of the river.

At the battle of Wagram, 6th June 1809, Napoleon, pivoting on his left, advanced his right, turning the Austrian left, and attacked the centre with a mass of 100 guns. This imposing display of artillery power covered the French centre, and fixed the attention of the Austrian commander to the point, while the left was enabled to execute its turning movement. The French artillery, however, suffered excessively, the range being too short, and the want of mobility of the field batteries conspicuous.

The battle of Lützen or Gross-Görschen was fought between the allied Russians and Prussians and the French in May 1812. The former had 438 guns, the latter only 236. The allied artillery was not well handled, the fire being kept up in a dispersed and thriftless manner, the guns scattered between the infantry columns, and no powerful reserve being formed. Napoleon, reserving the artillery power he possessed, brought up a mass of 80 guns at the decisive moment, and with such effect that the allies gave ground and ultimately retreated.

The battle of Hanau, October 30, 1813, is a striking instance of an artillery fight. Napoleon was retreating from Erfurt after his defeat at Leipsic. Wrede barred his retreat, holding the issues of the forest of Hanau. Wrede had formed a battery of 60 guns, which for some time defeated all efforts of Napoleon to break out from the forest; and it was only Drouet's skilful concentration of fire, from three gradually reinforced masses of artillery upon Wrede's large battery, that enabled Napoleon ultimately to win his way out.

For other illustrations of the use of artillery on the battle-field, the reader is referred to Taubert's work *On the Use of Field Artillery*, translated by Col. H. H. Maxwell, R.A., and Hohenlohe-Ingelfingen's treatise *On the Employment of Field Artillery*, translated by Capt Clarke, R.A.

In the Italian campaign of 1859 a close country prevented much use being made of artillery, but at Solferino both Austrians and French massed considerable numbers of guns, and a brilliant example of the use of artillery was presented on the plain of Medole. M'Mahon having inclined to his left to support the attack on the Solferino heights, while Niel was fully engaged with a superior Austrian force on his right, a gap was created between these two corps. To fill this a mass of 42 guns, supported by cavalry, formed on the plain of Medole, and their fire frustrated all offensive attempts of the Austrians at this point. Rifled guns were employed by the French in this campaign, and without doubt contributed largely to their success.

In the struggle for supremacy of the two great German powers in 1866, both combatants were armed with the new weapons, but their proper applications seem to have been totally misapprehended. The Prussian batteries were kept too much in rear of the other troops while on the march, and came into action at ranges which only a very exaggerated view of the powers of rifled guns could justify. At Trautenau, Nachod, and Skalitz their artillery played an unimportant part; at Sadowa comparatively few of the vast number of their batteries came into effective action. The Austrian artillery had but little opportunity of displaying superiority of management or tactical training, though its heroism and self-sacrifice in covering the retreat on the eve of Sadowa is worthy of mention.

Till the campaign of 1870–71, the proper management and powerful effect of modern artillery was never thoroughly realised. The pungent criticism of certain anonymous writers on the 1866 campaign bore its fruits, and revolutionised the system of artillery tactics. From the storming of the Spichern heights up to the capture of Le Mans the same tactical features were prominent on the victorious side. A battle was preluded by the bold advance of all available guns. The attack commenced with a concentrated fire of artillery, the moral, if not actual, effect of which enabled an offensive movement of infantry to be made with success, or at least kept the enemy in check till the flanking movements, so conspicuous in this war, were carried out. At Wörth more than 100 guns were massed on the heights opposite Fröschwiller, and enabled a frontal attack to be made across the open valley of the Sauer. In the battles about Metz the massing of batteries was especially prominent. At Rezonville groups of 6 to 10 batteries acted in effective concert; at St Privat more than 200 guns cannonaded the French position for some hours. At Sedan the German guns were pushed forward regardless of escort, even in front of the advanced guards, and enclosed the ill-fated French army in what has been aptly described as a circle of fire.

In the Napoleonic wars guns were massed at the crisis of an engagement in order to strike a decisive blow, now they are assembled much earlier in order to render an attack possible. Modern artillery tactics may be summed up in a few words. The artillery of advanced guards is considerably increased, and the greater proportion of the corps and divisional guns march close to the head of the main columns. At the commencement of an engagement batteries are pushed to the front with great boldness, massed as much as possible, and concentrate their fire. Frequent change of position is deprecated, but guns must be kept within effective range, and their safety subordinated to the success of the other troops. The contemporaneous action of the three arms is more common than it used to be.

In future wars it is doubtful whether the independent action of artillery will not be somewhat restrained. Mechanical contrivances may make the accurate finding of ranges possible, and the employment of shrapnel shell, with an efficient time-fuze, render artillery fire more destructive than it has hitherto been. The action of mitrailleurs will probably be important when their efficacy and sphere of employment are thoroughly comprehended. No great improvement in the range and accuracy of fire of guns can be expected, as the practical limits of both have already been nearly reached. A few years may, however, witness the advent of a projectile power superior to gunpowder, and a shell more destructive than any at present in use. (See Guns and Gunnery.) (E. H. H. C.)

ARTOIS, an ancient province of the north of France, corresponding to the present department of Pas de Calais, with the exclusion of the arrondissments of Boulogne and Montreuil, which belonged to Picardy. It is a rich and well-watered champaign, producing abundance of grain and hops, and yielding excellent pasture for cattle. The capital of the province was Arras, and the other important places were Saint-Omer, Béthune, Aire, Hesdin, Bapaume, Lens, Lillers, Saint-Pol, and Saint-Venant. The name Artois (still more corrupted in "Arras") is derived from the Atrebates, who possessed the district in the time of Cæsar. From the 9th to the 12th century Artois belonged to the Counts of Flanders It was bestowed in 1180 on Philip Augustus of France by Philip of Alsace, as the dowry of his niece, Isabella of Hainault. In 1237 it was raised to the rank of a countship by Saint Louis in favour of his brother Robert. Philip, the son of Robert II., having died before his father, the transmission of the title was disturbed. The countship was claimed by Robert, Philip's son, and his descendants, better known as the counts of Edu, continued to style themselves counts of Artois; but it was actually inherited by Mahaud or Matilda, daughter of Robert II. By her marriage with Otho IV., Artois passed to the house of Burgundy, in whose possession it remained till the marriage of Mary, the daughter of Charles the Bold, to the Archduke Maximilian brought it to the house of Austria. By the peace of Nimeguen it was ceded to France in 1678. The title of count of Artois was borne by Charles X. of France before his accession to the throne.

ARU ISLANDS, a group of about thirty islands, nominally under the Dutch government of the Moluccas, which lie south of New Guinea, between lat. 5° 20′ and 6° 55′ S., long. 134° 10′ and 134° 45′ E. Tana-busar, the largest island, is 80 miles from north to south, and is crossed by three river-like creeks tunning east and west, called Watelai, Vorkai, and Maykor. No part exceeds 100 feet in elevation, but it is only on the coast that the ground is swampy. The principal formation is coralline limestone; the eastern coast is defended by coral reefs, and the neighbouring sea is shallow, and abounds in coral in full growth. The other islands of importance are Wamma, Pulo Bali, Oujia, and Wassia. A large part of the surface is covered with virgin forest, consisting of screw-pines, palm-trees, tree ferns, canariums, &c. Kangaroos, and a number of other marsupials, wild pigs, brush-turkeys, cassowaries, parroquets, cockatoos, birds of paradise, butterflies, ants, scorpions, sandflies, and mosquitoes are the predominant animals, the fauna being altogether Papuan. The aborigines belong to the Papuan race, but have received intermixture of foreign blood. They are a simple, emotional people, with dark-brown skins and frizzled hair. They wear little clothing, practise polygamy, purchase their wives, and are very lazy, and remarkably talkative. A few villages are nominally Christian, but elsewhere there seems to be no religion or even fetishism of any kind. In Wamma there is a town, Dobbo, to which Dutch, Malay, and Chinese traders resort once a year to traffic with the natives, obtaining trepang, pearl shell, birds of paradise, &c., and giving in exchange cloths, cutlery, muskets, gongs, tobacco, arrack, and elephants' teeth. The islands are thickly peopled, the inhabitants numbering about 60,000. The Italian naturalist Beccari spent some time among the islands in 1874; and Di Lenná, an Italian major, has executed a partial survey. (See Wallace's *Malay Archipelago*; *Ocean Highways*, 1873 and 1874; and G. Cora's *Cosmos*, 1873.)

ARUNDEL, a town in Sussex, on the river Arun, about 4 miles from its mouth, 10 miles E. of Chichester, 19 W. of Brighton, and 55 S.W. of London. It is built on the slope of a hill surmounted by the castle of the duke of Norfolk, which dates from the time of Alfred the Great. It confers on its possessor the title of Earl of Arundel. At the time of the Conquest the castle was rebuilt by Roger de Montgomerie, but it was taken from his son, who rebelled against the reigning monarch, Henry I. In 1397 it was the scene of a conspiracy organised by the earl of Arundel, archbishop of Canterbury, and duke of Gloucester, to dethrone Richard II. and murder the lords of his council, a plot which was discovered before it could be carried into execution. During the parliamentary wars of the 17th century the stronghold was frequently assaulted by the contending parties, and consequently greatly damaged; but it was restored by Charles the 11th duke of Norfolk, who made it what it now is, one of the most splendid baronial mansions in England. The town which, according to the whimsical etymology of the corporation seal, takes its name from *hirondelle* (a swallow), is divided into two parts by the river Arun, which is here navigable for vessels of 300 tons, and a canal connects it with the Thames and Portsmouth. The town-hall is a castellated building, which cost £9000, and was presented to the corporation by the duke of Norfolk. The church of St Nicholas is a very ancient structure (founded about 1375), with a low tower rising from the centre. In the north aisle of the chancel there are several ancient monuments of the earls of Arundel, and the high altar is held to be the only perfect original example in England. The church is otherwise remarkable for its reredos and iron work. Some remains of a *Maison Dieu*, or hospital, erected in the time of Richard II. still exist. Arundel was a borough by prescription, and returned two members to parliament from the time of Edward I., but it lost one by the Reform Act of 1832, and the other by that of 1868. (See Tierny's *Hist. of Castle and Town of Arundel*, 2 vols., 1834.)

Arms of Arundel.

ARUNDEL, Thomas, Archbishop of Canterbury, born in 1353, was the second son of Robert, earl of Arundel and Warren. At 22 years of age he was raised to the bishopric of Ely, to the church and palace of which he was a great benefactor. In 1386, after the deposition of the earl of Suffolk, he was appointed lord chancellor of England; he was deprived of this office in 1389, but again reinstated. In 1388 he was translated to the see of York, and in 1396 was advanced to the primacy of Canterbury, when he resigned the chancellorship. This was the first instance of the translation of an archbishop of York to the see of Canterbury. Scarcely was he fixed in this see when he had a contest with the University of Oxford about the right of visitation. The affair was referred to the king (Richard II.), who determined it in favour of the archbishop. At his visitation in London he revived an old constitution, by which the inhabitants of the respective parishes were obliged to pay to their rector one halfpenny in the pound out of the rent of their houses. While bishop of Ely, Arundel had taken a leading part in forcing the king to consent to the commission of regency; Richard never forgave this, and in 1397 the parliament, with the king's leave, impeached the archbishop, with his brother Richard earl of Arundel, and the duke of Gloucester, on a charge of high treason. He was sentenced to be banished, and to depart the kingdom within forty days on pain of death. He retired, first to France, and then to the court of Rome, where Pope Boniface IX. gave him a kind reception, and nominated him to the Scottish archbishopric of St Andrews. He was actively engaged in the plot to depose Richard, and place the duke of Lancaster on the throne; and on Henry's accession, he was restored to the see of Canterbury. Two years after, the Commons moved that the revenues of the church might be applied to the public service, but Arundel opposed the measure with such vigour that it was thrown out. In the year 1408 his zeal for the suppression of heresy was directed against the followers of Wycliffe. Sir John Oldcastle, Lord Cobham, was arrested by his orders, and sentenced to the flames, but contrived to escape from prison. The archbishop also procured a synodical constitution, which prohibited the translation of the Scriptures into the vulgar tongue. He died at Canterbury on the 20th February 1413 of inflammation of the throat, with which he was seized, as was affirmed by the Lollards, while pronouncing sentence upon Lord Cobham.

ARUNDELIAN or OXFORD MARBLES, part of a collection of ancient sculptures and antiquities, including the famous Parian Chronicle, formed by Thomas earl of Arundel, and presented by his grandson, the Hon. Henry Howard (afterwards duke of Norfolk), to the University of Oxford in the year 1667. They were purchased for the first proprietor in 1624 by Mr (afterwards Sir William) Petty, who, along with John Evelyn, had been employed by the earl of Arundel to collect marbles, books, statues, and other curiosities in Italy, Greece, and Asia Minor. On their arrival in London in the year 1627 they were placed in the gardens of Arundel House, the site of which is now occupied by Arundel, Norfolk, Surrey, and Howard Streets in the Strand. Thomas Howard, earl of Arundel and Surrey, the founder of the collection, was born in 1586 (or, according to others, 1592). He had at first only the honorary title Lord Maltravers, but in 1603 he was restored to most of the honours previously in the possession of his family. For several years he resided or travelled in Italy, and there acquired a strong taste for works of art, specimens of which he began to collect. In 1621 he was made earl marshal of England, and afterwards discharged the offices of ambassador, general, and lord high steward. He went abroad in 1641, and died at Padua in 1646. His large collection contained not only sculptured marbles, but also coins, busts, statues, and gems. In the turbulent reign of Charles I., and during the Protectorate, Arundel House was often deserted by its owners; and, in their absence, some of the marbles were defaced and broken, and others either stolen or used for the ordinary purposes of architecture. After the death of the earl his collection was divided among his family. The inscribed marbles, which fell to the elder son, ultimately found their way to Oxford; the busts and some statues were sold and dispersed; and the gems descended to the Marlborough family, in whose possession they now are. Some of the statues, which had been purchased at the sale of Arundel House by Sir William Fermor, were presented to the University of Oxford in 1755. Of the large collection now known as the Arundel or Oxford marbles the most remarkable is the Parian Chronicle, or Marmor Chronicon. This when found consisted of a large oblong slab of Parian marble, on which was engraved in capital letters a chronological compendium of the principal events of Greece during a series of 1318 years, beginning with the reign of Cecrops, 1582 B.C., and ending with the archonship of Diognetus, 264 B.C. The marble originally measured 3 feet 7 inches and 2 feet 11 inches on the two sides respectively, its breadth being 2 feet 7 inches; but the chronicle of the last 90 years is lost, so that the part now remaining ends with the archonship of Diotimus, 354 years before the birth of Christ; and in this fragment the inscription is at present so much corroded and effaced that the sense must in some measure be supplied by conjecture. Immediately on the arrival of these marbles in England the greatest curiosity was excited among literary men. Selden, with the assistance of some other scholars, cleaned and examined first the marble containing the Smyrnean and Magnesian league, and then the Marmor Chronicon. The following year Selden published a small volume in quarto, including about 39 inscriptions copied from the marbles. His researches were continued and completed by Prideaux (1676), Maittaire (1732), and Chandler (1763). The Arundelian marbles, though generally regarded as genuine relics of antiquity, have been discovered in some instances to differ somewhat from the most authentic historical accounts. Their authenticity was called in question in a dissertation by the Rev. J. Robertson, published in 1788, entitled *The Parian Chronicle*. This essay has been answered by several writers, particularly by the eminent scholar, Professor Porson, and the authenticity of the marbles may be regarded as fairly established. See Boeckh, *Corpus Inscriptionum Græcarum*, 1843.

ARVAL BROTHERS (*Fratres Arvales*), in *Roman Antiquities*, a college or priesthood (*sacerdotes arvorum*), consisting of twelve members, elected for life from the highest ranks in Rome, and always apparently, during the empire, including the emperor. Their chief duty was to offer annually public sacrifice for the fertility of the fields (*ut fruges ferant arva*). The origin of the brotherhood was traced to Acca Larentia, the foster-mother of Romulus, who, with her twelve sons, had instituted sacrifices of this kind, and probably this legend arose from the connection of Acca Larentia, as *mater Larum*, with the Lares who had a part in the religious ceremonies of the arvales. But apart from this, there is proof of the high antiquity of the college in the verbal forms of the song with which, down to late times, a part of the ceremonies was accompanied, and which is still preserved (Becker, *Handbuch der Röm. Alterthümer*, iv. p. 407). It is clear also that, while the members were themselves always persons of distinction, the duties of their office were held in high respect. And yet it is singular that no mention of them occurs in Cicero or Livy, and that altogether literary allusions to them are very scarce. On the other hand, we possess a long series of what may be called the minutes of their proceedings, drawn up by themselves, and inscribed on stone. At the time of Marini (*Gli Atti e Monumenti de' Fratelli Arvali*, Roma, 1795) 67 of these sets of records were known, beginning at 14 A.D. and extending to the time of Gordian. Since then several others have been discovered. The college consisted of a master (*magister*), a vice-master (*promagister*), a *flamen*, and a *prætor*, with eight ordinary members, attended by various servants, and in particular by four boys, sons of senators, having both parents alive. These officers were elected annually in May, but did not enter on their duties till the 17th December. Each wore a wreath of grain, a white fillet, and the prætexta. The great annual festival which they had to conduct was held in honour of the Dea Dia, who appears to have resembled the goddess Ops, the wife of Saturn. It occupied three days, and fell either on the 17th, 19th, 20th, or the 27th, 29th, 30th of May. The ceremony of the first day of the May festival took place in Rome itself, in the house of the magister or his deputy, or *in Palatio Divorum*, where after sunrise the peculiar ceremony was gone through of "touching" (*tangere fruges*) samples of the old and the young grain. On the second and principal day of the festival the ceremonies were conducted *in luco Deæ Diæ*, that is, in a grove just beyond the fifth milestone from

Rome on the Via Portuensis. The first act was to sacrifice two young pigs (*porciliæ piaculares*) to purify the grove, which, it was held, was liable to be defiled in a religious sense by the felling of trees, and by the presence in it of any iron tool or instrument, such as was required by the lapidary who engraved on stone the records of the proceedings. Then, after the sacrifice of a white cow, the magister drew up a minute of what had been done, and all retired to their tents. At midday they again met, settled and confirmed the minutes, and the public being now excluded, went into the depth of the grove to sacrifice a fat sheep. Returning to the temple, the *thesauri*, which seem to have been money collected from the people present, were placed on the altar, and the arvales arranged themselves in a line, with an attendant at each end. The attendant at one end received from the public the samples of grain and fruits which they had brought to be "touched," or blessed, and handed them to the brother next him, who passed them on till they reached the attendant at the other end, who restored them to the owners. The arvales now entered the temple, and with closed doors proceeded to dance and sing the song of the brotherhood, which is known to have been sung by them in its ancient form down to the 3d century A.D. This was followed by the election of officers for the next year, a banquet, and races. On the third day the sacrifice took place in Rome, and was of the same nature as that offered on the first day. Among the many minor occasions on which the arvales had to offer sacrifice were the birthday of an emperor, the beginning of a consulate, an escape from danger, the starting for or return from a journey, or other event of importance to the imperial family, but especially on the 3d of January, on which day a particular form of prayer for the ruling emperor was recited, and sacrifice offered to a series of deities, male animals to male deities, and female to female. In the British Museum is a bust of Marcus Aurelius in the dress of a Frater Arvalis. (Henzen in the *Hermes*, ii. p. 37; De Rossi, *Annali d. Inst. Arch. Rom.*, 1858, p. 58.)

ARVE, a river which rises in the Col de Balme, one of the Savoyan Alps, and passing through the valley of Chamouni, falls into the Rhone near Geneva, after a course of about 50 miles. (See *Journ. R. Geog. Soc.*, vol. xxvii.)

ARYAN, a technical term, applied to one of the great families of language, which extends from India to Europe, and which, for that reason, is called also *Indo-European*. Friedrich Schlegel, who first recognised the family relationship of these languages (*Die Sprache und Weisheit der Indier*, 1808), assigned to them the name of *Indo-Germanic*, a name still used by preference by many scholars in Germany (Pott, Benfey, &c.) Bopp (*Vergleichende Grammatik*, vol. i. p. xxiv.) decided in favour of *Indo-European* as a more appropriate name for that large family of speech. Other scholars have used the names *Japhetic*, *Sanskritic* (W. von Humboldt), and *Mediterranean* (Ewald).

The objection to *Indo-Germanic* as the technical name of the whole family is that it is too long, and yet not sufficiently extensive. If the family is to be distinguished by the names of its two extreme members, the name ought to be *Indo-Celtic*, rather than Indo-Germanic; if by its most important members, then, as remarked by Bopp, the name should be *Indo-Classic*. *Indo-European* is an equally cumbersome name, and less correct even than Indo-Germanic, considering that there are many languages spoken both in India and Europe which do not belong to that family. *Sanskritic* would be a misleading name, as countenancing the idea that all the members of this family are derived from Sanskrit. *Japhetic* seems to revive the Jewish conception of the three ancestors of the human race, *Shem*, *Ham* and *Japhet* and would, from the strictly Hebrew point of view, comprehend many tribes in the north of Asia and Europe who speak Turanian languages. Ewald, who suggested the name of *Mediterranean*, distinguishes, besides the Mediterranean, three other families of speech, the *Northern*, commonly called North Turanian or Altaic, the *Semitic*, and the *Copto-African*. He explains the name of Mediterranean by saying, that "the races speaking these languages inhabited the large central circle, surrounded by Semitic, South-Indian, Chinese, Turko-Tataric, and Bask languages" (*Lehrbuch der Hebräischen Sprache*, p. 17, note). The reason why this name has not been accepted, seems to be that locality has little to do with the essential character of languages, and that the central position once occupied by the people who spoke these tongues belongs to them no longer.

Aryan, as a name for a whole family of languages, has the advantage of being short, and, being a word of foreign origin, of lending itself more easily to any technical definition that may be assigned to it. It has been accepted by many writers in England, France, and India. In Germany, too, it is used in this wide sense by Lassen and others, while some scholars have used the term in the more restricted sense of *Indo-Iranian*,—*i.e.*, as comprehending the languages of India and Persia, which constitute the south-eastern as distinct from the north-western (Greek, Latin, Celtic, Teutonic, Slavonic) branch of the family.

Origin of the Word.—*Aryan*, as a technical term, has been borrowed from the Sanskrit *arya* or *ârya*, the Zend *airya*. In the later Sanskrit *ârya* means, of a good family. It is used as a complimentary address. Originally, however, it was used as a national name, and even as late as the time of the Laws of Manu, India is still called *Ârya-âvarta*, *i.e.*, the abode of the Aryas. In the Veda, *Ârya* is the name by which the believers in the gods of the Veda call themselves, in opposition to their enemies, who are called *Dāsas* or *Dasyus*. The distinction appears in passages such as the following:—

I. 51, 8. "Distinguish, Indra, the *Âryas* and those who are *Dasyus*" (vî *g*ānihi ā́ryān yé *k*a dásyava*h*).

X. 86, 19. "I, Indra, distinguishing the *Dāsa* and the *Ârya*" (vi*k*invân dā́sam ā́ryam).

We frequently read of the gods protecting the *Ârya* and destroying his enemies.

III. 34, 9. "Indra, having killed the *Dasyus*, protected the *Âryan* colour" (hatvî dásyūn prá ā́ryam vár*n*am āvat). This looks like an ethnological distinction of colour between *Aryas* and *Dasyus*.

X. 49, 3. "I (Indra) who do not give over the *Âryan* name to the *Dasyu*" (ná yá*h* raré ā́ryam nā́ma dasyáve).

In X. 11, 4, we read of Aryan clans, ā́ryā*h* visa*h*

I. 103, 3. "Indra, increase the *Âryan* power" (ā́ryam sáha*h* vardhaya).

VIII. 103, 1. "Agni, the increaser of the *Ârya*" (ā́ryasya várdhanam).

VII. 18, 7. "Indra, the companion of the *Ârya*" (sadhamā́*h* ā́ryasya).

I. 130, 8. "Indra protected in battles the *Âryan* sacrificer" (I′ndra*h* samátsu yá*g*amānam ā́ryam prá āvat).

The gods, it is said, bring light for the Arya.

I. 59, 2. "Agni is made a light for the *Ârya*" (tám tvā devā́sa*h* a*g*anayanta devám vais*v*ānara *g*yóti*h* ít ā́ryāya); or, "Agni creates broad light for the *Ârya*, driving the *Dasyus* from the house" (VII. 5, 6).

II. 11, 18. "He (Indra) uncovered the light for the *Ârya*, the *Dasyu* was left on the left hand" (ápa av*r*i*n*o*h* *g*yóti*h* ā́ryāya ní savyatá*h* sādi dásyu*h* indra).

IV. 26, 2. "I gave the earth to the *Ârya*, and rain to the liberal mortal" (Ahám bhū́mim adadām ā́ryāya ahám v*r*ish*t*ím dāsúshe mártyāya).

117, 21. "The two Asvins have made the light wide for the *Ārya*" (urú gyótih kakrathuh ãryāya).

That light itself, the light of the day or the daily light and life, are called the *Āryan* light, X. 43, 4, and some of the gods too are addressed by the name of *Ārya*. In V. 34, 6, we read of Indra, "that he, the *Ārya*, leads the *Dāsa*, according to his will" (yathāvasám nayati dãsam ãryah). In X. 138, 3, too, Indra seems to be called by that name.

Most frequently, no doubt, the *Ārya* is conceived as the worshipper of the gods. He was called so in I. 130, 8; again in I. 156, 5, *Ārya* and *Yagamāna*, sacrificer, are mentioned together.

In IX. 63, 5, the *Ārya* is opposed to the *árāvān*, the enemy, the man who offers no sacrifices; and I. 51, 8, the same distinction is drawn between the *barhishmat*, the sacrificer or *Ārya*, and the *avratá*, the lawless, the *Dasyu*.

But the enemies of the poets and their friends are not only among the *Dasyus*, but also among the *Āryas*, and in their tribal feuds one Ārya speaks of the other as *adeva*, godless, in the original sense of the word. Thus we read:—

X. 102, 3. "Turn away the weapon of the *Dāsa* or the *Ārya*" (dãsasya vā maghavan ãryasya vā sanutáh yavaya vadhám).

X. 83, 1. "Let us withstand the *Dāsa*, the *Ārya*, with thee as helper" (sahyãma dãsam ãryam tvấyā yugã).

VI. 33, 3. "Thou, O hero, struckest these two enemies, the *Dāsa* fiends and the *Ārya*" (tvám tãn indra ubháyān amítrān dãsā vritrãni ãryā ka sūra vádhih).

VI. 60, 6. "They (Indra and Agni) kill the *Ārya* fiends, they kill the *Dāsa* fiends, they strike off all haters (fem.)" (hatáh vritrãni ãryā hatáh dãsāni sátpatī hatáh visvāh ápa dvíshah).

Similar passages, mentioning *Ārya* and *Dāsa* enemies, occur, VI. 22, 10; VII. 83, 1, X. 69, 6, &c. In VIII. 24, 27, the *Ārya* enemy is contrasted with the *riksha*, literally, the bear.

The *Arya* enemy is called godless in X. 38, 3, "Whatever *Dāsa* or godless *Arya* means to fight us". (yáh nah dãsah ãryah vā purustuta ádevah indra yudháya kiketati).

Lastly, *Ārya* means in some passages what befits or belongs to an *Arya*, what is proper and right.

X. 65, 11. "The gods spread all over the earth the *Āryan* laws" (sudānavah, ãryā vratã vi srigántah ádhi kshámi).

In IX. 63, 14, the sacred receptacles of the Soma are called *ārya* (eté dhãmāni ãryā sukrãh ritásya dhãrayā vãgam gómantam aksharan).

It is clear from these passages that *Arya* is one of the oldest names by which people belonging to this great family of speech called themselves in distinct opposition to their enemies. It is admitted also that the Veda, in which this name occurs, surpasses in antiquity every other literary document belonging to the same race, and it would be difficult, therefore, to find another name better adapted to serve as a technical term for the whole Aryan family of languages.

As *Ārya* had become a proper name as early as the poems of the Veda, its original and etymological meaning would be of little consequence, had it not been used as an additional argument both in favour of and against the technical use of Ārya. Professor Bopp derived ãrya from the root ar, to go, or even from ark, to venerate. The former etymology would give no adequate sense, the latter is impossible. Lassen explains ãrya as *adeundus*, like ãkārya, teacher. But in explaining ãrya, it must be remembered that it cannot be separated from árya with a short a, and that in consequence no etymology of ãrya can be entertained which does not at the same time account for árya. This word is used in the Yagurveda in exactly the same sense as ãrya in the Rig-veda. Thus we read, Vāgasaneyi-Sanhitā, 20, 17, "Whatever sin we have committed against an Arya, or against a *S*ūdra" (yák khūdré yád árye yád énas kakrimã vayám).

Here Arya is used in opposition to *S*ūdra, as Arya was used in the Rig-veda in opposition to Dāsa. In the Rig-veda, too, we find at least some traces of arya, used in the sense of ārya, and in opposition to dāsa, viz., in the compound aryá-patnī, having an Arya as husband, as opposed to dāsá-patnī, having a Dāsa as husband.

There can be no doubt, therefore, that ãrya, the word which, as soon as the system of the four castes became more firmly established, took the technical meaning of "belonging to the three upper castes," viz., the Brāhmanas, Kshatriyas, and Vaisyas, came from ărya, and that in *ărya* must be discovered the original etymological meaning of the word.

Here it is of great importance to observe, that ărya is not only used as a comprehensive title of the three upper castes, but also as the special name of one of them, viz., the third caste, the householders or cultivators of the soil.

In Vāgg-Samhitā, XXVI. 2, it can mean nothing but Vaisya, a man of the third class, for it is used together with Brahman, Rāganya, and *S*ūdra. It is therefore not the commentator only, as Dr Roth says, who here gives the meaning of Vaisya to the word árya, but, from the context itself, it can have no other meaning in that passage. This meaning is still clearer in a passage from the Lātyāyana Sūtras, IV. 3, 6. Here it is said that some sacrificial act should be performed, primarily by an Ārya, but if no Ārya is forthcoming, then by any Ārya, *i.e.*, either by a Brāhmana or Kshatriya (Aryābhāve yah kas kāryo varnah. Comment, yadi vaisyo na labhyate yah kas kāryo varnah syāt, brāhmano vā kshatriyo vā).

Pānini (III. 1, 103) distinctly ascribes to árya the meaning of Vaisya and master; in IV. 1, 49, the 7th Vārttika distinguishes between Arya and Kshatriya; and what is still more important, both the author of a Vārttika to Pān., III. 1,103, and the author of the Phit-sūtras, state that when árya means Vaisya, it has the accent on the first syllable, like ãrya.

Having thus traced the connection of ãrya and árya, both in form and meaning, we have now to consider how *árya* came to mean Vaisya. Vaisya, is formed from vis, house, settlement, like ãrya and árya, from ar. We have also vesyām in the Veda, meaning, as it seems, family or clan. Vaisya, meant a householder, and vis also, plural visah, is frequently used in the Veda as a name for people. Other old names for people in the Veda are kshiti, a dwelling and a dweller, from kshi, to dwell; Greek, κτι in ἀμφικτίονες; or krishti ploughing or ploughers.

If, therefore, there was a Sanskrit word *ar*, meaning earth, then árya, in the sense of landholder, or countryman, would have been formed regularly like Kshámya, χθόνιος, from ksham, χθών, earth; like gávya, from go, cow, nárya, from nár, man. Now ar, in the sense of earth, does not occur in Sanskrit; but that such a word existed is proved by its derivatives. The Greek ἔρα in ἔραζε would correspond to a Sanskrit irā, which irā again stands to ir, like kshudhā, hunger, to kshudh. Finally, ir must be traced back to a radical ar, the change of a to i being analogous to that of Sk. pitar, father, as compared with πατήρ, pater, Goth. fadar.

The question now arises, whether irā or ir ever occurs in Sanskrit as a name of earth. The native dictionaries, such as the Amarakosha, assign that meaning to irā, and to ilā, and the latter form occurs in the famous name of Ilāvrita (explained as ilā prithivī vritā yena), the district of *Ilā*, the centre of gambudvīpa or India, gambudvīpa itself being the centre of the seven great continents of the world (Vishnu-Purāna, B. II. cap. 2).

In the Rig-veda irā occurs but once, and there, V. 83, 4, it has the meaning of food springing from the earth. "Food is produced for every being, when Parganya quickens the earth with seed" (írā vísvasmai bhúvanāya gāyate yát pargányah prithivîm rétasā ávati).

Here irā cannot mean simply "a liquid, a draught, feast, particularly a draught of milk;" for the simile shows that the rain is taken as seed, and that from it the food (irā) is supposed to spring (gāyate).

In another passage in the Atharva-veda, IV. 11, 10, irā may mean earth, but the sense is doubtful. If it be asked how irā, originally meaning earth, could take the meaning of food, we must remember the tendency of ancient language to mix up cause and effect, the producer and the produced. Irā, meaning originally earth, would be used in many circumstances as the food and sustenance supplied by the earth, just as gauh, cow, in the Veda is used, not only for milk, but even for leather.

The adjective irāvat means possessed of nourishment, nourishing. Anira means without food, and anirā amîvā seems to be a name for famine. In one place, Rig-veda, IX. 97, 17, ilāvat stands for írāvat; vrishtím nah arsha divyām gigatnúm ílāvatīm, "Give us the heavenly, streaming, fruitful rain."

Considering the antiquity of the name arya, we may refer its origin to a period in the history of the Aryan language, when the primitive substantive ar was still used instead of the later *arā, irā, ἔρα. As from χαμᾶζε we should be justified in postulating the former existence not only of χαμᾶ, earth, but even of a more primitive substantive χαμ, which is actually preserved in χθών, so from ἔραζε, we conclude the former existence not only of ἔρα, but also of a substantive ἐρ, Sk. ar.

Whether ărya means born of the earth, or holding, cultivating, possessing the earth, in either case such a name finds ample analogies in the names by which the early dwellers on the earth spoke of themselves. It is not in modern languages only that people call those of their own country, *Landsmann*, countryman, but in Greek, too, γηίτης is used in that sense, while γείτ-ων, equally derived from γῆ, means neighbour. The Latin vicinus, neighbour, is derived from vicus, the Greek, οἶκος, the Sanskrit, vesa; all connected with the Sanskrit vis, dwelling or dweller, the synonym of ărya in Sanskrit. In Gothic, gaujan, a countryman, is derived from gauja, land, probably connected with χαμ in χαμ-ᾶ-ζε. Connected with this same χαμ (χθών, χθαμαλός) is the Gothic guma(n), man; Lithuanian, žmón-es, plur., men; and the Latin, hemōnes (nehemo = nemo), and homines, men, not derived from humus, but from an older nominal base, ham, hem, or hom.

Mythology also supplies several instances showing that man was conceived as born of the earth, the son and then the lord of the earth, made of dust, and meant to "till the ground from whence he was taken." Erechtheus or Erichthonios (both chtheus and chthonios point to χαμ), the national hero of the Athenians, worshipped in the oldest shrine on the Acropolis, was represented as γηγενής or αὐτόχθων (Her., VIII. 55), while Homer (*Il.*, II. 548) says of him that the Earth bore him (τέκε δὲ ζείδωρος ἄρουρα). Hellen is the son of Pyrrha, and Pyrrha, the red, was the oldest name of Thessaly. The Germans derive their race from Mannus, who was the son of Tuisco, the heavenly, who was the son of the Earth.

The root ar, which as a substantive supplied the oldest names for earth, took in its verbal application the meaning of ploughing, at least among the members of the north-western branch, Gr., ἄρο-τρον, ἀρο-τήρ, ἀρό-ω; Lat., ar-ā-re, ar-ā-trum, ar-ā-tor; Goth., ar-jan, to ear; Lith., ar-ti, to plough; Old Slav., oralo, plough; Irish, airim, I plough, arathar, plough. In the south-eastern branch it took the technical meaning of ploughing the sea, Sanskrit, ari-tram, meaning rudder, never plough (*cf.* κύματα τέμνειν and ἄρουραν τέμνειν). Yet the meaning of moving, stirring up, belonged to the root ar from the beginning, and though we ought not to derive *ar, *arā, irā, ἔρα, from a root ar, to plough, as little as homo from humus, we may well understand how ar, as the broken, reclaimed, arable land could be used, even before the Aryan separation, as one of the names of earth.

The common etymology which would assign to ărya the meaning of "belonging to the faithful" (Roth) is untenable, because arya, with the short a and accent on the last syllable, does not mean faithful or devoted, and it is extremely doubtful whether arí, from which aryá is said to be derived, occurs anywhere in the Veda with the meaning of desirous, devoted, or faithful. But even if it did, it would be impossible to leave out of consideration the name árya, meaning simply landholder, Vaisya, without any admixture of the meaning of faithful or devoted. The national name, ărya, comes directly from this árya, landholder, and árya, landholder, comes from ar, land, not from ari, which means enemy. To distinguish aryá, as a term of honour, in the sense of lord or master, from árya, the mere appellative, a change of accent was admitted, which is recognised by the earliest grammarians who mention aryá, lord, as distinguished from árya, landlord, while no native authority ever assigns to arya, still less to ari, the meaning of faithful.

Arya and Ārya, as national names, can be traced from India to Persia. In the Avesta, *airya* means venerable, and is at the same time the name of the people. The first country created by Ormuzd or Ahuramazda is called in the Avesta, Airyanem vaēgō, *Arianum semen.* The whole extent of country occupied by the worshippers of Ormuzd is also called Airyā. As opposed to the Aryan clans (airyāo dainhāvo), we hear in the Avesta of the un-Aryan clans (anairyāo dainhāvō), and the same name is contained in the Ἀναριάκαι of Strabo, a people and town on the frontiers of Hyrcania. Greek geographers use the name of Ariana in a wider sense than the Avesta. All the country between the Indian Ocean in the south and the Indus on the east, the Hindu-Kush and Paropamisus in the north, the Caspian gates, Karamania, and the mouth of the Persian Gulf in the west, is included by Strabo under the name of Ariana; Bactria is called by him the ornament of the whole of Ariana. As the Zoroastrian religion spread westward, Persia, Elymais, and Media, all claimed the Aryan title. Hellanicus, who wrote before Herodotus, gives Aria as a name of Persia. Herodotus attests that the Medians were called Arii; and even for the northernmost part of Media, Atropatene, the name of Ariania has been preserved by Stephanus Byzantinus. Even Elymais has been supposed to be derived from Ailama, a modification of Airyama. That airya was considered a name of honour we see from the cuneiform inscriptions. There Darius calls himself Ariya and Ariyakitra, an Aryan, and of Aryan descent. The same element enters into many historical Persian names, Ariaramnes, Ariobarzanes, &c. When after centuries of foreign invasion and occupation Persia rose again under the sceptre of the Sassanians to the rank of a national kingdom, the kings, the worshippers of Masdanes, called themselves again in their inscriptions, Kings of the Aryan and un-Aryan races, Irān va Anirān, Ἀριάνων καὶ Αναριάνων. Hence the modern name of Persia, Irán.

In the name of Armenia the same element of arya has been supposed to exist. The old name of the country is Armina, and its etymology is doubtful. In the language of Armenia, however, ari exists, used in the widest sense for Aryan or Iranian, and also with the meaning of brave.

More westward still traces of the name have been discovered in Aghovan, the name of the Albanians on the border of the Caspian Sea, the gh being the representation of an original r or l. In the Caucasus itself the only class speaking an Iranian language, the Os of Ossethi, call themselves Iron.

Along the Caspian and in the country washed by the Oxus and Yaxartes, Aryan and non-Aryan tribes were mingled together. Their wars find their poetical record in the Persian epic, the Shahnameh, describing the feuds and friendships between Iran and Turan. Many Scythian names, preserved by Greek writers, have an Aryan character. Beyond the Oxus, in Transoxiana, too, people are mentioned under the name of Ariacæ and Antariani. Here, however, all certain traces of the word, as a geographical term, vanish. We have indeed Aria as an old name of Thrace, and on the Vistula we meet a German tribe called Arii; but nothing is known of the origin of these names, and no conclusions should be built on them.

It should be mentioned that some scholars (Curtius) connect the Greek ἄριστος with Sanskrit arya, though deriving it from a different root; while others (Pictet) recognise arya in the Irish er, good, brave, hero. (F. M. M.)

AS, an ancient weight, consisting of 12 ounces, identical with *libra*, the Roman pound. The word is common in the old Italic dialects, and may perhaps be connected with the Greek *αἶς*, which, in the Doric dialect, is used for εἷς, *one*, *i.e.*, an entire thing; according to others it is derived from *æs*, because made of the mixed metal known under that name.

It was also the name of a Roman coin, which was of different weight and value at different periods. The first introduction of coined money is ascribed to Servius Tullius, who probably borrowed from the neighbouring Etruscans the general form and scale of value. The old *as* was composed of the mixed metal *æs*, an alloy of copper and tin, and was called *as libralis*, or *librarius*, because actually weighing a pound or 12 ounces. The *asses* were cast in a mould, and their original shape seems to have been an irregular oblong, which was stamped with the figure of a sheep, ox, or sow. After the round shape was introduced, the one side was always inscribed with the figure of a ship's prow, and the other with the double head of Janus. The subdivisions of the *as* had also the ship's prow on one side, and on the other the head of some deity. The first Punic war having exhausted the treasury, the *as* was reduced to two ounces. In the second Punic war, it was again reduced to half its weight, viz., to one ounce. And lastly, by the Papirian law it was further reduced to the diminutive weight of half an ounce. It appears to have been still more reduced under Octavianus, Lepidus, and Antony, when its value was $\frac{1}{3}$ of an ounce. It probably continued at this value till the time of the Emperor Severus, when it was again lowered to about $\frac{6}{24}$ of an ounce. During the commonwealth and empire *æs grave* was used to denote the old *as* in contradistinction to the existing depreciated coin; while *æs rude* was applied to the original oblong coinage of primitive times.

As also denoted any integer or whole; whence the English word *ace*. Thus *as* signified the whole inheritance; whence *hæres ex asse*, the heir to the whole estate.

ASAFŒTIDA, a gum-resin obtained principally from *Narthex asafœtida*, and probably also from one or two other closely allied species of umbelliferous plants. It is produced in the southern provinces of Persia, in Bokhara, and in Beloochistan, and the plant grows as far south as the Chenab Valley in the Panjab. *Narthex asafœtida* grows to a height of from 5 to 6 feet, and when the plant has attained the age of 4 years, it is ready for yielding asafœtida. The stems are cut down close to the root, and the juice flows out, at first of a milky appearance, but quickly setting into a solid resinous mass. Fresh incisions are made as long as the sap continues to flow, a period which varies according to the size and strength of the plant. A freshly-exposed surface of asafœtida has a translucent, pearly-white appearance, but it soon darkens in the air, and assumes a yellowish-brown colour. In taste it is acrid and bitter; but what peculiarly characterises it is the strong alliaceous odour it emits, from which it has obtained the name asafœtida, as well as its German name *Teufelsdreck* (devil's dung). According to the analysis of Pelletier, asafœtida contains of resin, 65·0; soluble gum, 19·4, bassorin, 11·2; volatile oil, 3·6; and malate of calcium, 0·3 per hundred parts. The oil, to which its peculiar odour is entirely due, can be distilled off with water, and contains from 20 to 25 per cent. of sulphur. Asafœtida is found in commerce in "lump" or in "tear," and it is always very much adulterated. It is chiefly carried from the various ports on the Persian Gulf to Bombay, and so powerful is the smell of the new resin that special vessels have to be employed in the trade. The whole plant is strongly impregnated with the odour of asafœtida; in the regions of its growth it is used as a fresh vegetable, the inner portion of the full-grown stem being regarded as a luxury. The gum-resin itself is very highly relished as a condiment in India and Persia, and it is in demand in France for use in cookery. In Great Britain it is only employed in medicine, being of high value in spasmodic and convulsive diseases, such as hysteria, infantile convulsions, &c., but its offensive odour is a great bar to its use.

ASBEN, a country of Central Africa, known also as AIR, which see.

ASBESTOS, or ASBESTUS (from ἄσβεστος, *unconsumable*), is a variety of the amphibole or hornblende family of minerals, and akin to tremolite, actinolite, and common hornblende. The chemical composition of the whole family is chiefly silica, magnesia, alumina, and ferrous oxide, but varies considerably. Those containing most iron are most easily fused. Asbestos consists of fine crystalline elastic fibres, with a silky lustre, varying in colour from white to grey and green, and derives its name from being specially indestructible by fire. A single fibre of it fuses to a white enamel, but in the mass it is capable of resisting ordinary flame, and has on this account been regarded from ancient times as a most interesting substance. Woven into cloth it forms a fireproof texture, which, to be purified, requires only to be thrown in the fire; gloves, napery, towels, handkerchiefs, and even dresses have been woven of it, and it is said that the ancients used to wrap the bodies of their dead in asbestos cloth to keep their ashes separate from those of the surrounding funeral pile. There are several varieties of asbestos:—(1.) *Amianthus* is the rarest and most delicate kind, its fibres being beautifully white, flexible, long, and regularly laid. It is found in the centre of the older crystalline rocks, in the Pyrenees, the Alps of Dauphiny, on Mount St Gotthard, in North America, in the serpentine of Sweden, in the Ural Mountains, Silesia, and New South Wales. But the most beautiful specimens come from Tarantaise, in Savoy, and from Corsica, where it is somewhat abundant. (2.) *Common Asbestos* is not so light, either in colour or weight, as amianthus, and is more splintery, inflexible, and irregular in structure. It fuses with difficulty before the blow-pipe into a black scoria. It is found in serpentine rocks in Anglesea, in Cornwall, and also in several parts of Scotland, as Glenelg, in Inverness. (3.) *Mountain leather* and *Mountain cork* are other varieties, where the fibres are less flexible and regular than in either of the above. Their colour is brown or a dirty white. Mountain leather is in thin flexible sheets, and mountain cork is so named from being not unlike common cork, and so light as to swim on water. It is found in Lanarkshire. (4.) *Mountain wood* is a soft, tough, opaque, brownish-coloured variety of asbestos, much heavier than the last, and melting to a black slag before the blow-pipe. It is found in Tyrol, in Dauphiny, and in Scotland at Glen Tilt, Portsoy, and Kildrummy.

It has been often proposed to employ asbestos in the manufacture of fireproof goods, and it was at one time thought that an important industry would grow out of this application. In early times the art of weaving amianthine cloth was its chief application, and was much valued. It was accomplished by weaving the fibres along with those of flax, and then heating the cloth in a furnace to destroy the flax. It is said that Charlemagne had an amianthine tablecloth, which he used to have thrown into the fire after dinner for the astonishment of his guests. Chevalier Aldini, of Milan, is said to have had a complete dress—cap, gloves, tunic, and stockings—made of asbestos cloth, and to have made very successful experiments with it by way of testing its protective power for firemen. Advantage has also been taken of its qualities for the performance of clever tricks of fire-handling. Paper has been manufactured from asbestos, and would prove invaluable, in case of fire, for charters and other important documents, were it not that the paper is rather tender for use, and that the writing disappears after a red heat. Its feeble consistency has proved the chief obstacle to its use in textile fabrics. More success has attended its employment for fireproof roofing and flooring, for non-conducting envelopes of steam pipes, and for the packing in fireproof safes. Lately it has been proposed to use it for piston-packing in steam engines, it having been found to exceed in durability any material hitherto employed—a matter of importance, especially in the case of marine engines that have to be at work night and day on long voyages.

ASCALON, now ASKULAN, one of the five chief cities of the Philistines, on the coast of the Mediterranean, 12 geographical miles N. of Gaza. It was a well-fortified town, and the seat of the worship of Derceto. Though situated in the nominal territory of the tribe of Judah, it was never for any length of time in the possession of the Israelites. After the fall of the Macedonian empire, it became, like the rest of Phœnicia, tributary alternately to Syria and Egypt. Herod the Great was a native of the city, and added greatly to its beauty; but it suffered severely in the later wars of the Romans and Jews. It again became a flourishing and important place, and from the 4th to the 7th century was the seat of a bishopric. During the first Crusade a signal victory was gained by the Christians in the neighbouring plain on the 15th August 1099; but the city remained in the hands of the caliphs till 1157, when it was taken by Baldwin III., king of Jerusalem, after a siege of five months. By Baldwin IV. it was given to his sister Sibylla, on her marriage with William of Montferrat in 1178. When Saladin (1187) had almost annihilated the Christian army in the plain of Tiberias, Ascalon offered but a feeble resistance to the victor. At first he repaired and strengthened its fortifications, but afterwards, alarmed at the capture of St Jean d'Acre by Richard Cœur de Lion in 1191, caused it to be dismantled. It was again restored in the following year by the English king, but only again to be abandoned. From this time Ascalon lost much of its importance, and at length, in 1270, its fortifications were totally destroyed by Sultan Bibars, and its port filled up with stones. The place is now a desolate heap of ruins, with remains of its walls and fragments of granite pillars.

ASCENSION, a solitary island in the Atlantic Ocean, in lat. 7° 56′ S. and long. 14° 24′ W., about 7½ miles in length and 6 in breadth, with an area of 34 square miles, and within the immediate influence of the south-east trade-wind. It is one of the peaks of a submarine ridge which separates the northern and southern basins of the Atlantic. The whole character of the island is volcanic, and its surface is broken into mountains, hills, and ravines. Towards the south-east, the Green Mountain, the highest in the island, rises 2870 feet above the level of the sea, while the plains or table-lands surrounding it vary in height from 1200 to 2000 feet. On the north side they sweep gradually down towards the shore; but, on the south, they terminate in bold and lofty precipices. Steep and rugged ravines intersect the plains, opening into small bays or coves on the shore, fenced with masses of compact and cellular lava; and all over the island are found the usual products of volcanic action. The chief productions of the island are green vegetables. Ascension has long been noted for the abundance of turtle and turtle eggs found on its shores, the season lasting from December to May or June. The coasts abound with a variety of fish of excellent quality, of which the most important are the rock-cod, the cavalha, the conger-eel, and the "soldier." The wild animals are guinea-fowl, goats, cats, rats, and land-crabs; but the goats have been almost exterminated to make way for sheep and cattle. The air is clear and light, and the climate remarkably healthy. The island was discovered by the Portuguese navigator, Juan de Nova, on Ascension day 1501; but remained uninhabited till after the arrival of Napoleon at St Helena (1815), when it was taken possession of by the British Government. The garrison, with their retainers, resided in George Town, on the north-west coast, which is abundantly supplied with fresh water from a magnificent cistern capable of containing 1700 tons of water, supplied by means of iron pipes from springs in the Green Mountain, 6 miles distant, which were reached by boring in 1830. Ascension is found useful as a station and rendezvous for the vessels employed on the coasts of Africa and Brazil; and letters were formerly often left by passing ships in a crevice in one of the rocks. Population in 1871, 27. (See Darwin's *Observations on Volcanic Islands* and *A Naturalist's Voyage.*)

ASCENSION DAY, a festival of the church, held forty days after Easter, or ten days before Whit Sunday, in memory of Christ's ascension into heaven forty days after his resurrection.

ASCETICISM, from Greek ἄσκησις, meaning the exercise or training to which the athletes subjected themselves when preparing for the games or contests, is used metaphorically to denote the habitual practice of exercising restraint over, or subduing, the bodily desires and affections which tend to lower objects, in order thereby to advance in the higher life of purity and virtue. It is the means by which the mind withdraws itself from the hindrances and temptations of the world, and clears its vision for what is spiritual and true. In its lowest stage it consists in the mortification of the flesh by fasting, penance, and the like; but in a higher sense it involves the uprooting of all worldly or temporal desires, and withdrawal from the natural relations of life. The origin of such a peculiar aspect of thought or mode of action is to be found in the wide-spread idea, not wholly Oriental, that in Unity or Identity alone is true goodness and happiness, while in Multiplicity or Difference is evil and misery. Unity is but the abstract expression for God, the Absolute, or Spirit, and Multiplicity for Matter, in which both Orientals and Greeks thought to find the origin of evil. Now, in man exist both spirit, which is the shadow of or emanation from the divine, and the body, with its various desires and passions, which is of the nature of matter, and therefore in itself evil. True happiness—nay, true life for man—consists in contemplation of God, absorption into the divine unity and essence, and this ecstatic vision can only be attained by the cultivation of the spirit, and the mortification of the body. The desires and passions must be subdued, rooted up, and the means recommended are solitude, poverty, celibacy, fasting, and penance. We find, accordingly, that in all nations, those who seek divine illumination prepare themselves by these means. In this respect the Hindoo fakirs, jogis, dervishes, and gymnosophists, and the numerous sect of the Buddhists, are at one with the Hebrew prophets, Nazarites, and Chasidim, and with the priests of the Grecian mysteries. In most of the Greek schools of thought, however, asceticism had less a mystical and religious than a moral and practical bearing. Even the solitude and abstinence practised by the Pythagoreans were connected partly with their theory of metempsychosis, but mainly with their ethical training. Socrates, who called temperance, or self-restraint, the chief of virtues, had in view only the higher ethical life of the human spirit; and the Cynics and Stoics, who carried out his doctrine to an extreme, endeavoured to stifle the natural desires, and violate the natural relations of life, in order to realise their ideal of a wise and self-sufficing man of virtue. In Plato, however, appears very prominently the idea of matter as in itself evil and hostile to the divine; and among the neo-Platonic and neo-Pythagorean schools of Alexandria, who draw mainly from him, the doctrine and practice of a mystical and religious asceticism were essentially involved in their philosophical systems. About the same time similar principles had taken root among the Jews, and appeared in Palestine among the Essenes (by some supposed to be an offshoot from the Chasidim), in Egypt among the Therapeutæ. Into the heart of this circle of ideas Christianity entered, it incorporated many of them, and lent additional strength to the principle of asceticism in its higher signification. The deep sense of the nothingness of temporal phenomena when compared with spiritual realities, the conviction that in this world believers are but pilgrims, exposed to many temptations through the weakness of the flesh, in which is the origin of sin, and the many expressions which seemed to imply that riches and the ties of marriage were real hindrances in the Christian life, contributed to strengthen the already powerful tendency towards ascetic practices. Accordingly, in the early church celibacy and poverty, with occasional fasting and penance, were commonly recommended as means for the attainment of true virtue and communion with God, and such practices soon began to be looked upon as having a special merit in themselves. The natural consequence was that certain enthusiasts—such as Paul of Thebes, Anthony, and Simeon Stylites—vied with each other in their fanatical asceticism, withdrawing to the desert, and spending their lives in self-mortification. The persecutions of the church, which drove the Christians together, and the introduction of cenobitism by Pachomius in the 4th century, gave rise to monasticism, in which, for the first time, asceticism was reduced to an organised system. But the constant reforms required to preserve the purity of the monastic life, and the continuous protests against the whole practice, which began in the 11th century with such men as Peter of Bruis and Henry of Lausanne, and culminated in the Reformation, demonstrated the weakness of the foundation on which the system had been built. Asceticism, meanwhile, was not confined to the church, but had spread through the heretical and religious sects which sprang up alongside of it. The Ebionites and Gnostics inculcated the subjection of the body to the spirit; the new religion of Mani advocated the absolute withdrawal of all desires from the world; and among the followers of Mahomet, one sect, the Persian Sufis, specially distinguished themselves by their practice of abstinence and solitary meditation. Even in modern times, although ascetic practices have been modified, traces of the idea on which they rest are not wanting. The principles of the Quaker Society, of the Methodists, of the Communist bodies in America,—*e.g.*, the Shakers,—and other enthusiasts, are modifications, more or less pronounced, of the ascetic way of thinking.

ASCH, a town of Bohemia, in the circle of Eger, at the foot of the Hainberg, with a population of upwards of 9000, carrying on extensive manufactures of woollen, cotton, and other fabrics, as well as of paper, leather, and beer. The district of Asch, with an area of 42 square miles, was originally an immediate dependency of the empire, but has been since 1331 a fief of the Bohemian crown, and since 1770 incorporated with the kingdom. It is now held by the Zedtwitz family.

ASCHAFFENBURG, a town in the government of Lower Franconia, in the kingdom of Bavaria, at the confluence of the Aschaffa with the Maine, near the foot of the Spessart-Wald. Its chief buildings are the Johannisburg, built (1605–14) by Archbishop Sweikard of Kronberg, which contains a library, with a number of *incunabula*, a collection of engravings and paintings, the *Stiftkirche*, or cathedral, founded in 980 by Otto of Bavaria, in which are preserved various monuments by the Vischers, and a sarcophagus, with the relics of St Margaret (1540), the Capuchin hospital; a theatre, which was formerly the house of the Teutonic order; and several mansions of the German nobility. The town, which has been remarkable for its educational establishments since the 10th century, has a gymnasium, lyceum, seminarium, and other schools. The grave of Clemens Brentano (d. 1842) and his brother Christian (d. 1851) is in the churchyard near the Wennebach gate; and Wilhelm Heinse (d. 1803) is buried in the town. Cloth and stained paper are the chief manufactures; and the trade is principally in wood. The 10th and 23d Roman legions had their station at Aschaffenburg, and on the ruins of their *castrum* the Frankish mayors of the palace built a castle. Bonifacius erected a chapel to St Martin, and founded a Benedictine monastery. The stone bridge over the Maine was built by Archbishop Willigis in 989. Adalbert increased the importance of the town in various ways about 1122. In 1292 a synod was held there, and in 1474 an imperial diet, preliminary to that of Vienna, in which the famous concordats were decided, which have therefore been sometimes called the Aschaffenburg concordats. The town suffered greatly during the Thirty Years' War, being alternately held by the various belligerents. In 1842–9, King Louis built himself a country house to the west of the town, called the *Pompeianum*, from being an imitation of the house of Castor and Pollux at Pompeii. In 1866 the Prussians inflicted a severe defeat on the Austrians in the neighbourhood. Population, 9212.

The principality of Aschaffenburg, deriving its name from the city, comprehended an area of 336 geographical square miles. It formed part of the electorate of Mentz, and in 1803 was made over to the archchancellor, Archbishop Charles of Dalberg. In 1806 it was annexed to the grandduchy of Frankfort, and in 1814 was transferred to Bavaria, in virtue of a treaty concluded 19th June between that power and Austria. Conjointly with Lower Franconia, it now forms a circle of the kingdom of Bavaria.

ASCHAM, Roger, a very distinguished scholar and writer, was born at Kirby Wiske, a village in Yorkshire, near Northallerton, about the year 1515. John Ascham, his father, was house-steward in the family of Scroop, and by his wife Margaret was connected with several respectable families. A short time before his death, Sir Anthony Wingfield having conceived a predilection for his third son Roger, took him into his family, and extended his bounty so far as to give him the advantage of a private education along with his own sons. Under a domestic tutor he made a rapid progress in classical learning, and early discovered a great partiality for reading. The superiority of genius and docility of temper which he constantly displayed induced his patron to send him to St John's College, Cambridge, in the year 1530.

The revival of Greek and Roman literature at the period Ascham entered upon his studies was peculiarly favourable to the natural bent of his inclination. A desire of excelling uniformly influenced his conduct; and, adopting the maxim *Qui docet discit*, he began to teach boys the rudiments of the Greek language, as soon as he was acquainted with the elementary parts himself. His plan was approved by Pember, and under the direction of this valued friend he soon became acquainted with the best Greek and Latin authors. He devoted himself particularly to Cicero and Cæsar, and from his constant study of these writers acquired the elegant Latin style which proved so honourable and so advantageous in the after part of his life. Ascham took his degree of Bachelor of Arts in his 18th year, and was chosen fellow of the college about a month afterwards. The favourable disposition, however, which he manifested towards the reformed religion was no small obstacle in the way of his preferment. He was admitted Master of Arts in the year 1537, and about this period he began to act in the capacity of a tutor.

His reputation for Greek learning soon brought him many pupils, several of whom afterwards rose to considerable eminence. Of these one of the most distinguished was William Grindall, who obtained the station of master of languages to the Lady Elizabeth, upon the recommendation of Sir John Cheke. The reason why Ascham himself was not appointed to that honourable office is not known; but his partiality for the university seems, from a hint in one of his letters, to have been the cause. At that period there was no particular chair appropriated to the Greek language, but Ascham was appointed by the university to read lectures upon that language in the schools. A dispute arose in the university at that time about the pronunciation of the Greek language, in which Ascham first opposed the method observed by Sir John Cheke and Sir Thomas Smith; but, upon more mature deliberation, he adopted that method, which has ever since been practised in the English schools. Both on account of the beauty of his handwriting, and the purity and elegance of his Latin, he was employed to write the public letters of the university. In 1544, on the resignation of Cheke, he obtained the appointment of university orator, an office which he retained with great reputation during the period he was connected with the university.

By the advice of his friend Pember, he turned his attention to the study of instrumental music, and thereby enlivened his leisure hours, and prepared his mind for renewed exertion. In his study he also amused himself with embellishing the pages of his manuscripts with beautiful drawings, and in the field he took part in the diversion of archery. The learned Ascham did not deem his labour improperly bestowed in writing a book entitled *Toxophilus*, in an age when the proper use of the bow was of more importance than for mere amusement. This work was written in a more natural, easy, and truly English diction than had hitherto been in use; and it also abounds with beautiful allusions and curious fragments of English history. Ascham candidly acknowledges that, being anxious to make the tour of Italy, which was then the great republic of letters, and particularly of Greek literature, he wished, by dedicating his book to the king, to obtain a pension to enable him to make that tour. It reflects credit on Henry VIII. that in the year 1545 he settled upon him an annual pension of £10, which Dr Johnson estimates at the value of £100. Upon the death of Henry this pension was renewed by Edward VI., to whom Ascham was afterwards appointed Latin secretary.

For some years he received an annual gratuity from Lee, archbishop of York, but the amount of it is not recorded; and, in 1548, upon the death of his pupil Grindall, preceptor to the Lady Elizabeth, his pupils and writings had acquired him such celebrity, that he was appointed to direct the studies of that princess. He successfully acquitted himself in that honourable charge; but two years after, from some unknown cause of dissatisfaction, he returned to the university, having taken an abrupt leave of the princess. This conduct of his did not greatly affect his favour with royalty; for in the same year he was recalled to court, and appointed secretary to Sir Richard Morisine, ambassador to the Emperor Charles V. On his way to London he paid a visit to Lady Jane Grey, whom he found in her chamber reading Plato's *Phædo*, in Greek, "and that," says he, "with as much delight as some gentlemen would read a merry tale in Boccace," while the duke and duchess, and the rest of the household, were hunting in the park.

In the character of secretary to Sir Richard, besides aiding him in the management of his public affairs, he also conducted his private studies. During the mornings of four days in the week, he read with him a portion of Herodotus or Demosthenes, and in the evenings some pages of Sophocles or Euripides; on the other mornings he wrote the letters of public business, and on the evenings he either wrote his own private letters, or continued his diary and remarks. While Ascham was on his travels, he made a short excursion to Italy, but was much disgusted with the manners of the people, especially of the Venetians. After his return from that tour, he published a curious tract, entitled *A Report and Discourse of the Affairs and State of Germany*, &c.

Upon the death of Edward VI., Morisine was recalled, and Ascham returned to the university. The accession of a Catholic queen held out little prospect of advancement to a Protestant; but his fortune soon took a favourable turn, through the interest of Bishop Gardiner, who obtained for him the office of Latin secretary to the queen, with a salary of £20 a year, and permission to retain his university emoluments. The prudence of Ascham enabled him to act a respectable part, both under the government of Mary, and also in the most perilous situations during the reign of Elizabeth; and the readiness and elegance of his Latin style rendered him a useful member at court. He is reported to have written, during the course of three days, 47 letters to persons in the highest ranks of life.

When the crown passed to Elizabeth, it made little alteration in the condition of Ascham, who still retained his station. He spent several hours every day in reading the learned languages with the queen. Her proficiency was equal to his pains; and it might have been expected that his services would have received some reward more ample than £20 per annum, together with the prebend of Westwang. The allegation that the queen kept him poor because he was extravagant and addicted to cock-fighting, is hardly satisfactory.

In consequence of a conversation which took place in the apartment of secretary Cecil, upon the subject of education, Sir Richard Sackville, who was present, requested Ascham to write a book on the general subject of education. This work is entitled *The Scholemaster*, and contains many excellent directions to the instructors of youth, particularly with regard to teaching languages; where he recommends the method of double translation. It was published by his widow after his death. By too close application in composing a poem, which he intended to present to the queen on the New Year's day of 1569, he was seized with an illness which proved fatal. He died on the 23d of December 1568. His death was universally lamented, and the queen expressed her regret by saying, that "she would rather have lost £10,000 than her tutor Ascham." His epistles, which are valuable both on account of their style and historical information, were published after his death, and dedicated to the queen; the best edition is that of Elstob, published at Oxford in 1703. His English works were published in 4to, with a life by Dr Johnson, in 1771. This edition has been reprinted in 8vo. The whole works have been edited by Dr Giles, London, 1864–5. Of the *Toxophilus* and *Scholemaster* there are several reprints.

ASCHE, Rabbi, was the first and chief editor of the *Talmud*. He was born at Babylon in 353 A.D., and was in high repute among his contemporaries for his great learning. He began the Babylonian *Talmud*, and spent 30 years of his life at it. He left the work incomplete, and it was finished by his disciples, Rabbi Abina and Rabbi Jose.

ASCHERSLEBEN, a manufacturing city of Prussia, in the government of Magdeburg, formerly the chief town of a circle. It contains one Roman Catholic and five Protestant churches, a synagogue, a poor-house, an asylum for destitute children, and several schools. The discovery of coal in the neighbourhood has at once stimulated and altered its industries. In addition to the manufacture of woollen wares, for which it has long been known, there is now extensive production of vinegar, paraffin, potash, and especially beetroot-sugar; while the surrounding district, which was formerly devoted in great part to market-gardening, is now turned almost entirely into beetroot fields. Population, 16,741. Aschersleben was probably founded in the 11th century by Count Esika of Ballenstedt, the ancestor of the house of Anhalt, whose grandson, Otto, called himself count of Ascania and Aschersleben, deriving the former part of the title from his castle in the neighbourhood of the town. On the death of Otto III. (1315) Aschersleben passed into the hands of the bishop of Halberstadt, and at the peace of 1648, was, along with the bishopric, united to Brandenburg.

ASCLEPIADES, of Prusa in Bithynia, a celebrated physician, flourished at Rome in the end of the 2d century B.C. He travelled much when young, and seems at first to have settled at Rome as a rhetorician. In that profession he did not succeed, but he acquired great reputation as a physician. He founded his medical practice on a modification of the atomic or corpuscular theory, according to which disease results from an irregular or inharmonious motion of the corpuscles of the body. His remedies were, therefore, directed to the restoration of harmony, and in many cases were not unpleasant. He trusted most to changes of diet, accompanied by friction, bathing, and exercise, though he also employed emetics and bleeding. He recommended the use of wine, and in every way strove to render himself as agreeable as possible to his patients. His pupils were very numerous, and the school formed by them was called the Methodical. Asclepiades died at an advanced age from the effects of a fall.

ASCOLI (*Asculum Picenum*), the chief town and a bishop's see in the Italian province of Ascoli Piceno, situated on a rising ground on the river Tronto (*Truentus*), a few miles to the west of the Apennines, and commanding a large and fertile plain. It possesses a citadel, a cathedral, built on the site of a basilica erected by Constantine on the ruins of a temple of Hercules, a number of other churches, that of St Francesco dating from the 14th century, and remains of an ancient theatre, temples, &c. The city is built of travertine, and many of its public buildings were designed by Cola dell' Amatrice. It carries on considerable trade, and manufactures woollen cloth, leather, hats, majolica, glass wares, wax, rosoglio, confections, &c. Population, 22,937.

Asculum was the chief city of the Piceni, and a place of great strength. It was captured by P. Sempronius Sophus (268 B.C.), but afterwards took an important part in the Social War, and defied for a time the Roman consul Pompeius Strabo. It fell 89 B.C.; Judacilius, its gallant defender, put an end to his life; its magistrates were executed, and its inhabitants banished. At a later period it received a Roman colony, and recovered its prosperity. In 545 A.D. it was besieged by Totila. It was under the control of its bishops from the 3d to the 13th century; afterwards passed under the power of the Malatesti of Rimini; and in 1426 was annexed to the Papal States by Pope Martin V.

ASCONIUS PEDIANUS, Quintus, author of some commentaries on Cicero, was born probably a year or two before the Christian era, and died about 83 A.D. He is supposed to have been a native of Padua. Some minor works ascribed to him have been lost; all that are now extant consist of commentaries on some of Cicero's orations. These notes, written in very pure Latin, relate chiefly to matters of law, history, or antiquities, and are very valuable for the light they cast on some obscure parts of Cicero. As the commentaries on the Verrine orations deal more with questions of grammar, and do not show such purity of diction as the others, it has been conjectured that they are not the work of Asconius. The manuscript of the commentaries was discovered in 1416 by Poggio Bracciolini in the cellars of the convent of St-Gall. He took a copy of it, from which, as the original has been lost, all subsequent reprints have been taken. The best recent edition is by Orelli and Baiter, forming part of their large edition of Cicero's works. See also Madvig, *De Asconii Pediani Commentariis Disputatio*, Copenhagen, 1828.

ASELLI, Asellius, or Asellio, Gasparo (born 1581), a physician of Cremona, afterwards professor of anatomy at Pavia. He is best known by his important discovery of the *Lacteal Vessels*. His treatise (*De lactibus*, Milan, 4to) on this subject was posthumous, being published in 1627, a year after his death.

ASGARD (from *As*, god, and *gard*, home or hall), the home of the Æsir, *q.v.*, the Olympus of northern mythology. The city of Asgard is fabled to have been built on the highest part and in the middle of Ida's plain, which is the very centre of the universe. Here the Æsir erected a court for themselves with seats for twelve, and one high seat for Odin, the All-father, also a lofty abode for the goddesses, called Vingolf. They worked diligently, played at games, were rich in gold and all precious things, and happy, till three maidens from Jotunheim, the giants' world, crossed Ida's plain, and entered Asaheim, when corruption spread amongst its inmates. Asgard had many mansions, the largest and noblest of which was Gladsheim; whilst another, not so spacious, but the fairest of all, and brighter than the sun, was called Gimli. This will stand when both heaven and earth have passed away, and will be the habitation of all good and upright men through eternity. When the Æsir created men, and placed them in Midgard, they connected the latter with Asgard by a bridge, Bifrosh, known to mortals as the rainbow, which also leads to the sacred fountain of Urd, by the ash Yggdrasil, where the gods of Asgard take council together. For the other parts of Asgard, which are closely interwoven with the history of the creation of the world and of mankind, as taught in the Odinic faith, the reader is referred to MYTHOLOGY, in which the subject is treated more at length. The historical explanation of Asgard, as given by the early northern authorities, is that, in the country called Asaheim to the east of Tanagvise (the Tanais or Don) in Asia, there was a city, Asgard, in which ruled a great chief, known as Odin or Woden, who presided over the religious sacrifices which were held there. At that time the Roman generals were marching over the world, and reducing nations to subjection, and Odin, foreknowing that he and his posterity would occupy the northern lands, and unwilling to encounter the Romans, left Asaheim with a vast multitude of followers, and wandered first westward to Garderike (Russia), and afterwards to Saxland (North and East Germany). After some time he proceeded northward, till at length he came to the Malar Lake in Sweden, where he settled at a place known as Sigtuna, the present Upsala. His twelve diar, or chief priests, in the course of time founded states for themselves, and everywhere set up the laws and usages which they had followed in Asaheim. Here we have an historical link with the mythic story of Odin's halls in Asgard, and his twelve attendant Æsir; but we have no means of fixing the date of the events referred to. It has been conjectured that Odin may have lived at the time when Mithridates Eupator was defying the armies of Rome, 120-80 B.C.; and that, to avoid subjection to either power, he and other Sarmatian or Caucasian chiefs left their settlements on the Black Sea, and wandered forth in search of new and independent homes, to the north and west of the primary Asiatic seat of their tribes. It is not improbable that traditionary records of such earlier migrations had lingered among the people dwelling on the shores of the Euxine, for it is certain that, whatever may be the age of Odin's appearance in Scandinavia, previous waves of population had passed from the Black Sea to the Baltic, and cleared the way for the reception of that highest phase of Aryan civilisation brought to Northern Europe by Odin and his followers.

ASGILL, JOHN, an eccentric writer who flourished during part of the 17th and 18th centuries. The exact date of his birth is uncertain. He was bred to the law, and gained considerable reputation, not only by his skill in his profession, but from his first published writings. These consisted of two pamphlets—the first advocating the establishment of some currency other than the usual gold and silver, the second on the registry for titles of lands. His affairs, however, became embarrassed, and in 1699, when a commission was appointed to settle disputed claims in Ireland, he set out for that country, attracted by the hopes of practice. Before leaving London he put in the hands of the printer a tract, entitled *An Argument proving that, according to the Covenant of Eternal Life revealed in the Scripture, Man may be translated from hence into that Eternal Life without passing through Death.* The fame of this extraordinary pamphlet, in which Asgill spoke of dying as an unnecessary and foolish custom, preceded the author, and was of material service in securing his professional success. He amassed money, and purchased an estate, which unfortunately involved him in a lengthy litigation. In 1703 he took his seat in the Irish Parliament, but was dismissed after four days on account of his so-called blasphemous pamphlet. In 1705 he sat in the English Parliament for Bramber, but in 1707 he was expelled, nominally on account of his unlucky pamphlet, but really, perhaps, because of his debts. The remainder of his life he spent in the Fleet and King's Bench prisons, in one of which he died in 1738. He wrote a number of pamphlets on the Pretender and on the Hanoverian succession. Several of his tracts were collected, and published in London, 1715.

ASH (French, *Frêne*, German, *Esche*) is the name given to several kinds of trees. The taller or common ash (*Fraxinus excelsior*) belongs to the Natural Order *Oleaceæ*, the olive family. It is distinguished by its fruit, which is dry and winged. Normally the fruit should be two-celled and two-seeded; but generally, by abortion, there is only one cavity and one seed. The Hebrew word *Oren*, translated ash in Isaiah xliv. 14, cannot refer to an ash tree, as that is not a native of Palestine, but probably to the Syrian pine (*Pinus halepensis*). The ash is indigenous in Europe, and also extends to Asia. The tree is distinguished for its height and contour, as well as for its graceful foliage. It is one of the most useful of British trees as regards both timber and rapidity of growth. The tree attains a height of from 50 to 80 feet, and flowers in March and April, before the leaves are developed. It thrives best in a dry loamy soil, and, as it exhausts the soil in which it grows, it injures plants growing near it. The flowers grow in clusters, but are not showy. The leaves are compound, and unequally pinnate. A variety of ash, called *Fraxinus heterophylla*, diverse-leaved, has simple leaves. Another variety of ash is met with in which the branches are pendulous and weeping. Sometimes this variety is grafted on the tall stem of the common ash, so as to produce a pleasing effect. It is said that the weeping variety was first observed at Gamlingay, in Cambridgeshire. A variety also occurs with curled leaves, and another with warty stems and branches, called *Fraxinus verrucosa*. In Europe there is also a small-leaved ash, called *Fraxinus parvifolia*. In America there are several additional species—such as *Fraxinus americana*, the white American ash; *F. pubescens*, the black ash; and *F. sambucifolia*, the winter ash. Another plant which bears the name of ash is *Fraxinus Ornus*, or, more properly, *Ornus europœa*, the flowering or manna ash. Another species is *Ornus rotundifolia*, the round-leaved manna ash. The manna ash is a small tree found in Italy, and extending to Switzerland, South Tyrol, Hungary, Greece, Turkey, and Asia Minor. It also grows in the islands of Sicily, Corsica, and Sardinia. It blossoms early in summer, producing numerous clusters of whitish flowers. The word manna was first applied to the food supplied miraculously to the Israelites in the desert, but what it was cannot be determined. The name is now given to various saccharine exudations. The manna of commerce is collected almost entirely in Sicily from the manna ash. In order to get it, transverse cuts are made deep into the bark, so as to allow the manna to exude. The best kind is called "flake" manna. It consists of manna sugar, or mannite. The mountain ash belongs to a totally different family from the common ash. It is called *Pyrus aucuparia*, and belongs to the Natural Order *Rosaceæ*, and the tribe *Pomeæ*, which includes also apples, pears, &c. Its common name in Scotland is the rowan-tree, and it is well known by its succulent scarlet fruit. Pear trees are sometimes grafted on the mountain ash. The name of poison ash is given to *Rhus venenata*, belonging to the *Anacardiaceæ* (Cashew family). The bitter ash of the West Indies is *Simaruba excelsa*, which belongs to the Natural Family *Simarubaceæ*. The Cape ash is *Ekebergia capensis*, belonging to the Natural Order *Meliaceæ*. The prickly ash, *Xanthoxylon fraxineum*, belongs to the Natural Order *Xanthoxylaceæ*.

ASH-WEDNESDAY, the first day of Lent, is supposed to have received this name from a custom in the church of sprinkling ashes on the heads of penitents then admitted to penance. The early church did not commence Lent until the following Sunday; the additional days were probably included by Gregory the Great.

ASHANTEE, or SIANTI, a country in Western Africa, in the interior of the Gold Coast, the extent and population of which can only be approximately given. Stretching from lat. 5° to 9° N., and from long. 0° to 4° W., it comprises about 70,000 English square miles, and its population has been variously stated at from 1,000,000 to 3,000,000.

Tradition represents the Ashantees as deriving their origin from bands of fugitives, who, two or three centuries ago, were driven before the Moslem tribes migrating southward from the countries on the Niger and Senegal. Having cleared for themselves a region of impenetrable forest, they defended themselves with a valour which, becoming part of their national character, raised them to the rank of a powerful and conquering nation. They are supposed to be originally of the same race as the Fantees, nearer the coast, and speak the same language. The separation of Fantees and Ashantees is ascribed to a famine which drove the former south, and led them to live on *fan*, or herbs, while the latter subsisted on *san*, or Indian corn, &c. (whence the names Fantees and Santees).

Ashantee proper is covered with almost impenetrable forest, the routes through which consist merely of narrow winding tracts, where, though it is possible for a man to ride, or a palanquin to be carried, no waggon of any description could pass. Many of the trees attain splendid proportions, but the monotony is oppressive, and is hardly ever relieved by the sight of either bird or beast. The country round the towns in the interior, however, is cultivated with care, the fields being kept clean, and yielding in abundance grain, yams, vegetables, and fruits. The territory yields also a considerable quantity of gold. The Ashantees are skilful in several species of manufacture, particularly in weaving the great African fabric of cotton. Their pottery and works in gold also show skill, though surpassed by those produced in the more southern countries. A large quantity of silver-plate and goldsmith's work of great value and considerable artistic elaboration was found in 1874 in the king's palace of Coomassie, not the least remarkable objects being masks of beaten gold. The influence of Moorish art is perceptible in everything.

The government of Ashantee is a mixture of monarchy and military aristocracy; the lower orders being held in complete thraldom, and liable to be put to death or sold into slavery at the will of the chiefs. The king carries on all the ordinary administration of the state; but in questions relating to peace or war he is bound to consult the council of the caboceers or captains. Each of these caboceers keeps a little court, where he makes a profuse display of barbaric pomp. Polygamy is indulged in to an enormous extent, the king has a regular allowance of 3333 wives, but many of these are employed as guards or in menial services. The crown descends to the king's brother, or his sister's son, not to his own offspring.

The dreadful system of human sacrifice, practised among the Ashantees, is founded on a wild idea of piety towards parents and other connections—the chiefs fancying that the rank of their dead relatives in the future world will be measured by the number of attendants sent after them. There are two periods, called the great Adai and little Adai, succeeding each other at intervals of eighteen and twenty-four days, at which human victims, chiefly prisoners of war or condemned criminals, are often immolated to a monstrous extent. On the great Adai, which always falls on a Sunday, the king visits the burial-grounds of the princes and the royal mausoleum at Bantama, where the skeletons of his predecessors—their bones held together by links of gold—sit in grim mockery of state. Still more dreadful is the "custom" celebrated after the death of the king, or any member of the royal house.

Early in the 18th century the Ashantees first came under the notice of Europeans, through their successful wars with the kingdoms bordering on the maritime territory. Osai Tutu may be considered as the real founder of the Ashantee power. He either built or greatly extended Coomassie, the capital; he subdued the neighbouring state of Denkera (1719) and the Mahometan countries of Gaman and Banna, and extended the empire by conquests both on the east and west. At last he was defeated and slain (1731); but his successor, Osai Apoko, made further acquisitions towards the coast.

In 1800, Osai Tutu Quamina, an enterprising and ambitious man, who appears early to have formed the desire of opening a communication with white nations, became king. About 1807 two chiefs of the Assins, whom he had defeated in battle, sought refuge among the Fantees, the ruling people on the coast. On the refusal of the Fantees to deliver up the fugitives, he invaded their country, defeated them, and drove them towards the sea. At length they reached the town of Annamaboe, where there was then a British fort. The governor exhorted the citizens to come to terms, and offered to mediate; but they resolved to abide the contest. The result was the destruction of the town, with great slaughter of the inhabitants. The Ashantees failed, however, to storm the English fort, though the garrison was reduced from 24 to 8 men. A truce was agreed to, and the king refusing to treat except with the chief governor of Cape Coast, Colonel Torranne repaired to Annamaboe, where he was received with great pomp. A treaty was concluded by which the whole territory of Fantee, including Cape Coast Castle, was ceded by right of conquest to the Ashantee empire.

In 1817 the British Government sent Messrs James, Bowdich, and Hutchison on a mission to Coomassie. They were received with dignified politeness. After one or two harmonious interviews, the king advanced a claim for certain sums which the British were bound to pay to the native Governments, and which the Fantees had been accustomed to receive, for permission to hold fortified factories. Mr James proposed to refer this claim to the Government at Cape Coast Castle; whereupon the king broke out into uncontrollable rage, calling the deputies cheats and liars. Messrs Bowdich and Hutchison, thinking that the English interests and the safety of the mission were endangered, took the negotiation into their own hands. A treaty was concluded, by which all the king's demands were satisfied; and, after a residence of several months, they returned to Cape Coast.

The Government at home, though they demurred somewhat to the course that had been pursued, saw the wisdom of cultivating intercourse with this powerful African king. They sent out, therefore, to his court, as a fixed resident, M. Dupuis, who arrived at Cape Coast in January 1819. By that time the British local Government had been gained over to the interest of the Fantees. An insurrection had arisen in the interior of the Ashantee territory, respecting which exaggerated rumours had been listened to with blind credulity. Insulting messages were sent to the king, who was also informed that the inhabitants of Cape Coast were setting his authority at defiance, and were forming a wall to defend the town. The governor, on various pretences, detained M. Dupuis for some time; but at length, on the arrival of more than one ambassador from the king, allowed him to proceed. M. Dupuis set out on the 9th February 1820, and on the 28th arrived at Coomassie. After several confidential meetings with the king, a treaty was drawn up, which adjusted all the differences between the two parties. The king dismissed M. Dupuis with many marks of esteem and kindness, sending along with him two natives of distinction, to proceed as ambassadors to England. On his return to Cape Coast he found that the governor disowned the treaty, as betraying British interests and transferring to Ashantee the sovereignty of the Gold Coast. At the same time the Fantee party persuaded Sir George Collier to refuse to transport the Ashantee ambassadors to Britain.

M. Dupuis returned to England to represent the particulars to the Government, but an entire change meantime took place in the administration of British affairs in Africa. The African Company was abolished by Act of Parliament in 1821, and the forts and possessions transferred to the Crown. Sir Charles M'Carthy was invested with the government of all this range of coast. On his arrival in 1822 he adopted the Fantee policy, placed the town in a posture of defence, and formed alliances with the neighbouring tribes. It was hoped that the hostile attitude of the English would overawe the king, but he speedily declared open war.

After one or two unimportant successes, the British force was completely routed in Essamaco, near the boundary stream of the Prah, by a native army of about 10,000 men. Sir Charles M'Carthy was slain, and only 50 men, including two officers, returned to the castle. On the very day of this defeat Osai Tutu Quamina died, and was succeeded by Osai Okoto. The Ashantee army now marched upon Cape Coast, laying waste the country with fire and sword. At that place, however, detachments of reserve had united with the wrecks of the main corps, and vigorously prepared for defence. The king made repeated and desperate assaults, but at last sustained a signal defeat at Dudowah, on the 7th August 1826. In 1828 all public establishments were withdrawn by the British Government, and the chief power was transferred to a company of African merchants. In 1831 the king was obliged to purchase peace at the price of 6000 ounces of gold, and to send his son as a hostage to Cape Coast Castle. Since this event the Ashantee power has become extinct on the coast. By the treaty concluded at the end of the war, the river Prah was fixed as the boundary of the Ashantee kingdom, and all the tribes to the south of it were placed under British protection.

In 1843 the Crown resumed the government of the Gold Coast. Towards the end of 1852 the Ashantee monarch seemed disposed to interfere with the states absolved from his jurisdiction. Two Assin chiefs, who had revolted from Ashantee and joined the Fantee alliance, were discovered to be intriguing with the king of Ashantee; and that monarch, under pretext of making "custom" for the late chief of Denkera, crossed the Prah with a force of about 7000 men. These warlike movements naturally excited much uneasiness at Cape Coast Castle, but the negotiations of the authorities were successful in averting the storm. From 1853 to 1863 there was peace between Ashantee and the Government of Cape Coast Castle; but in the latter year disagreements broke out on account of a refusal to deliver up certain Ashantee refugees. In 1867 it was agreed that all the Dutch forts to the east of the Sweet River should be handed over to Britain in exchange for all the British forts to the west of that river. Unexpected difficulties, however, arose, which led the Dutch Government to offer all their possessions in that district to Britain, on certain commercial privileges being guaranteed to them. Hereupon the king of Ashantee objected to the transfer of Fort Elmina; but the superiority he alleged was completely disproved, and the proposal took effect on April 6, 1872.

Meanwhile another matter of dispute arose between the king and the English. Messrs Kuhne, Ramsayer, and Palmer, and a Frenchman named Bonnat, having been inveigled into captivity by an Ashantee chief, the British Government demanded their surrender, but this, on various pretexts, was obstinately refused by the king. War had for some time been imminent, and at length, on January 22, 1873, an Ashantee force crossed the Prah, and invaded the British protectorate. The importance of the invasion was soon recognised, not only by the local authorities, but by the Government at home; and measures were taken for the defence of the territory and the punishment of the assailants, which ultimately culminated in the despatch of Sir Garnet Wolseley as her Majesty's administrator, £800,000 being voted in parliament for the expenses of the expedition. On landing (October 2) at Cape Coast, he found that the Ashantee nation was in arms to the number of 40,000; the Fantee tribes were fragmentary and languid; and the country was extremely unhealthy for European troops. He determined, however, to march to Coomassie, and dictate terms to the king from his own capital. On January 20, 1874, the river Prah was crossed; on the 24th the Adansi hills were reached; on the 31st there was severe fighting at Amoaful; on the 1st of February Becquah was captured; and on the 4th the victorious army was in Coomassie. The town was full of Ashantee soldiers, but no attempt was made to turn the fortune of the war. As the rainy season was setting in, all possible haste was requisite; in two days, therefore, the homeward march was commenced, the city being left behind in flames. By the time that Fommanah was reached (February 13), the king sent his envoys to conclude a treaty, whereby he agreed, among other conditions, to pay 50,000 ounces of gold, to renounce all claim to homage from certain neighbouring kings, and all pretensions of supremacy over any part of the former Dutch protectorate, to promote freedom of trade, to keep open a road from Coomassie to the Prah, and to do his best to check the practice of human sacrifice. Besides coloured troops, there were employed in this campaign about 2400 Europeans, who suffered severely from fever and otherwise, though the mortality on the whole was slight. The success of the expedition was greatly facilitated by the exertions of Captains Glover, Butler, and Dalrymple, who effected important diversions with very inadequate resources.

See the works of Bowdich (1819), Dupuis (1824), Ricketts (1831), Beecham (1841), Stanley, Winwood Reade, Boyle, Brackenbury (1874).

ASHBURTON, a borough and market-town of England, in the county of Devon, 192 miles W.S.W. of London, and 18 from Exeter. It stands in a valley surrounded on every side by hills, at a short distance from the river Dart, and consists principally of one long street. The church of St Andrew is a handsome Gothic structure, built in the form of a cross, with a tower 90 feet high. Ashburton was the seat of one of the stannary courts. Before the Reform Act of 1832 it returned two members to parliament; from that time it returned one till 1868, when it was disfranchised. Population in 1871, 2335, principally employed in the manufacture of serge, or in the tin and copper mines and slate quarries in the vicinity.

ASHBY-DE-LA-ZOUCH, a market-town of England, county of Leicester, 17 miles north-west of Leicester, on the railway from that city to Burton. The town, which derives the adjunct to its name from the Norman family of La Zouch, consists principally of one long street. It contains six churches and chapels, and has a grammar school and several charity schools. The church of St Helen is a fine old building, containing the tombs of the Huntingdon family, and a "finger pillory." The Ivanhoe baths, erected in 1826, are much frequented for their saline waters, which, as containing bromine, are found useful in scrofulous and rheumatic complaints. To the south of the town are the extensive remains of Ashby Castle, built in 1480 by Sir William Hastings, ancestor of the earls of Huntingdon, who was created baron of Ashby-de-la-Zouch in 1461. It was one of the castles in which Mary Queen of Scots was confined. Population (1871), 7302, principally engaged in the manufacture of stockings, leather, malt, and firebricks, or in the coal and iron mines of the vicinity.

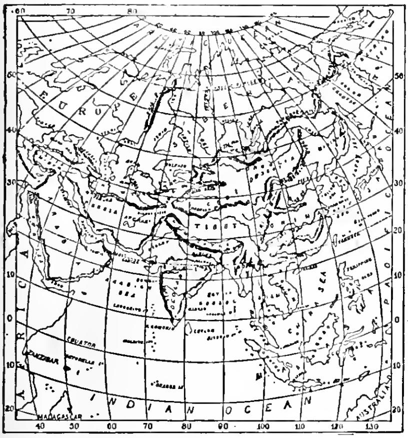
ASHDOD. See AZOTUS.

ASHFORD, a market-town of England, county of Kent, 12 miles south-west of Canterbury, and 53 from London. It is pleasantly situated on a gentle eminence near the junction of the upper branches of the river Stour, and is a chief station of the South-Eastern Railway. Many of its houses are well built and handsome; its principal street is nearly half a mile in length, and well paved and lighted. It has a fine old Gothic church, with a lofty, well-proportioned tower, and many handsome monuments. The free grammar school was founded by Sir Norman Knatchbull in the time of Charles I. Population of parish (1871), 8458.

ASHTON-UNDER-LYNE, or ASHTON, a parliamentary borough in the county of Lancaster, and hundred of Salford, on the northern bank of the river Tame, 6½ miles east of Manchester, and 197 from London. Like Manchester, it has had a rapid growth from an insignificant country town to a populous and thriving borough. Notwithstanding this it is well built, and contains many spacious streets and handsome public edifices. Among the latter are 4 large churches, 15 dissenting chapels, a spacious town-hall, and a very large and prosperous market-house. There are three banks, a savings-bank, a theatre, a mechanics' institute, and numerous week-day and Sunday schools. The corporation have built, at a cost of £16,000, a magnificent set of public baths. There are three newspapers published in the town. At a short distance to the north of the town are the infantry and cavalry barracks, erected in 1843 at a cost of £42,500, and the union workhouse, erected in 1851 at an expenditure of £12,000. A magnificent infirmary, built and endowed by public subscriptions, fronts the workhouse. A large public park is provided for the people midway between this and neighbouring borough of Stalybridge. A union hospital for infectious and other diseases has just been completed. The modern growth of Ashton dates from the introduction of the cotton trade in 1769. It enjoys many facilities for manufacturing industry, coal being very plentiful in the neighbourhood, four important railway lines passing through it, and canals connecting it with Manchester, Huddersfield, and Derbyshire. The town, though essentially modern, has an origin of great antiquity, and still exercises many of its ancient feudal customs and manorial privileges. It is divided into four wards, governed by a mayor, eight aldermen, and twenty-four councillors; and since the Reform Act of 1832 it has returned one member to the House of Commons. In 1821 it had a population of only 9222, which in 1851 had increased to 29,798, chiefly engaged in spinning cotton yarn and weaving ginghams and calicoes by machinery in the numerous large factories. Population of parliamentary borough in 1871, 37,389; of municipal borough, 31,984.

ASIA

Asia. 1. THIS division of the earth's surface embraces the north-eastern portion of the great mass of land which constitutes what is generally known as the Old World, of which Europe forms the north-western and Africa the south-western region.



Sketch Map of Asia.

Ancient geography. 2. Geography, in common with most of the other branches of human learning which have supplied the foundation of modern science, originated in Egypt and Greece, and its nomenclature naturally carries with it the stamp of the place where it had its birth. The earliest conceptions of geographical position were necessarily formed and expressed in relation to the region in which the ancient geographers lived and wrote; and the first steps in generalisation which recognised and distinguished the special characteristics of the countries and people grouped round the eastern end of the Mediterranean, and suggested the three great divisions of the Old World, attest the sagacity of the founders of geography, whose landmarks their successors still respect.

Origin of name. 3. Much doubt attaches to the origin of the words Europe, Africa, and Asia. Some of the earliest Greek geographers divided their known world into two portions only, Europe and Asia, in which last Libya (the Greek name for Africa) was included. Herodotus, who ranks Libya as one of the chief divisions of the world, separating it from Asia, repudiates as fables the ordinary explanations assigned to the names Europe and Asia, but confesses his inability to say whence they came. It would appear probable, however, that the former of these words was derived from an Assyrian or Hebrew root, which signifies the west or setting sun, and the latter from a corresponding root meaning the east or rising sun, and that they were used at one time to imply the west and the east. There is ground also for supposing that they may at first have been used with a specific or restricted local application, a more extended signification having eventually been given to them. After the word Asia had acquired its larger sense, it was still specially used by the Greeks to designate the country around Ephesus. The word Africa is the Latin substitute for the Greek Libya; its origin is obscure. It may have been a local name. It was long used with special reference to the country about Carthage, and this seems to have been the case even to the time of the Mahometan conquest. The idea of Asia as originally formed was necessarily indefinite, and long continued to be so; and the area to which the name was finally applied, as geographical knowledge increased, was to a great extent determined by arbitrary and not very precise conceptions, rather than on the basis of natural relations and differences subsisting between it and the surrounding regions.

Area. 4. The entire surface of the earth being about 196 millions of square miles in area (of which 51 millions are land, and 145 millions water), Asia contains about 17 millions of square miles, or say one-third of the whole of the dry land and one-twelfth part of the whole surface of the globe. Europe contains about $3\frac{1}{2}$ millions of square miles, or close upon one-fifth of the area of Asia; Africa, $11\frac{1}{2}$ millions; and the two Americas together, rather more than 15 millions. The remainder of the land belongs to Australia, the islands of the Eastern Archipelago and the Pacific, and the Antarctic regions.

Boundaries. 5. The northern boundary of Asia is formed by the Arctic Ocean; the coast-line falls between the 70th and the 75th parallels of N. lat., and so lies within the Arctic circle, having its extreme northern point in Cape Sievero-Vostochny (*i.e., north-east*), in lat. 78° N. On the south the coast-line is far more irregular, the Arabian Sea, the Bay of Bengal, and the China Sea, reaching about to the northern tropic at the mouths of the Indus, of the Ganges, and of the Canton river; while the great peninsulas of Arabia, of Hindostan, and Cambodia, descend to about the 10th degree of N. lat., and the Malay peninsula extends within a degree and a half of the equator. On the west the extreme point of Asia is found on the shore of the Mediterranean, at Cape Baba, in long. 26° E. from Greenwich, not far from the Dardanelles. Thence the boundary passes in the one direction through the Mediterranean, and down the Red Sea to the southern point of Arabia, at the Straits of Báb-el-mándeb, in long. 45° E.; and in the other through the Black Sea, and along the range of Caucasus, following approximately the 40th degree of N. lat. to the Caspian, whence it turns to the north on a line not far from the 60th meridian, along the Ural Mountains, and meets the Arctic Ocean nearly opposite the island of Nova-Zembla. The most easterly point of Asia is Cape Vostochnyii (*i.e., east*), in long. 190° E., at the entrance of Behring's Straits. The boundary between this point and the extremity of the Malay peninsula follows the coast of the Northern Pacific and the China Sea, on a line deeply broken by the projection of the peninsulas of Kamchatka and Corea, and the recession of the Gulfs of Okotsk, the Yellow Sea, Tonquin, and Siam.

Islands. 6. On the east and south-east of Asia are several important groups of islands, the more southern of which link this continent to Australia, and to the islands of the Pacific. The Kurile Islands, the Japanese group, Loo-choo, Formosa, and the Philippines, may be regarded as unquestionable outliers of Asia. Between the islands of the Malay Archipelago from Sumatra to New Guinea, and the neighbouring Asiatic continent, no definite relations appear ever to have existed, and no distinctly-marked boundary for Asia has been established by the old geographers in this quarter. Modern science, however, has indicated a line of physical separation along the channel between Borneo and the Celebes, called the Straits of Macassar, which follows acproximately the 120th meridian of E. long., to the west of which the flora and fauna are essentially Asiatic in their type, while to the south and east the Australian element begins to be distinctly marked, soon to become predominant. To this boundary has been given the name of Wallace's line, after the eminent naturalist who first indicated its existence.

Form of continent.

7. Owing to the great extent of Asia, it is not easy to obtain a correct conception of the actual form of its outline from ordinary maps, the distortions which accompany projections of large spherical areas on a flat surface being necessarily great and misleading. Turning, therefore, to a globe, Asia, viewed as a whole, will be seen to have the form of a great isosceles spherical triangle, having its north-eastern apex at Cape Vostochnyii, in Behring's Straits; its two equal sides, in length about a quadrant of the sphere, or 6500 miles, extending on the west to the southern point of Arabia, and on the east to the extremity of the Malay peninsula; and the base between these points, occupying about 60° of a great circle, or 4500 miles, and being deeply indented by the Arabian Sea and the Bay of Bengal on either side of the Indian peninsula. A great circle, drawn through Cape Vostochnyii and the southern point of Arabia, passes nearly along the coast line of the Arctic Ocean, over the Ural Mountains, through the western part of the Caspian, and nearly along the boundary between Persia and Asiatic Turkey. Asia Minor and the north-western half of Arabia lie outside of such a great circle, which otherwise indicates, with fair accuracy, the north-western boundary of Asia. In like manner a great circle drawn through Cape Vostochnyii and the extremity of the Malay peninsula, passes nearly over the coasts of Manchuria, China, and Cochin-China, and departs comparatively little from the eastern boundary.

Relative importance of geographical features.

8. Although for the purposes of geographical nomenclature, boundaries formed by a coast line—that is, by depressions of the earth's solid crust *below* the ocean level—are most easily recognised, and are of special convenience; and although such boundaries, from following lines on which the continuity of the land is interrupted, often necessarily indicate important differences in the conditions of adjoining countries, and of their political and physical relations, yet variations of the elevation of the surface *above* the sea level frequently produce effects not less marked. The changes of temperature and climate caused by difference of elevation are quite comparable in their magnitude and effect on all organised creatures with those due to differences of latitude; and the relative position of the high and low lands on the earth's surface, by modifying the direction of the winds, the fall of rain, and other atmospheric phenomena, produces effects in no sense less important than those due to the relative distribution of the land and sea. Hence the study of the mountain ranges of a continent is, for a proper apprehension of its physical conditions and characteristics, as essential as the examination of its extent and position in relation to the equator and poles, and the configuration of its coasts.

Tibeto-Himalayan mountains.

9. From such causes the physical conditions of a large part of Asia, and the history of its populations, have been very greatly influenced by the occurrence of the mass of mountain, which includes the Himalaya and the whole elevated area having true physical connection with that range, and occupies an area about 2000 miles in length and varying from 100 to 500 miles in width, between the 65th and 100th meridians east from Greenwich, and between the 28th and 35th degrees of N. lat. These mountains, which are the highest in the world, rise, along their entire length, far above the line of perpetual snow, and few of the passes across the main ridges are at a less altitude than 15,000 or 16,000 feet above the sea. Peaks of 20,000 feet abound along the whole chain, and the points that exceed that elevation are numerous, the highest hitherto measured being more than 29,000 feet above the sea. A mountain range such as this, attaining altitudes at which vegetable life ceases, and the support of animal life is extremely difficult, constitutes an almost impassible barrier against the spread of all forms of living creatures. The mountain mass, moreover, is not less important in causing a complete separation between the atmospheric conditions on its opposite flanks, by reason of the extent to which it penetrates that stratum of the atmosphere which is in contact with the earth's surface and is effective in determining climate. The highest summits create serious obstructions to the movements of nearly three-fourths of the mass of the air resting on this part of the earth, and of nearly the whole of the moisture it contains; the average height of the entire chain is such as to make it an almost absolute barrier to one-half of the air and three-fourths of the moisture; while the lower ranges also produce important atmospheric effects, one-fourth of the air and one-half of the watery vapour it carries with it lying below 9000 feet.

Their physical importance.

GEOGRAPHY.

10. This great mass of mountain, constituting as it does a complete natural line of division across a large part of the continent, will form a convenient basis from which to work, in proceeding, as will now be done, to give a general view of the principal countries contained in Asia.

Tibet.

11. The summit of the great mountain mass is occupied by *Tibet*, a country known by its inhabitants under the name of *Bod*, or *Bodyul*. *Tibet* is a rugged table-land, narrow as compared to its length, broken up by a succession of mountain ranges, which follow as a rule the direction of the length of the table-land, and commonly rise into the regions of perpetual snow; between the flanks of these lie valleys, closely hemmed in, usually narrow, having a very moderate inclination, but at intervals opening out into wide plains, and occupied either by rivers, or frequently by lakes from which there is no outflow and the waters of which are salt. The eastern termination of Tibet is in the line of snowy mountains which flanks China on the west, between the 27th and 35th parallels of latitude, and about on the 103d meridian east. On the west the table-land is prolonged beyond the political limits of Tibet, though with much the same physical features, to about the 70th meridian, beyond which it terminates; and the ranges which are covered with perpetual snow as far west as Samárkhand thence rapidly diminish in height, and terminate in low hills north of Bukhára.

Its extent.

Its mountains.

12. The mean elevation of Tibet may be taken as 15,000 feet above the sea. The broad mountainous slope by which it is connected with the lower levels of Hindostan contains the ranges known as the Himalaya; the names of Kouenlun, or Karakorum, have been given by some geographers to the northern slope that descends to the central plains of the Gobi, though these mountains are not locally known under those names, Kouenlun being apparently a Chinese corruption of some Turkish or Tibetan word, and Karakorum only one of the many passes that lead from Western Tibet to the northward.

Its climate and people.

13. The extreme rigour of the climate of Tibet, which combines great cold with great drought, makes the country essentially very poor, and the chief portion of it little better than desert. The vegetation is everywhere most scanty, and anything deserving the name of a tree is hardly to be found unless in the more sheltered spots, and then artificially planted. The population in the lower and warmer valleys live in houses, and follow agriculture; in the higher regions they are nomadic shepherds, thinly scattered over a large area.

China.

14. *China* lies between the eastern flank of the Tibetan

plateau and the North Pacific, having its northern and southern limits about on the 40th and the 20th parallels of N. lat. respectively. The country though generally broken up with mountains of moderate elevation, possesses none of very great importance apart from those of its western border. It is well watered, populous, and, as a rule, highly cultivated, fertile, and well wooded; the climate is analogous to that of southern Europe, with hot summers, and winters everywhere cold and in the north decidedly severe.

Indo-Chinese region.

15. From the eastern extremity of the Tibetan mountains, between the 95th and 100th meridians, high ranges extend from about lat. 35° N., in a southerly direction, which, spreading outwards as they go south, reach the sea at various points in Cochin-China, the Malayan peninsula, and the east flank of Bengal. Between these ranges, which are probably permanently snowy to about the 27th degree of N. lat., flow the great rivers of the Indo-Chinese peninsula, the Mekong, the Menám, the Sálwen, and the Irawády, the valleys of which form the main portions of the states of Cochin-China (including Tonquin and Camboja), of Siam (including Laos), and of Burmah. The people of Cochin-China are called *Anam*; it is probably from a corruption of their name for the capital of Tonquin, *Kechao*, that the Portuguese *Cochin* has been derived. All these countries are well watered, populous, and fertile, with a climate very similar to that of eastern Bengal. The geography of the region in which the mountains of Cochin-China and Siam join Tibet is still very imperfectly known, but there is no ground left for doubting that the great river of eastern Tibet, the Tachok-tsangpo, supplies the main stream of the Brahmaputra. The two great rivers of China, the Hoang-ho and the Yang-tse-kyang, take their rise from the eastern face of Tibet, the former from the north-east angle, the latter from the south-east. The main stream of this last is called Bri-chu in Tibet, and its chief feeder is the Ya-lung-kyang, which rises not far from the Hoang-ho, and is considered the territorial boundary between China and Tibet.

British India.

16. *British India* comprises approximately the area between the 95th and 70th meridians, and between the Tibetan table-land and the Indian Ocean. The Indian peninsula from the 25th degree of latitude southwards is a table-land, having its greatest elevation on the west, where the highest points rise to over 8000 feet, though the ordinary altitude of the higher hills hardly exceeds 4000 feet; the general level of the table-land lies between 3000 feet as a maximum and 1000 feet.

Great northern plain.

17. From the delta of the Ganges and Brahmaputra on the east to that of the Indus on the west, and intervening between the table-land of the peninsula and the foot of the Himalayan slope of the Tibetan plateau, lies the great plain of northern India, which rises at its highest point to about 1000 feet, and includes altogether, with its prolongation up the valley of Assam, an area of about 500,000 square miles, comprising the richest, the most populous, and most civilised districts of India. This great plain extends, with an almost unbroken surface, from the most western to the most eastern extremity of British India, and is composed of deposits so finely comminuted, that it is no exaggeration to say that it is possible to go from the Bay of Bengal up the Ganges, through the Punjab, and down the Indus again to the sea, over a distance of 2000 miles and more, without finding a pebble, however small.

Rivers.

18. The great rivers of Northern India—the Ganges, the Brahmaputra, and the Indus—all derive their waters from the Tibetan mountain mass; and it is a remarkable circumstance, that the waters of almost the whole of the summit of the plateau are carried off into British India between the 95th and 75th meridians, and that the only part of the drainage thrown off to the north, is that of the northern mountain slope.

Population and climate.

19. The population of India is very large, some of its districts being probably among the most densely peopled in the world. The country is generally well cleared; and forests are, as a rule, found only along the flanks of the mountains, where the fall of rain is most abundant. The more open parts are highly cultivated, and large cities abound. The climate is generally such as to secure the population the necessaries of life without severe labour; the extremes of heat and drought are such as to render the land unsuitable for pasture, and the people everywhere subsist by cultivation of the soil or commerce, and live in settled villages or towns.

Ceylon.

20. The island of *Ceylon* is distinguished from the neighbouring parts of British India by little more than its separate administration and the Buddhistic religion of its population. The highest point in Ceylon rises to about 9000 feet above the sea, and the mountain slopes are densely covered with forest. The lower levels are in climate and cultivation quite similar to the regions in the same latitude on the Malay peninsula.

Nicobars and Andamans.

21. Of the islands in the Bay of Bengal, the *Nicobar* and *Andaman* groups are alone worth notice. They are placed on a line joining the north end of Sumatra and Cape Negrais, the south-western extremity of Burmah. They possibly owe their existence to the volcanic agencies which are known to extend from Sumatra across this part of the Indian Ocean.

Laccadives and Maldives.

22. The *Laccadives* and *Maldives* are groups of small coral islands, situated along the 73d meridian, at no great distance from the Indian peninsula, on which they have a very slight and ill-defined political dependency.

High lands of Persia.

23. The portion of Asia west of British India, excluding Arabia and Syria, forms another extensive plateau covering an area as large as that of Tibet, though at a much lower altitude. Its southern border runs along the Arabian Sea, the Persian Gulf, the Tigris, and thence westward to the north-east angle of the Levant; on the north the high land follows nearly the 36th degree of N. lat. to the southern shore of the Caspian, and thence to the Black Sea and Sea of Marmora. *Afghánistán*, *Balúchistán*, *Irán* or Persia, *Armenia*, and the provinces of *Asia Minor*, occupy this high region, with which they are nearly conterminous. The eastern flank of this table-land follows a line of hills drawn a short distance from the Indus, between the mouth of that river and the Himalaya, about on the 72d meridian; these hills do not generally exceed 4000 or 5000 feet in elevation, but a few of the summits reach 10,000 feet or more. The southern and south-western face follows the coast closely up the Persian Gulf from the mouth of the Indus, and is formed further west by the mountain scarp which, rising in many points to 10,000 feet, flanks the Tigris and the Mesopotamian plains, and extends along Kurdistan and Armenia nearly to the 40th meridian; beyond which it turns along the Taurus range, and the north-eastern angle of the Mediterranean. The north-eastern portion of the Afghan table-land abuts on the Himalaya and Tibet, with which it forms a continuous mass of mountain between the 71st and 72d meridians, and the 34th and 36th parallels of N. lat. From the point of intersection of the 71st meridian with the 36th parallel of latitude, which falls nearly on the pass called *Hindu-kosh* (a name which has been extended by geographers to the ridge on which it is placed), an unbroken range of mountain stretches on one side towards the north-east, up to the crest of the northern slope of the Tibetan plateau, and on the other nearly due west as far as the Caspian. The north-eastern portion of this range is of

Afghanistan.

great altitude, and separates the head waters of the Oxus, which run off to the Aral Sea, from those of the Indus and its Cabul tributary, which, uniting below Peshâwar, are thence discharged southward into the Arabian Sea. The western part of the range, which received the name of Paropamisan Mountains from the ancients, diminishes in height west of the 65th meridian, and constitutes the northern face of the Afghan and Persian plateau, rising abruptly from the plains of the Turkoman desert, which lies between the Oxus and the Caspian. These mountains at some points attain a height of 10,000 or 12,000 feet. Along the south coast of the Caspian this line of elevation is prolonged as the Elburz range (not to be confused with the Elburz of the Caucasus), and has its culminating point in Demavend, which rises to 18,500 feet above the sea; thence it extends to the north-west to Ararat, which rises to upwards of 17,000 feet, from the vicinity of which the Euphrates flows off to the south-west, across the high lands of Armenia. Below the north-east declivity of this range lies Georgia, on the other side of which province rises the Caucasus, the boundary of Asia and Europe between the Caspian and Black Seas, the highest points of which reach an elevation of nearly 19,000 feet. West of Ararat high hills extend along the Black Sea, between which and the Taurus range lies the plateau of Asia Minor, reaching to the Ægean Sea; the mountains along the Black Sea, on which are the Olympus and Ida of the ancients, rise to 6000 or 7000 feet; the Taurus is more lofty, reaching 8000 and 10,000 feet; both ranges decline in altitude as they approach the Mediterranean.

Asia Minor.

Extent, climate, population.

24. This great plateau, extending from the Mediterranean to the Indus, has a length of about 2500 miles from east to west, and a breadth of upwards of 600 miles on the west, and nowhere of less than 250 miles. It lies generally at altitudes between 2000 feet and 8000 feet above the sea level. Viewed as a whole, the eastern half of this region, comprising Persia, Afghanistan, and Baluchistan, is poor and unproductive. The climate is very severe in the winter, and extremely hot in summer. The rainfall is very scanty, and running waters are hardly known, excepting among the mountains which form the scarps of the elevated country. The population is sparse, frequently nomadic, and addicted to plunder; progress in the arts and habits of civilisation is small. The western part of the area falls within the Turkish empire. Its climate is less hot and arid, its natural productiveness much greater, and its population more settled and on the whole more advanced.

Arabia and Syria.

25. The peninsula of *Arabia*, with *Syria*, its continuation to the north-west, have some of the characteristics of the hottest and driest parts of Persia and Baluchistan. Excepting the northern part of this tract, which is conterminous with the plain of Mesopotamia (which at its highest point reaches an elevation of about 700 feet above the sea), the country is covered with low mountains, rising to 3000 or 4000 feet in altitude, having among them narrow valleys in which the vegetation is scanty, with exceptional regions of greater fertility in the neighbourhood of the coasts, where the rainfall is greatest. In Northern Syria the mountains of Lebanon rise to about 10,000 feet, and with a more copious water supply the country becomes more productive. The whole tract, excepting south-eastern Arabia, is nominally subject to Turkey or Egypt, but the people are to no small extent practically independent, living a nomadic, pastoral, and freebooting life under petty chiefs, in the more arid districts, but settled in towns in the more fertile tracts, where agriculture becomes more profitable, and external commerce is established.

Turkistan.

26. The area between the northern border of the Persian high lands and the Caspian and Aral Seas is a nearly desert low-lying plain, extending to the foot of the north-western extremity of the great Tibeto-Himalayan mountains, and prolonged eastward up the valleys of the Oxus and Jaxartes, and northwards across the country of the Kirghiz and Kassaks, to the south-western border of Siberia. It includes *Bukhara*, *Khiva*, and *Turkistan* proper, in which the Uzbeg Turks are dominant, and for the most part is inhabited by nomadic tribes, who are marauders, enjoying the reputation of being the worst among a race of professed robbers. The tribes to the north, subject to Russia, are naturally more peaceable, and have been brought into some degree of discipline. In this tract the rainfall is nowhere sufficient for the purposes of agriculture, which is only possible by help of irrigation; and the fixed population (which contains a non-Turkish element) is comparatively small, and restricted to the towns and the districts near the rivers.

Pámir.

27. The most northern extremity of the elevated Tibeto-Himalayan mountain plateau is situated about on the 73d meridian east, and 39° N. lat. This region is known as *Pámir;* it has all the characteristics of the highest regions of Tibet, and so far fitly receives the Russian designation of steppe; but it seems to have no special peculiarities, and the reason of its having been so long regarded as a geographical enigma is not obvious. From it the Oxus, or Amu, flows off to the west, and the Jaxartes, or Sir, to the north, through the Turki state of Kokand, while to the east the waters run down past Kashgar to the central desert of the Gobi, uniting with the streams from the northern slope of the Tibetan plateau that traverse the principalities of *Yárkend* and *Khoten*, which are also Turki. Here the Tibetan mountains unite with the line of elevation which stretches across the continent from the Pacific, and which separates Siberia from the region commonly spoken of under the name of Central Asia.

Manchuria.

28. A range of mountains, called Stanovoi, rising to heights of 4000 or 5000 feet, follows the southern coast of the eastern extremity of Asia from Kamchatka to the borders of Manchuria, as far as the 135th meridian, in lat. 55° N. Thence, under the name of Yablonoi, it divides the waters of the river Lena, which flows through Siberia into the Arctic Sea, from those of the river Amur, which falls into the North Pacific; the basin of this river, with its affluents, constitutes *Manchuria.* Approximately at right angles to the last named range, another, known as the Khingan, extends between the 120th and 115th meridians, from the 55th to the 42d parallel of N. lat., east of which the drainage falls into the Amur and the Yellow Sea, while to the west is an almost rainless region, the inclination of which is towards the central area of the continent, which is *Mongolia.*

Mongolia

29. From the western end of the Yablonoi range, on the 115th meridian, a mountainous belt extends along a somewhat irregular line to the extremity of Pamir, known under various names in its different parts, and broken up into several branches, enclosing among them many isolated drainage areas, from which there is no outflow, and within which numerous lakes are formed. The most important of these ranges is the Thian-shan, or Celestial mountains, which form the northern boundary of the Gobi desert; they lie along the 42d and 43d parallels of N. lat., between the 75th and 95th meridians, and some of the summits are said to exceed 20,000 feet in altitude; along the foot of this range lie the principal cultivated districts of Central Asia, and here too are situated the few towns which have sprung up in this barren and thinly-peopled region. Next may be named the Ala-tau, on the prolongation of the Thian-shan, flanking the Sir on the north, and rising to 14,000 or 15,000 feet. It forms the barrier between the Issik-kul and Balkash lakes, the elevation of which is about 5000 feet. Last is the Altai, near the 50th parallel, rising to 10,000 or 12,000 feet, which separates the waters of the great rivers of Western Siberia from those that col-

lect into the lakes of North-west Mongolia, Zungaria, and Kalka. A line of elevation is continued west of the Altai to the Ural Mountains, not rising to considerable altitudes; this divides the drainage of South-west Siberia from the great plains lying north-east of the Aral Sea.

Gobi. 30. The central area bounded on the north and north-west by the Yablonoi Mountains and their western extension in the Thian-shan, on the south by the northern face of the Tibetan plateau, and on the east by the Khingan range before alluded to, forms the great desert of Central Asia, known as the Gobi. Its eastern part is nearly conterminous with South Mongolia, its western forms East Turkistan. It appears likely that no part of this great central Asiatic desert is less than 2000 feet above the sea-level. The elevation of the plain about Kashgar and Yarkend is from 4000 to 6000 feet. The more northern parts of Mongolia are between 4000 and 6000 feet, and no portion of the route across the desert between the Chinese frontier and Kiákhta is below 3000 feet. The precise positions of the mountain-ridges that traverse this central area are not properly known; their elevation is everywhere considerable, and many points are known to exceed 10,000 or 12,000 feet.

Climate and people. 31. In Mongolia the population is essentially nomadic, their wealth consisting in herds of horned cattle, sheep, horses, and camels. The Turki tribes, occupying Western Mongolia, are among the least civilised of human beings, and it is chiefly to their extreme barbarity and cruelty that our ignorance of Central Asia is due. The climate is very severe, with great extremes of heat and cold. The drought is very great; rain falls rarely, and in small quantities. The surface is for the most part a hard stony desert, areas of blown sand occurring but exceptionally. There are few towns or settled villages, except along the slopes of the higher mountains, on which the rain falls more abundantly, or the melting snow supplies streams for irrigation. It is only in such situations that cultivated lands are found, and beyond them trees are hardly to be seen.

Siberia. 32. The portion of Asia which lies between the Arctic Ocean and the mountainous belt bounding Manchuria, Mongolia, and Turkistan on the north, is Siberia; it is almost equal in area to the whole of Europe. It is for the most part a low-lying diluvial plain, with a nearly level or slightly undulating surface, which extends eastwards from the Ural Mountains almost to Kamchatka. Beyond the 125th meridian the plain is more broken by hills. The extremes of heat and cold are very great. The rainfall, though not heavy, is sufficient to maintain such vegetation as is compatible with the conditions of temperature, and the surface is often swampy or peaty. The mountain sides are commonly clothed with pine forests, and the plains with grasses or shrubs. The population is very scanty; the cultivated tracts are comparatively small in extent, and restricted to the more settled districts The towns are entirely Russian. The indigenous races are nomadic Mongols, of a peaceful character, but in a very backward state of civilisation. The Ural Mountains do not exceed 2000 or 3000 feet in average altitude, the highest summits not exceeding 6000 feet, and one of the passes being as low as 1400 feet. In the southern half of the range are the chief mining districts of Russia. The Ob, Yenisei, and Lena, which traverse Siberia, are among the largest rivers in the world.

Malay islands. 33. The southern group of the Malayan Islands, from Sumatra to Java and Timor, extends in the arc of a circle, between the 95th and 127th meridians, and from the 5th degree of N. to the 10th degree of S. lat. The central part of the group is a volcanic region, many of the volcanoes being still active, the summits frequently rising to 10,000 feet or more.

34. *Sumatra*, the largest of the islands, is but thinly peopled; the greater part of the surface is covered with dense forest, the cultivated area being comparatively small, confined to the low lands, and chiefly in the volcanic region near the centre of the island. *Java* is the most thickly peopled, best cultivated, and most advanced island of the whole Eastern Archipelago. It has attained a high degree of wealth and prosperity under the Dutch Government. The people are peaceful and industrious, and chiefly occupied with agriculture. The highest of the volcanic peaks rises to 12,000 feet above the sea. The eastern islands of this group are less productive and less advanced. Sumatra. Java.

35. *Borneo*, the most western and the largest of the northern group of islands which extends between the meridians of 110° and 150° E., as far as New Guinea or Papua, is but little known. The population is small, rude, and uncivilised; and the surface is rough and mountainous, and generally covered with forest except near the coast, to the alluvial lands on which settlers have been attracted from various surrounding countries. The highest mountains are supposed to rise to about 10,000 feet, but the ordinary elevations seem not to exceed 4000 or 5000 feet. Borneo.

36. Of *Celebes* less is known than of Borneo, which it resembles in condition and natural characteristics. The highest known peaks rise to 8000 feet, some of them being volcanic. Celebes.

37. *Papua* is perhaps somewhat smaller than Borneo. It extends almost to the same meridian as the eastern coast of Australia, from the north point of which it is separated by Torres Straits. Very little is known even of its coasts. The mountains in the interior are said to rise to 20,000 feet, having the appearance of being permanently covered with snow; the surface seems generally to be clothed with thick wood. The inhabitants are of the Negrito type, with curly or crisp and bushy hair; those of the west coast have come more into communication with the traders of other islands, and are fairly civilised. Eastward, many of the tribes are barbarous savages, with whom it is almost impossible for foreigners to hold intercourse. Papua.

38. The *Philippine* islands lie between the 15th and 20th degrees of N. lat., between Borneo and southern China. The highest land does not rise to a greater height than 6000 feet; the climate is well suited for agriculture, and the islands generally are fertile and fairly cultivated, though not coming up to the standard of Java either in wealth or population. The Spanish Government is established over the greater part of the group, though a considerable numerical proportion of the people is in some districts beyond their active control. Philippines.

39 *Formosa*, which is situated under the northern tropic, near the coast of China, is traversed by a high range of mountains, reaching nearly 13,000 feet in elevation. On its western side, which is occupied by an immigrant Chinese population, are open and well-cultivated plains; on the east it is mountainous, and occupied by independent indigenous tribes in a less advanced state. Formosa

40. The islands of *Japan* lie between the 30th and 45th parallels. The whole group is traversed by a line of volcanic mountains, some of which are in activity, the highest point being about 13,000 feet above the sea. The country is well watered, fertile, and well cultivated. The people are industrious and intelligent, and show much capacity for mechanical and ornamental art. They have recently attracted special attention from the sudden efforts made by their Government to accept and introduce Western civilisation. Japan.

41. Materials are wanting for anything like a connected sketch of the geological structure of the continent of Asia, and little more can be done than to indicate a few GEOLOGY.

facts which tend to throw light on the probable epochs at which the land has assumed its present configuration.

Tertiary deposits.

42. There is evidence of the very recent formation, speaking geologically, of the great plains of Northern India, of Mesopotamia, and of portions of Central Asia and Siberia. The existence of deposits containing large mammalian remains of the older Pliocene or Miocene divisions of the Tertiary period, has been ascertained at many places on the low lands of British India, in Burmah on the east, along the foot of the Himalaya, and near the Gulf of Cutch on the west, which indicates that very great changes of level and of conditions of surface have taken place in those localities since the later Tertiary epoch. The far wider spread of the older tertiaries proves that far greater alterations have occurred since the Eocene period. Nummulitic limestones are found from Burmah to Eastern Bengal; they are continuous along the flank of the table-land of Baluchistan, through Sindh to the Himalaya; they are frequent throughout Persia, Asia Minor, Syria, Egypt, and along the Caspian; they are found at great elevations in the Himalaya—in one locality at more than 16,000 feet above the sea; all this indicates that over a vast region, which is now dry land, often rising to very great altitudes, there existed a sea area at a period which, geologically speaking, appertains to the more recent epochs of the earth's history. Hence the present configuration of the land must be due to movements of a subsequent date; and it is thus shown that the vast elevation of the great Tibetan table-land is due to changes which are among the latest to which the earth's surface has been subjected. No doubt the Caspian and Aral seas formed part of the ancient ocean which once occupied a great part of what is now Western Asia.

Recent elevation of mountains and plains.

Himalaya.

43. The occurrence of a regular succession of the older fossiliferous deposits, from Upper Silurian upwards to the Triassic and Jurassic, and even to the Cretaceous formations, along the line lying to the north of the highest Himalayan ranges, gives ground for the supposition that an ancient sea-coast may have existed along this line; and that from a still earlier period there was dry land to the south, where the Himalaya now stands. Thus these mountains may have continued, as a chain of some importance, to occupy their present position from a period anterior to the Silurian epoch, while their existing very great elevation is probably due to the disturbances which have taken place since the middle of the Tertiary period.

Indian peninsula.

44. There is no sufficient evidence of the former extent or distribution of the land south of the Himalaya. But from the absence of marine fossiliferous deposits of the older epochs, it has been inferred that the greater part, at least, of the peninsula of India may have been an area of dry land from a very remote time up to the middle of the Tertiary period, during which the great basaltic formations of Central India are supposed to have been thrown up; a partial submergence then seems to have occurred, followed by a re-elevation, which gave the continent its present form. The fossil remains that have been found indicate the presence, in the Triassic or Permian age, of a great continental area, extending from Europe, and forming a connection across the Indian Ocean between South Africa and the peninsula of India. Grounds also exist for supposing that the Indian peninsula was formerly united by dry land with Australia, and that, when these conditions prevailed, the peninsula was separated by sea from the rest of Asia. Other evidence of this is to be found in the distribution of the races of men, and of plants and animals.

Siberia.

45. The occurrence of a large area of Silurian and other Palæozoic rocks in Northern Siberia, extending to the Altai mountains, with an apparent absence of the Mesozoic, has been explained as probably due to the existence of a marine area during the Palæozoic epoch, at the close of which it was replaced by an area of land; this was again submerged in the latest Tertiary period, during which a great part of the country was covered with the diluvial deposits, in which are found the remains of large mammalia.

China. Central Asia.

46. The presence of coal in many parts of China and Mongolia is a further indication of great former changes of condition of the surface in that part of the continent.

Himalayan glaciers.

47. Evidence exists of a former far greater extension of glaciers on the Himalaya, possibly at the period during which the great glacial phenomena of Europe occurred; but too little is known to enable us to affirm that this indicates any general period of cold that affected the northern hemisphere as far south as the Himalaya, though the facts are sufficiently striking to suggest such a conclusion. Another explanation of the decrease of Himalayan glaciers is that it was a consequence of the diminution of the fall of snow, consequent on the gradual change of climate which must have followed a gradual transformation of an ocean area into one of dry land. This last-named circumstance would also account for the great changes in the quantity of rain-fall, and in the flow of the rivers, of which there are many indications in Western India, in Persia, and the regions east of the Caspian.

Volcanoes.

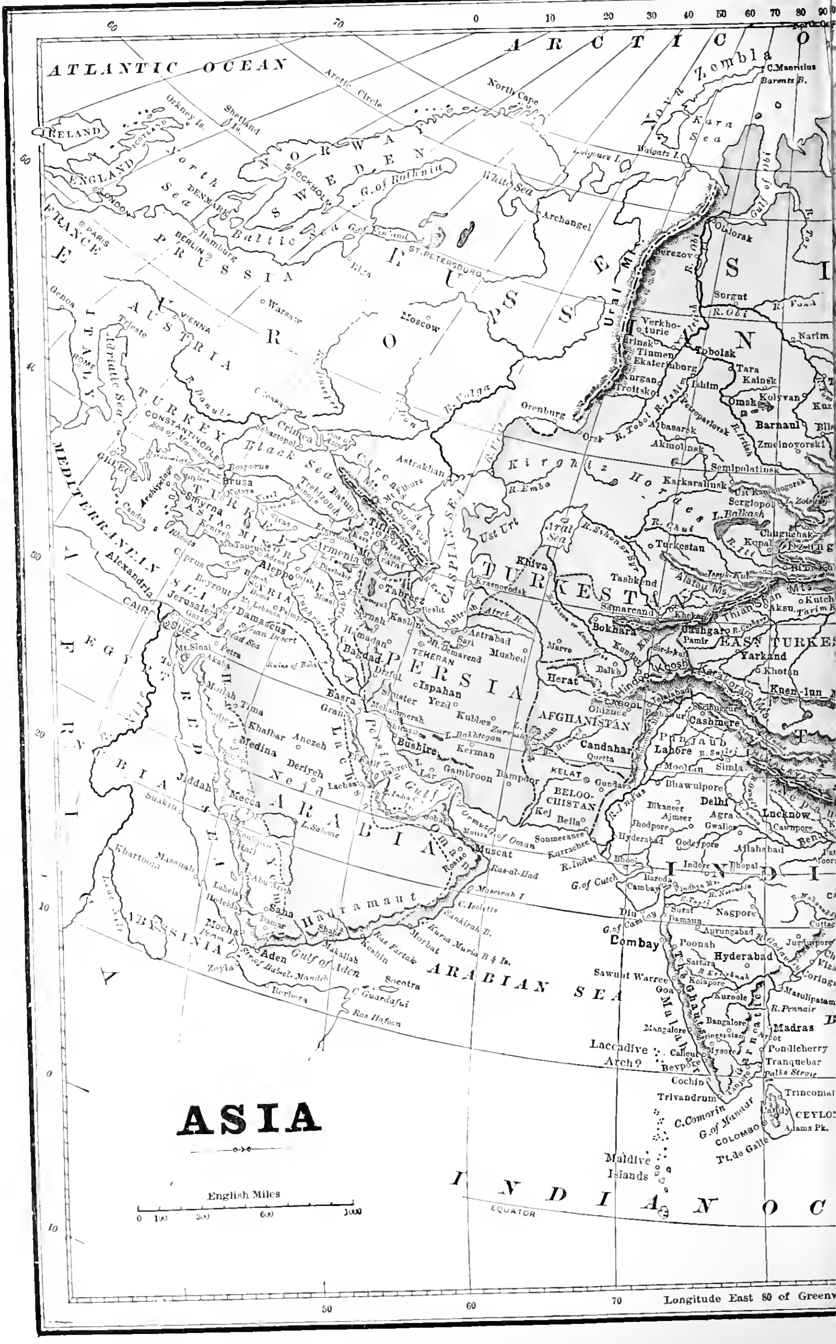
48. A remarkable feature of Asia is the line of volcanic activity which extends along its eastern coast through Kamchatka, the Kurile and Japanese islands, Formosa, and the Philippines, to the Malay archipelago. Thence the line is prolonged to the west, through Java and Sumatra to the Bay of Bengal, where it ends about in lat. 20° N. on the coast of Aracan. To the east and south there also seems to be a connection with the volcanic regions of New Zealand and the islands of the Pacific, and possibly with that of the antarctic land. There is no authentic evidence of active volcanoes in the interior of the continent.

Dependence of present organic forms on past conditions.

49. Although these facts give an extremely incomplete view of the geological structure of Asia, they will afford some slight idea of the great changes that have taken place throughout all parts of the continent, and serve to convey a warning of the necessity for taking such changes into account, when attempts are made to understand the manner in which animals and plants are distributed on the earth's surface, and how their development may have taken place. The phenomena of living creatures as now observed are the results of various causes which have been in operation through a long period of time. Those causes which still continue to be in action may, in some respects, call for special attention, as determining the precise conditions under which organisations now have to exist, and as being those which now tend to destroy what has been, and to substitute something different in its place. But what remains necessarily depends on what preceded it, and the knowledge of the conditions and forms of life in the past is an essential element of the proper understanding of life as it now is.

CLIMATE

50. *Climate* is among the most important of the conditions affecting all forms of life. Under this general term is designated the complicated series of phenomena which arise in the air surrounding any locality, and in the watery vapour diffused through that air. These phenomena, which include the variations of temperature and of moisture, the winds, the rain, and the electrical condition of the air, depend essentially on the action of solar heat on the atmosphere and the materials of the terrestrial globe. The main conditions which determine the climate of any place, are position on the earth in respect to latitude, elevation above the sea level, and character of the surface in relation to its power of absorbing or radiating heat. Owing to the extreme mobility of the air, its temperature and the quantity of moisture it contains are further influenced in a very


ASIA
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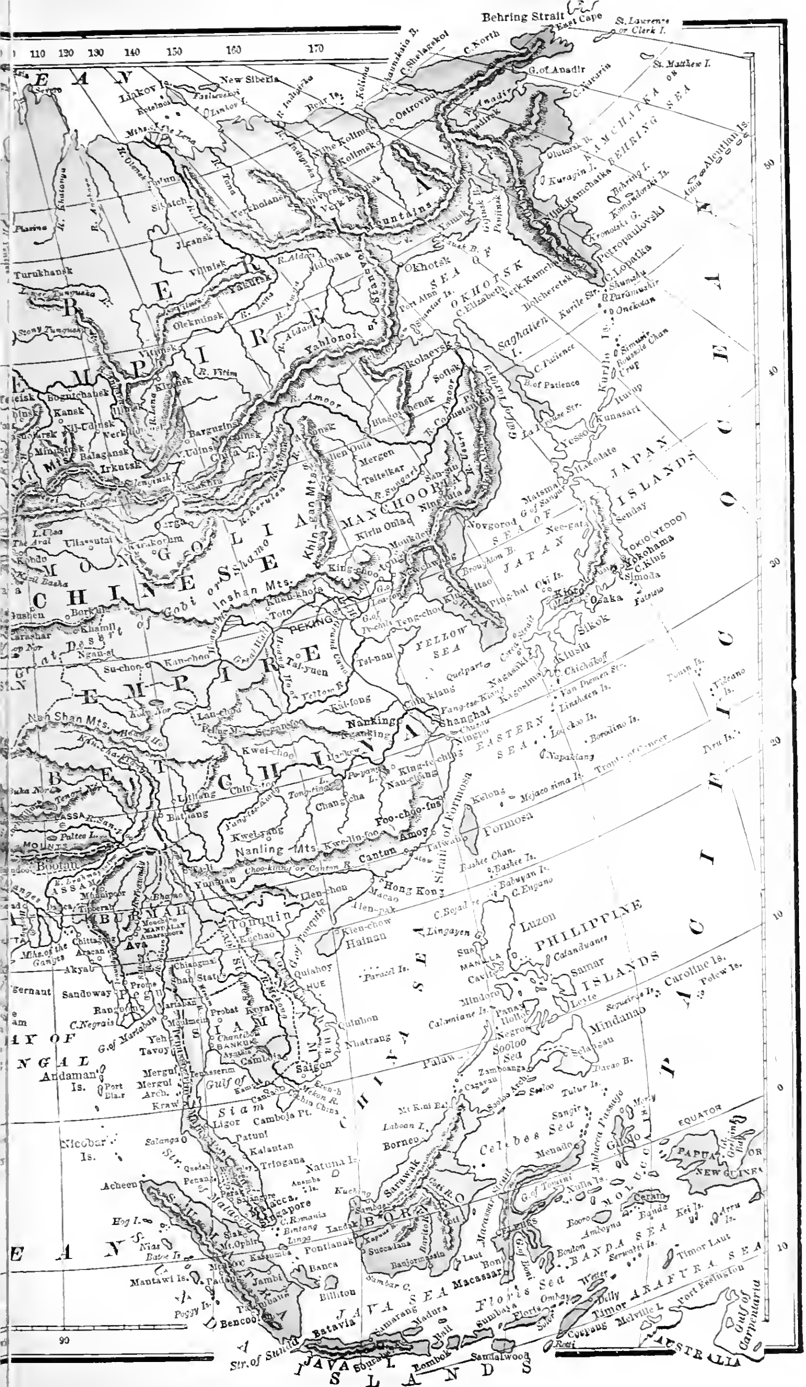
ENGLAND
LONDON
SCOTLAND
FRANCE
PARIS
North Sea
DENMARK
Hamburg
BERLIN
PRUSSIA
Baltic Sea
NORWAY
SWEDEN
STOCKHOLM
G. of Bothnia
North Cape
Arctic Circle
Orkney Is.
Shetland Is.
White Sea
Archangel
ST. PETERSBURG
Nova Zembla
C. Mauritius
Barentz B.
Kara Sea
Waigatz I.
Kolguev I.
EUROPEAN RUSSIA
AUSTRIA
VIENNA
Warsaw
Moscow
R. Volga
Orenburg
Trieste
Genoa
ROME
ITALY
Adriatic Sea
TURKEY
CONSTANTINOPLE
Sea of Marmora
Black Sea
Crimea
Sebastopol
GREECE
Archipelago
MEDITERRANEAN SEA
Candia
Rhodes
Cyprus
Smyrna
Brusa
Bosporus
ASIA MINOR
Trebizond
Batum
Sivas
Caucasus Mts.
Mt Elburz
Tiflis
GEORGIA
Armenia
Ararat
Erzeroum
Aleppo
SYRIA
Damascus
Beyrout
Jerusalem
Syrian Desert
Dead Sea
Euphrates
Tigris
Mosul
Tabreez
Astrakhan
CASPIAN SEA
Alexandria
CAIRO
SUEZ
Mt. Sinai
Petra
Akaba
EGYPT
Nile
RED SEA
Medina
Mecca
Jiddah
Suakin
Khartoum
Massuah
Loheia
Hodeida
Mocha
Aden
Gulf of Aden
Str. of Bab-el-Mandeb
Zeyla
Berbera
C. Guardafui
Ras Hafoon
Socotra
ABYSSINIA
AFRICA
ARABIA
Nejd
Deriyeh
Anezeh
Lachsa
L. Salome
Hadramaut
Saba
Makallah
Keshin
Ras Fartak
Morbat
Kuria Muria B. & Is.
Masirah I.
Ras-al-Had
Muscat
Oman
G. of Oman
Ormuz
Persian Gulf
Bahrein I.
Basra
Bagdad
Hamadan
PERSIA
TEHERAN
Ispahan
Yezd
Shiraz
Bushire
Kerman
Gambroon
Bampoor
Astrabad
Mushed
Herat
AFGHANISTAN
CABOOL
Candahar
Quetta
KELAT
BELOOCHISTAN
Kej
Sonmeeanee
Kurrachee
R. Indus
Hindoo Koosh
Balkh
Merve
Khiva
Aral Sea
Ust Urt
TURKESTAN
Krasnovodsk
Samarcand
Bokhara
Tashkend
Turkestan
Kirghiz Horde
R. Emba
Orsk
Akmolinsk
Karkaralinsk
Sergiopol
L. Balkash
Semipolatinsk
Kopal
Chuguchak
Alatau Ms.
Thian Shan Mts.
Kuldja
Aksu
Tarim R.
Kashgar
Pamir
EAST TURKESTAN
Yarkand
Khotan
Karakoram Mts.
Kuen-lun Mts.
Cashmere
Punjaub
Lahore
Simla
Mooltan
Bhawulpore
Delhi
Agra
Gwalior
Lucknow
Cawnpore
Benares
Allahabad
Bikaneer
Ajmeer
Jhodpore
Hyderabad
Godeypore
Indore
Bhopal
INDIA
G. of Cutch
Bhooj
Baroda
Cambay
Diu
Surat
Damaun
Nagpore
Aurungabad
Bombay
G. of Cambay
Poonah
Sattara
Hyderabad
Kolapore
Goa
Sawunt Warree
Kurnole
Masulipatam
R. Pennair
Bangalore
Madras
Mangalore
Seringapatam
Mysore
Arcot
Pondicherry
Tranquebar
Palks Strait
Calicut
Beypore
Cochin
Trivandrum
C. Comorin
G. of Manaar
Trincomalee
CEYLON
Kandy
COLOMBO
Adams Pk.
Pt. de Galle
Laccadive Arch.
Maldive Islands
EQUATOR
INDIAN OCEAN
ARABIAN SEA
Ural Mts.
Verkhoturie
Tiumen
Ekaterinburg
Kurgan
Troitskoi
Tobolsk
Ishim
Tara
Kainsk
Omsk
Kolyvan
Barnaul
Zmeinogorski
Petropavlovsk
R. Tobol
R. Ishim
R. Irtish
R. Obi
Obdorsk
Berezov
Sorgut
Narim
Gulf of Obi
SIBERIA
Ust Kamenogorsk



Behring Strait
East Cape
St. Lawrence or Clerk I.
St. Matthew I.
G. of Anadir
C. North
New Siberia
Liakov Is.
Kamchatka
Behring Sea
Aleutian Is.
Behring I.
Komandorski Is.
Petropaulovski
C. Lopatka
Okhotsk
Sea of Okhotsk
Kurile Is.
Saghalien I.
C. Patience
B. of Patience
Nikolaevsk
Yablonoi
Turukhansk
Olekminsk
Vitimsk
Irkutsk
Kansk
Nijni Udinsk
Verkholansk
Yakutsk
Barguzinsk
Chita
Kiakhta
Verkh Kolimsk
Nijne Kolimsk
Siberia
Russian Empire
Amoor
Blagovestchensk
Mergen
Tsitsikar
Manchooria
Kirin Oulad
Moukden
Ninguta
Mongolia
Chinese Empire
Gobi or Shamo
Inshan Mts.
Uliassutai
Karakorum
Kobdo
Barkul
Khamil
Karashar
Lop Nor
Great Desert
Ngan-si
Su-choo
Kan-choo
Nan Shan Mts.
Lan-choo
Tai-yuen
Peking
Tsi-nan
Yellow Sea
G. of Pechili
Kai-fong
Nanking
Shanghai
Ningpo
Hankow
Kwei-choo
China
Po-yang L.
Nan-chang
King-te-ching
Tong-ting L.
Chang-sha
Foo-choo-foo
Amoy
Kwei-yang
Nanling Mts.
Kwei-lin-foo
Canton
Hong Kong
Macao
Yunnan
Lien-chau
Tonquin
G. of Tonquin
Hainan
Hue
Quinhon
Saigon
Cambodia
Siam
Bangkok
Korat
Gulf of Siam
Tenasserim
Mergui
Mergui Arch.
Tavoy
Moulmein
G. of Martaban
Rangoon
Pegu
Prome
Sandoway
Akyab
Chittagong
Arracan
Ava
Mandalay
Amarapoora
Burmah
Munnipoor
Assam
Bootan
Tibet
Lhassa
Bay of Bengal
Andaman Is.
Port Blair
Nicobar Is.
Malacca
Singapore
Penang
Salangore
Str. of Malacca
Sumatra
Acheen
Padang
Jambi
Bencoolen
Mantawi Is.
Nias
Hog I.
Banca
Billiton
Str. of Sunda
Batavia
Samarang
Java
Madura
Bali
Lombok
Sumbawa
Flores
Sandalwood
Timor
Coepang
Java Sea
Flores Sea
Banda Sea
Arafura Sea
Timor Laut
Australia
Melville I.
Port Essington
Gulf of Carpentaria
Papua or New Guinea
Equator
Gilolo
Moluccas
Ceram
Amboyna
Banda
Kei Is.
Arru Is.
Booro
Celebes
Celebes Sea
Menado
G. of Tomini
Macassar
G. of Boni
Macassar Str.
Borneo
Sarawak
Kuching
Pontianak
Banjarmassin
Laut
Labuan I.
Natuna Is.
Sooloo Sea
Sooloo Arch.
Zamboanga
Mindanao
Samar
Leyte
Panay
Mindoro
Palawan
Calamianes Is.
Luzon
Manila
Cavite
Lingayen
Philippine Islands
Babuyan Is.
C. Engano
Bashee Is.
Bashee Chan.
Formosa
Strait of Formosa
Kelong
Taiwan
Paracel Is.
China Sea
Loochoo Is.
Borodino Is.
Eastern Sea
Tropic of Cancer
Quelpart
Corea
Corea Strait
Nagasaki
Kagoshima
Kiusiu
Sikok
Osaka
Kioto
Tokio (Yeddo)
Yokohama
Simoda
Sea of Japan
Japan Islands
Nee-gata
Senday
Matsmai
G. of Sangar
Hakodate
Yesso
Kunasari
La Perouse Str.
Pacific Ocean
Caroline Is.
Pelew Is.
Volcano Is.
Broughton B.

important degree by the proximity of large areas of land and water and mountain ranges, and by the position of such areas or ranges in relation to the direction of the earth's motion on its axis. On no portion of the globe are the diversities of climate due to these causes more remarkable, or brought into more striking contrast, than in Asia.

51. Among the places on the globe where the temperature falls lowest are some in Northern Asia, and among those where it rises highest are some in Southern Asia. The mean temperature of the north coast of Eastern Siberia is but a few degrees above the zero of Fahrenheit; the lowest mean temperature anywhere observed is about 4° Fahr., at Melville Island, north of the American continent. The isothermals of mean annual temperature lie over Northern Asia on curves tolerably regular in their outline, having their western branches in a somewhat higher latitude than their eastern; a reduction of 1° of latitude corresponds approximately—and irrespective of modifications due to elevation—to a rise of ½° Fahr., as far say as lat. 30° N., where the mean temperature is about 75° Fahr. Further south the increase is slower, and the highest mean temperature anywhere attained in Southern Asia is not much above 82° Fahr.

Monthly variations

52. The variations of temperature are very great in Siberia, amounting near the coast to more than 100° Fahr., between the mean of the hottest and coldest months, and to still more between the extreme temperatures of those months. In Southern Asia, and particularly near the sea, the variation between the hottest and coldest monthly means is very much less, and under the equator it is reduced to about 5° In Siberia the difference between the means of the hottest and coldest months is hardly anywhere less than 60° Fahr. On the Sea of Aral it is 80° Fahr.; and at Astrakhan, on the Caspian, more than 50°. At Tiflis it is 45° In Northern China, at Peking, it is 55°, reduced to 30° at Canton, and to 20° at Manilla. In Northern India the greatest difference does not exceed 40°; and it falls off to about 15° at Calcutta, and to about 10° or 12° at Bombay and Madras. The temperatures at the head of the Persian Gulf approximate to those of Northern India, and those of Aden to Madras. At Singapore the range is less than 5°; and at Batavia in Java, and Galle in Ceylon, it is about the same. The extreme temperatures in Siberia may be considered to lie between 80° and 90° Fahr. for maxima, and between −40° and −70° Fahr. for minima. The extreme of heat near the Caspian and Aral seas rises to nearly 100° Fahr., while that of cold falls to −20° Fahr., or lower. Compared with these figures, we find in Southern Asia 110° or 112° Fahr. as a maximum hardly ever exceeded. The absolute minimum in Northern India, in lat. 30°, hardly goes below 32°; at Calcutta it is about 40°, though the thermometer seldom falls to 50° At Madras it rarely falls as low as 65°, or at Bombay below 60° At Singapore and Batavia the thermometer very rarely falls below 70°, or rises above 90°. At Aden the minimum is a few degrees below 70°, the maximum not much exceeding 90°.

Siberia

China.

India

Java

Extreme temperatures

General characteristics.

53. These figures sufficiently indicate the main characteristics of the air temperatures of Asia. Throughout its northern portion the winter is long and of extreme severity; and even down to the circle of 35° N. lat., the minimum temperature is almost as low as zero of Fahrenheit. The summers are hot, though short in the northern latitudes, the maximum of summer heat being comparatively little less than that observed in the tropical countries further south. The moderating effect of the proximity of the ocean is felt in an important degree along the southern and eastern parts of Asia, where the land is broken up into islands or peninsulas. The great elevation above the sea level of the central part of Asia, and of the table-lands of Afghanistan and Persia, tends to exaggerate the winter cold; while the sterility of the surface, due to the small rain-fall over the same region, operates powerfully in the opposite direction in increasing the summer heat. In the summer a great accumulation of solar heat takes place on the dry surface soil, from which it cannot be released upwards by evaporation, as might be the case were the soil moist or covered with vegetation, nor can it be readily conveyed away downwards as happens on the ocean. In the winter similar consequences ensue, in a negative direction, from the prolonged loss of heat by radiation in the long and clear nights—an effect which is intensified wherever the surface is covered with snow, or the air little charged with vapour In illustration of the very slow diffusion of heat in the solid crust of the earth, and as affording a further indication of the climate of Northern Asia, reference may here be made to the frozen soil of Siberia, in the vicinity of Yakutsk. In this region the earth is frozen permanently to a depth of more than 380 feet, at which the temperature is still 5° or 6° Fahr. below the freezing point of water, the summer heat merely thawing the surface to a depth of about 3 feet. At a depth of 50 feet the temperature is about 15° Fahr. below the freezing point. Under such conditions of the soil, the land, nevertheless, produces crops of wheat and other grain from fifteen to forty fold.

High summer temperatures.

54. The very high summer temperatures of the area north of the tropic of Cancer are sufficiently accounted for, when compared to those observed south of the tropic, by the increased length of the day in the higher latitude, which more than compensates for the loss of heat due to the smaller midday altitude of the sun. The difference between the heating power of the sun's rays at noon on the 21st June, in latitude 20° and in latitude 45°, is only about 2 per cent; while the accumulated heat received during the day, which is lengthened to 15½ hours in the higher latitude, is greater by about 11 per cent. than in the lower latitude, where the day consists only of 13¼ hours.

Modifying causes.

55. Although the foregoing account of the temperatures of Asia supplies the main outline of the observed phenomena, a very important modifying cause, of which more will be said hereafter, comes into operation over the whole of the tropical region, namely, the periodical summer rains. These tend very greatly to arrest the increase of the summer heat over the area where they prevail, and otherwise give it altogether peculiar characteristics.

Periodical variation of air pressure.

56. The great summer heat, by expanding the air upwards, disturbs the level of the planes of equal pressure, and causes an outflow of the upper strata from the heated area. The winter cold produces an effect of just an opposite nature, and causes an accumulation of air over the cold area. The diminution of barometric pressure which takes place all over Asia during the summer months, and the increase in the winter, are hence, no doubt, the results of the alternate heating and cooling of the air over the continent.

Periodical winds.

57 The necessary and immediate results of such periodical changes of pressure are winds, which, speaking generally, blow from the area of greatest to that of least pressure,—subject, however, to certain modifications of direction, arising from the absolute motion of the whole body of the air due to the revolution of the earth on its axis from west to east. At the equator, where the velocity of revolution is about 1037 miles per hour, what is called calm air is in absolute motion from west to east with that velocity. If such air were impelled by any disturbance of pressure, from the equator northward, it would advance gradually to places having a less and less velocity of rotation, so that at lat. 15° N. the earth would be only moving with a

Effect of earth's revolution.

velocity of about 1002 miles per hour, while the air arriving from the equator (supposing it not to have been affected by friction) would be moving from west to east 35 miles per hour faster than the surface, and would therefore be felt as a wind having that velocity from the *west*. In fact, however, the motion from the south would be combined with that from the west, and the air would blow as a south-west wind; while the friction against the earth's surface would gradually check the excess of velocity toward the east, and no such great westerly velocity as that named would be developed. In a corresponding manner, air impelled from places situated on a higher latitude towards those on a lower, will be felt as wind having an easterly component. The south-westerly winds, which prevail north of the equator during the hot half of the year, to which navigators have given the name of the S.W. monsoon (the latter word being a corruption of the Indian name for *season*), arise, in the manner just explained, from the great diminution of atmospheric pressure over Asia, which begins to be strongly marked with the great rise of temperature in April and May, and the simultaneous relative higher pressure over the equator and the regions south of it. This diminution of pressure, which continues as the heat increases till it reaches its maximum in July soon after the solstice, is followed by the corresponding development of the S.W. monsoon; and as the barometric pressure is gradually restored, and becomes equalised within the tropics soon after the equinox in October, with the general fall of temperature north of the equator, the south-west winds fall off, and are succeeded by a N.E. monsoon, which is developed during the winter months by the relative greater atmospheric pressure which then occurs over Asia, as compared to the equatorial region.

Monsoons.

Direction, how modified.

58. Although the succession of the periodical winds follows the progress of the seasons as just described, the changes in the wind's direction everywhere take place under the operation of special local influences which often disguise the more general law, and make it difficult to trace. Thus the S.W. monsoon begins in the Arabian Sea with west and north-westerly winds, which draw round as the year advances to south-west, and fall back again in the autumn by north-west to north. In the Bay of Bengal the strength of the S.W. monsoon is rather from the south and south-east, being succeeded by north-east winds after October, which give place to northerly and north-westerly winds as the year advances. Among the islands of the Malay Archipelago the force of the monsoons is much interrupted, and the position of this region on the equator otherwise modifies the directions of the prevailing winds. The southerly summer winds of the Asiatic seas between the equator and the tropic do not extend to the coasts of Java, and the south-easterly trade winds are there developed in the usual manner. The China Sea is fully exposed to both monsoons, the normal directions of which nearly coincide with the centre of the channel between the continent of Asia and the eastern islands.

Do not extend inland.

59. The south-west monsoon does not generally extend, in its character of a south-west wind, over the land. The current of air flowing in from over the sea is gradually diverted towards the area of least pressure, and at the same time is dissipated and loses much of its original force. The winds which pass northward over India blow as south-easterly and easterly winds over the north-eastern part of the Gangetic plain, and as south winds up the Indus. They seem almost entirely to have exhausted their northward velocity by the time they have reached the northern extremity of the great Indian plain; they are not felt on the table-lands of Afghanistan, and hardly penetrate into the ranges of the Himalaya, by which mountains, and those which branch off from them into the Malay peninsula, they are prevented from continuing their progress in the direction originally imparted to them.

Cyclones.

60. Among the more remarkable phenomena of the hotter seas of Asia must be noticed the revolving storms or cyclones, which are of frequent occurrence in the hot months in the Indian Ocean and China Sea, in which last they are known under the name of typhoon. The cyclones of the Bay of Bengal appear to originate over the Andaman and Nicobar islands, and are commonly propagated in a north-westward direction, striking the east coast of the Indian peninsula at various points, and then often advancing with an easterly tendency over the land, and passing with extreme violence across the delta of the Ganges. They occur in all the hot months, from June to October, and more rarely in November, and appear to be originated by adverse currents from the north meeting those of the S.W. monsoon. The cyclones of the China Sea also occur in the hot months of the year, but they advance from N.E. to S.W., though occasionally from E. to W.; they originate near the island of Formosa, and extend to about the 10th degree of N. lat. They are thus developed in nearly the same latitudes and in the same months as those of the Indian Sea, though their progress is in a different direction. In both cases, however, the storms appear to advance towards the area of greatest heat. In these storms the wind invariably circulates from N. by W. through S. to E.

Bay of Bengal.

China.

Southern Indian Ocean.

61. In the cyclones observed in the Southern Indian Ocean off the coast of Madagascar the wind circulates in the opposite direction. These storms advance from N.E. to S.W., with a tendency to turn off to the S.E. as they die out. They occur between the months of December and April, and between the 10th degree of S. lat. and the southern tropic.

Their causes.

62. In all these cases the cyclones occur during the hot months of the year, when strong winds are developed by the proximity of large heated areas of land and relatively cool areas of sea, and when the air, being highly charged with vapour, is liable to great disturbances of temperature on any considerable condensation being set up. Moreover, they most frequently happen at the times when the direction of the dominant winds is changing, and when important variations of atmospheric pressure are certainly taking place. Actual barometric observations have not yet been obtained in sufficient number or continuity to establish the precise conditions under which these storms arise, but there is no reason to doubt the correctness of the general views held regarding them, or that with the progress of knowledge much may be done to enable mariners to avoid their worst consequences.

Rains of S.W. monsoon.

63. The heated body of air carried from the Indian Ocean over Southern Asia by the S.W. monsoon comes up highly charged with watery vapour, and hence in a condition to release a large body of water as rain upon the land, whenever it is brought into circumstances which reduce its temperature in a notable degree. Such a reduction of temperature is brought about along the greater part of the coasts of India and of the Burmo-Siamese peninsula by the interruption of the progress of the wind current by continuous ranges of mountains, which force the mass of air to rise over them, whereby the air being rarefied, its specific capacity for heat is increased and its temperature falls, with a corresponding condensation of the vapour originally held in suspension.

Their causes.

General character.

64. This explanation of the principal efficient cause of the summer rains of South Asia is immediately based on an analysis of the complicated phenomena actually observed, and it serves to account for many apparent anomalies. The heaviest falls of rain occur along lines of mountain of some extent directly facing the vapour-bearing winds, as on the Western Ghats of India and the west coast of the

Malay peninsula. The same results are found along the mountains at a distance from the sea, the heaviest rainfall known to occur anywhere in the world (not less than 600 inches in the year) being recorded on the Khasiya range about 100 miles north-east of Calcutta, which presents an abrupt front to the progress of the moist winds flowing up from the Bay of Bengal. The cessation of the rains on the southern border of Baluchistan, west of Kurrachee, obviously arises from the projection of the south-east coast of Arabia, which limits the breadth of the S.W. monsoon air current and the length of the coast line directly exposed to it. The very small and irregular rainfall in Sindh and along the Indus is to be accounted for by the want of any obstacle in the path of the vapour-bearing winds, which, therefore, carry the uncondensed rain up to the Punjab, where it falls on the outer ranges of the western Himalaya and of Afghanistan.

Land and sea breezes. 65. Somewhat similar results, though on a smaller scale, attend the operation of the well-known land and sea breezes, which are universally prevalent in hot countries bordering on the sea. The relative greater heating of the land than of the sea during the day disturbs the planes of atmospheric equilibrium, and a dispersion of air in the higher regions from over the land leads to a diminution of pressure there and an increase over the sea. This causes the sea breeze, which is an inflow of moist air over the land from below; and where, as is frequently the case, this breeze is forced, as it advances, to rise considerably above the sea level, condensation takes place on the mountain slopes either in clouds or rain. The constant precipitation of rain on tropical coasts is mainly due to this action.

Diurnal mountain winds. 66. An analogous, though less well understood, system of alternating winds is almost invariably set up over mountains rising abruptly from plains, currents blowing from the higher ground to the lower during the night, and from the lower to the higher during the day. Such winds are often combined with the land and sea breezes, which they tend to exaggerate. The diurnal mountain winds are very strongly marked on the Himalaya, where they probably are the most active agents in determining the precipitation of rain along the chain—the monsoon currents, as was before stated, not penetrating among the mountains. The formation of dense banks of cloud in the afternoon, when the up wind is strongest, along the southern face of the snowy ranges of the Himalaya, is a regular daily phenomenon during the hotter months of the year, and heavy rain, accompanied by electrical discharges, is the frequent result of such condensation.

Rainfall. 67. Too little is known of the greater part of Asia to admit of any more being said with reference to this part of the subject, than to mention a few facts bearing on the rainfall. At Tiflis the yearly fall is 22 inches; on the Caspian about 7 or 8 inches; on the Sea of Aral 5 or 6 inches. In South-western Siberia it is 12 or 14 inches, diminishing as we proceed eastward to 6 or 7 inches at Barnaul, and to 5 or 6 inches at Urga in Northern Mongolia. At Nertschinsk in Eastern Siberia it is about 15 to 20 inches. In China we find about 23 inches to be the fall at Peking; while at Canton, which lies nearly on the northern tropic and the region of the S.W. monsoon is entered, the quantity is increased to 78 inches. At Batavia in Java the fall is about 78 inches; at Singapore it is nearly 100 inches. The quantity increases considerably on that part of the coast of the Malay peninsula which is not sheltered from the south-west by Sumatra. On the Tenasserim and Burmese coast falls of more than 200 inches are registered, and the quantity is here nowhere less than 75 or 80 inches, which is about the average of the eastern part of the delta of the Ganges, Calcutta standing at about 64 inches. On the hills that flank Bengal on the east the fall is very great. On the Khasiya hills, at an elevation of about 4500 feet, the average of 10 years is more than 550 inches. As much as 150 inches has been measured in one month, and 610 inches in one year. On the west coast of the Indian peninsula the fall at the sea level varies from about 75 to 100 inches, and at certain elevations on the mountains more than 250 inches is commonly registered, with intermediate quantities at intervening localities. On the east coast the fall is far less, nowhere rising to 50 inches, and towards the southern apex of the peninsula being reduced to 25 or 30 inches. Ceylon shows from 60 to 80 inches. As we recede from the coast the fall diminishes, till it is reduced to about 25 or 30 inches at the head of the Gangetic plain. The tract along the Indus to within 60 or 80 miles of the Himalaya is almost rainless, 6 or 8 inches being the fall in the southern portion of the Punjab. On the outer ranges of the Himalaya the yearly fall amounts to about 200 inches on the east in Sikim, and gradually diminishes on the west, where north of the Punjab it is about 70 or 80 inches. In the interior of the chain the rain is far less, and the quantity of precipitation is so small in Tibet that it can be hardly measured. It is to the greatly reduced fall of snow on the northern faces of the highest ranges of the Himalaya that is to be attributed the higher level of the snow-line, a phenomenon which was long a cause of discussion.

Seasons of rain. 68. In Afghanistan, Persia, Asia Minor, and Syria, winter and spring appear to be the chief seasons of condensation. In other parts of Asia the principal part of the rain falls between May and September, that is, in the hottest half of the year. In the islands under the equator the heaviest fall is between October and February.

BIOLOGY. 69. Such are the climatal conditions of the principal regions of Asia, under which the plants and animals that inhabit them are at present distributed. In attempting to appreciate and to explain the very complicated facts of distribution it is essential to bear in mind that what we find at the present time is, as was before observed, the result of causes that have been in operation from periods long antecedent to that in which the earth has taken its existing form, and acquired its existing conditions of temperature, climate, and arrangement of land and sea areas. Our knowledge of the manner in which the successive changes which have affected the earth's surface took place is, however, still so imperfect, that it is often not possible to state with certainty how the facts of distribution have occurred, and much is yet open to conjecture. But there is, notwithstanding, an overwhelming force of argument to establish the conclusion, that the diffusion of the forms of animal and vegetable life has gone on for a vast length of time by natural descent, and subject to the action of tendencies to variation; the general result being that the forms which first existed have been suppressed, and others introduced in their places. This modification of form in *time* is seen to have been commonly accompanied by a corresponding movement or diffusion in *place*, governed no doubt primarily by the variations of temperature and climate and conditions of surface which have accompanied the movements of the solid crust of the earth, or may have been due to cyclical change. The conformity of the facts of the geographical distribution of life with this conception is no longer seriously questioned. The mutual relations among the several branches of animal and vegetable life, and the marked effects produced on all organised creatures by conditions of climate, are apparent. The abundance of certain forms of animals and plants in certain areas, and their gradual diminution in number beyond such areas until they disappear altogether, is well known; as also the ordinary similarity of the general assemblages of living creatures in countries not far distant from one

Distribution of life. Causes of change.

another, and having similar conditions of climate. In proportion as the distance between two areas increases, and their mutual accessibility diminishes, and their conditions of climate differ, the likeness of the forms of life within them becomes less, until the connection may be reduced to what is due to common descent from extremely remote ancestors.

Forms of life in Asia. 70. Turning to the continent of Asia, such broadly characterised similarities and differences will be seen to be well marked. The general assemblage of animals and plants found over Northern Asia resembles greatly that found in the parts of Europe which are adjacent, and which have a similar climate. Siberia. Siberia, north of the 50th parallel, has a climate not much differing from the similarly situated portion of Europe, though the winters are more severe and the summers hotter. The rainfall, though moderate, is still sufficient to maintain the supply of water in the great rivers that traverse the country to the Arctic Sea, and to support an abundant vegetation. A similar affinity exists between the life of the southern parts of Europe and that in the zone of Asia extending from the Mediterranean across to the Himalaya and Northern China. Persian plateau. Himalaya. This belt, which embraces Asia Minor, Northern Persia, Afghanistan, and the southern slopes of the Himalaya, from its elevation has a temperate climate, and throughout it the rainfall is sufficient to maintain a vigorous vegetation, while the summers, though hot, and the winters, though severe, are not extreme. The plants and animals along it are found to have a marked similarity of character to those of South Europe, with which region the zone is virtually continuous

Arabia. Sindh. 71. The extremely dry and hot tracts which constitute an almost unbroken desert from Arabia, through South Persia and Baluchistan, to Sindh, are characterised by considerable uniformity in the types of life, which closely approach to those of the neighbouring hot and dry regions of Africa. India. The region of the heavy periodical summer rains and high temperature, which comprises India, the Indo-Chinese peninsula, and Southern China, as well as the western part of the Malay Archipelago, is also marked by much similarity in the plants and animals throughout its extent. Central Asia. The area between the southern border of Siberia and the margin of the temperate alpine zone of the Himalaya and North China, comprising what are commonly called Central Asia, Turkistan, Mongolia, and Western Manchuria, is an almost rainless region, having winters of extreme severity and summers of intense heat. Its animals and plants have a special character suited to the peculiar climatal conditions, more closely allied to those of the adjacent northern Siberian tract than of the other bordering regions. The south-eastern parts of the Malay islands have much in common with the Australian continent, Malay islands. to which they adjoin, though their affinities are chiefly Indian. North China and Japan also have many forms of life in common. Much still remains to be done in the exploration of China and Eastern Asia; but it is China. known that many of the special forms of this region extend to the Himalaya, while others clearly indicate a connection with North America.

72. The foregoing brief review of the principal territorial divisions according to which the forms of life are distributed in Asia, indicates how close is the dependence of this distribution on climatal conditions, and this will be made more apparent by a somewhat fuller account of the main features of the flora and fauna.

BOTANY. Flora of Siberia. 73. The flora of the whole of Northern Asia is in essentials the same as that of Northern Europe, the differences being due rather to variations of species than of genera. The absence of the oak and of all heaths east of the Ural may be noticed. Pines, larch, birch, are the principal trees on the mountains; willows, alders, and poplars on the lower ground. The northern limit of the pine in Siberia is about lat. 70°.

74. Along the warm temperate zone, from the Mediterranean to the Himalaya, extends a flora essentially European in character. Warm temperate zone. Many European *species* reach the central Himalaya, though few are known in its eastern parts. The *genera* common to the Himalaya and Europe are much more abundant, and extend throughout the chain, and to all elevations. There is also a corresponding diffusion of Japanese and Chinese forms along this zone, these being most numerous in the eastern Himalaya, and less frequent in the west.

75. The truly tropical flora of the hotter and wetter regions of Eastern India is continuous with that of the Malayan peninsula and islands, Eastern India and Malay islands. and extends along the lower ranges of the Himalaya, gradually becoming less marked, and rising to lower elevations as we go westward, where the rainfall diminishes and the winter cold increases.

76. The vegetation of the higher and therefore cooler Himalaya. and less rainy ranges of the Himalaya has greater uniformity of character along the whole chain, and a closer general approach to European forms is maintained; an increased number of species is actually identical, among these being found, at the greatest elevations, many alpine plants believed to be identical with species of the north Arctic regions. Tibet. On reaching the Tibetan plateau, with the increased dryness the flora assumes many features of the Siberian type. Many true Siberian species are found, and more Siberian genera. Some of the Siberian forms, thus brought into proximity with the Indian flora, extend to the rainy parts of the mountains, and even to the plains of upper India. Assemblages of marine plants form another remarkable feature of Tibet, these being frequently met with growing at elevations of 14,000 to 15,000 feet above the sea, more especially in the vicinity of the many salt lakes of those regions.

77. The vegetation of the hot and dry region of the Hot and desert region. south-west of the continent consists largely of plants which are diffused over Africa, Baluchistan, and Sindh; many of these extend into the hotter parts of India, and not a few common Egyptian plants are to be met with in the Indian peninsula.

78. The whole number of species of plants indigenous in Indian flora. the region of south-eastern Asia, which includes India and the Malayan peninsula and islands, from about the 65th to the 105th meridian, is estimated by Dr Hooker at from 12,000 to 15,000. The principal orders, arranged according to their numerical importance, are as follows:—*Leguminosæ, Rubiaceæ, Orchideæ, Compositæ, Gramineæ, Euphorbiaceæ, Acanthaceæ, Cyperaceæ*, and *Labiatæ*. But within this region there is a very great variation between the vegetation of the more humid and the more arid regions, while the characteristics of the flora on the higher mountain ranges differ wholly from those of the plains. In short, we have a somewhat heterogeneous assemblage of tropical, temperate, and alpine plants, as has been already briefly indicated, of which, however, the tropical are so far dominant as to give their character to the flora viewed as a whole. The Indian flora contains a more general and complete illustration of almost all the chief natural families of all parts of the world than any other country. *Compositæ* are comparatively rare; so also *Gramineæ* and *Cyperaceæ* are in some places deficient, and *Labiatæ, Leguminosæ*, and ferns in others. *Euphorbiaceæ*, and *Scrophulariaceæ*, and *Orchideæ* are universally present, the last in specially large proportions.

79. The perennially humid regions of the Malayan peninsula Malayan peninsula. and western portion of the archipelago are everywhere covered with dense forest, rendered difficult to traverse by the thorny cane, a palm of the genus Calamus, which has

its greatest development in this part of Asia. The chief trees belong to the orders of *Terebinthaceæ*, *Sapindaceæ*, *Meliaceæ*, *Clusiaceæ*, *Dipterocarpeæ*, *Ternstrœmiaceæ*, *Leguminosæ*, laurels, oaks, and figs, with *Dilleniaceæ*, *Sapotaceæ*, and nutmegs. Bamboos and palms, with *Pandanus* and *Dracæna*, are also abundant. A similar forest flora extends along the mountains of eastern India to the Himalaya, where it ascends to elevations varying from 6000 to 7000 feet on the east to 3000 or 4000 feet on the west.

Eastern India.

North India.

80. The arboreous forms which least require the humid and equable heat of the more truly tropical and equatorial climates, and are best able to resist the high temperatures and excessive drought of the northern Indian hot months from April to June, are certain *Leguminosæ*, *Bauhinia*, *Acacia*, *Butea*, and *Dalbergia*, *Bombax*, *Shorea*, *Nauclea*, *Lagerstrœmia*, and *Bignonia*, a few bamboos and palms, with others which extend far beyond the tropic, and give a tropical aspect to the forest to the extreme northern border of the Indian plain.

Herbaceous forms.

81. Of the herbaceous vegetation of the more rainy regions may be noted the *Orchideæ*, *Orontiaceæ*, *Scitamineæ*, with ferns and other Cryptogams, besides *Gramineæ* and *Cyperaceæ*. Among these some forms, as among the trees, extend much beyond the tropic and ascend into the temperate zones on the mountains, of which may be mentioned *Begonia*, *Osbeckia*, various *Cyrtandraceæ*, *Scitamineæ*, and a few epiphytical orchids.

Special features of flora.

82. Of the orders most largely developed in South India, and more sparingly elsewhere, may be named *Aurantiaceæ*, *Dipterocarpeæ*, *Balsamineæ*, *Ebenaceæ*, *Jasmineæ*, and *Cyrtandraceæ;* but of these few contain as many as 100 peculiar Indian species. *Nepenthes* may be mentioned as a genus specially developed in the Malayan area, and extending from New Caledonia to Madagascar; it is found as far north as the Khasiya hills, and in Ceylon, but does not appear on the Himalaya or in the peninsula of India. The *Balsamineæ* may be named as being rare in the eastern region and very abundant in the peninsula. A distinct connection between the flora of the peninsula and Ceylon, and that of eastern tropical Africa is observable not only in the great similarity of many of the more truly tropical forms, and the identity of families and genera found in both regions, but in a more remarkable manner in the likeness of the mountain flora of this part of Africa to that of the peninsula, in which several species occur believed to be identical with Abyssinian forms. This connection is further established by the absence from both areas of oaks, conifers, and cycads, which, as regards the two first families, is a remarkable feature of the flora of the peninsula and Ceylon, as the mountains rise to elevations in which both of them are abundant to the north and east. With these facts it has to be noticed that many of the principal forms of the eastern flora are absent or comparatively rare in the peninsula and Ceylon.

Physiognomy of flora—Eastern India.

83. The general physiognomy of the Indian flora is mainly determined by the conditions of humidity of climate. The impenetrable shady forests of the Malay peninsula and Eastern Bengal, of the west coast of the Indian peninsula, and of Ceylon, offer a strong contrast with the more loosely-timbered districts of the drier regions of Central India and the North-western Himalaya. There are no plains covered with forest as in tropical America, the low lands of India being either highly cultivated and adorned with planted wood, or, where cut off from rain, nearly complete desert.

Himalaya.

84. The higher mountains rise abruptly from the plains; on their slopes, clothed below almost exclusively with the more tropical forms, a vegetation of a warm temperate character, chiefly evergreen, soon begins to prevail, comprising *Magnoliaceæ*, *Ternstrœmiaceæ*, sub-tropical *Rosaceæ*, rhododendron, oak, *Ilex*, *Symplocos*, *Laurineæ*, *Pinus longifolia*, with mountain forms of truly tropical orders, palms, *Pandanus*, *Musa*, *Vitis*, *Vernonia*, and many others. On the east the vegetation of the Himalaya is most abundant and varied. The forest extends, with great luxuriance, to an elevation of 12,000 feet, above which the sub-alpine region may be said to begin, in which rhododendron scrub often covers the ground up to 13,000 or 14,000 feet. Only one pine is found below 8000 feet, above which several other *Coniferæ* occur. Plantains, tree-ferns, bamboos, several *Calami*, and other palms, and *Pandanus*, are abundant at the lower levels. Between 4000 and 8000 feet epiphytal orchids are very frequent, and reach even to 10,000 feet. Vegetation ascends on the drier and less snowy mountain slopes of Tibet to above 18,000 feet. On the west, with the drier climate, the forest is less luxuriant and dense, and the hill sides and the valleys better cultivated. The warm mountain slopes are covered with *Pinus longifolia*, or with oaks and rhododendron, and the forest is not commonly dense below 8000 feet, excepting in some of the more secluded valleys at a low elevation. From 8000 to 12,000 feet, a thick forest of deciduous trees is almost universal, above which a sub-alpine region is reached, and vegetation as on the east continues up to 18,000 feet or more. The more tropical forms of the east, such as the tree-ferns, do not reach west of Nepaul. The cedar or Deodar is hardly indigenous east of the sources of the Ganges, and at about the same point the forms of the west begin to be more abundant, increasing in number as we advance towards Afghanistan.

Eastern.

Western.

Cultivated plants.

85. The cultivated plants of the Indian region include wheat, barley, rice, and maize; various millets, *Sorghum*, *Penicillaria*, *Panicum*, and *Eleusine;* many pulses, peas, and beans; mustard and rape; ginger and turmeric; pepper and capsicum; several *Cucurbitaceæ;* tobacco, *Sesamum*, poppy, *Crotolaria*, and *Cannabis;* cotton, indigo, and sugar; coffee and tea; oranges, lemons of many sorts; pomegranate, mango, figs, peaches, vines, and plantains. The more common palms are *Cocos*, *Phœnix*, and *Borassus*, supplying cocoa-nut and toddy. Indian agriculture combines the harvests of the tropical and temperate zones. North of the tropic the winter cold is sufficient to admit of the cultivation of almost all the cereals and vegetables of Europe, wheat being sown in November and reaped early in April. In this same region the summer heat and rain provide a thoroughly tropical climate, in which rice and other tropical cereals are freely raised, being as a rule sown early in July, and reaped in September or October. In southern India, and the other parts of Asia and of the islands having a similar climate, the difference of the winter and summer half years is not sufficient to admit of the proper cultivation of wheat or barley. The other cereals may be seen occasionally, where artificial irrigation is practised, in all stages of progress at all seasons of the year, though the operations of agriculture are, as a general rule, limited to the rainy months, when alone is the requisite supply of water commonly forthcoming.

Timber trees.

86. The trees of India producing economically useful timber are comparatively few, owing to the want of durability of the wood, in the extremely hot and moist climate. The teak, *Tectona grandis*, supplies the finest timber. It is found in greatest perfection in the forests of the west coasts of Burmah and the Indian peninsula, where the rainfall is heaviest, growing to a height of 100 or 150 feet, mixed with other trees and bamboos. The sál, *Shorea robusta*, a very durable wood, is most abundant along the skirts of the Himalaya from Assam to the Punjab, and is found in Central India, to which the teak also extends. The sal grows to a large size, and is more gregarious than the teak. Of other useful woods found in the plains may

be named the babool, *Acacia;* toon, *Cedrela;* and sissoo, *Dalbergia*. The only timber in ordinary use obtained from the Himalaya proper is the Deodar, *Cedrus*, not distinct from the cedar of Lebanon. Besides these are the sandal-wood, *Santalum*, of Southern India, and many sorts of bamboo found in all parts of the country. The chinchona has recently been introduced with complete success; and the mahogany of America reaches a large size, and gives promise of being grown for use as timber.

Flora of desert region.

87. The flora of the rainless region of South-western Asia is continuous with the desert flora of Northern and Eastern Africa, and extends from the coast of Senegal to the meridian of 75° E., or from the great African desert to the border of the rainless tract along the Indus and the southern parts of the Punjab. It includes the peninsula of Arabia, the shores of the Persian Gulf, South Persia, and Afghanistan, and Baluchistan. On the west its limit is in the Cape de Verde Islands, and it is partially represented in Abyssinia.

Special features.

88. The more common plants in the most characteristic part of this region in Southern Arabia are *Capparideæ*, *Euphorbiaceæ*, and a few *Leguminosæ*, a *Reseda* and *Dipterygium;* palms, *Polygonaceæ*, ferns, and other cryptogams, are rare. The number of families relative to the area is very small, and the number of genera and species equally restricted, in very many cases a single species being the only representative of an order. The aspect of the vegetation is very peculiar, and is commonly determined by the predominance of some four or five species, the rest being either local or sparingly scattered over the area. The absence of the ordinary bright green colours of vegetation is another peculiarity of this flora, almost all the plants having glaucous or whitened stems. Foliage is reduced to a minimum, the moisture of the plant being stored up in massive or fleshy stems against the long-continued drought. Aridity has favoured the production of spines as a defence from external attack, sharp thorns are frequent, and asperities of various sorts predominate. Many species produce gums and resins, their stems being encrusted with the exudations, and pungency and aromatic odour is an almost universal quality of the plants of desert regions.

Hot region of Persian plateau.

89. The cultivated plants of Arabia are much the same as those of Northern India—wheat, barley, and the common *Sorghum*, with dates and lemons, cotton and indigo. To these must be added coffee, which is restricted to the slopes of the western hills. Among the more mountainous regions of the south-western part of Arabia, known as Arabia Felix, the summits of which rise to 6000 or 7000 feet, the rainfall is sufficient to develop a more luxuriant vegetation, and the valleys have a flora like that of similarly situated parts of southern Persia, and the less elevated parts of Afghanistan and Baluchistan, partaking of the characters of that of the hotter Mediterranean region. In these countries aromatic shrubs are abundant. Trees are rare, and almost restricted to *Pistacia*, *Celtis*, and *Dodonæa*, with poplars, and the date palm. Prickly forms of *Statice* and *Astragalus* cover the dry hills. In the spring there is an abundant herbaceous vegetation, including many bulbous plants, with genera, if not species, identical with those of the Syrian region, some of which extend to the Himalaya.

North Afghanistan

90. The flora of the northern part of Afghanistan approximates to that of the contiguous western Himalaya. *Quercus Ilex*, the evergreen oak of Southern Europe, is found in forests as far east as the Sutlej, accompanied with other European forms. In the higher parts of Afghanistan and Persia *Boragineæ* and thistles abound; gigantic *Umbelliferæ*, such as *Ferula*, *Galbanum*, *Dorema*, *Bubon*, *Peucedanum*, *Prangos*, and others, also characterise the same districts, and some of them extend into Tibet.

Persia and Asia Minor.

91. The flora of Asia Minor and Northern Persia differs but little from that of the southern parts of Europe. The mountains are clothed, where the fall of rain is abundant, with forests of *Quercus*, *Fagus*, *Ulmus*, *Acer*, *Carpinus*, and *Corylus*, and various *Coniferæ*. Of these the only genus that is not found on the Himalaya is *Fagus*. Fruit trees of the plum tribe abound. The cultivated plants are those of Southern Europe.

Malayan islands.

92. The vegetation of the Malayan Islands is for the most part that of the wetter and hotter region of India; but the greater uniformity of the temperature and humidity leads to the predominance of certain tropical forms not so conspicuous in India, while the proximity of the Australian continent has permitted the partial diffusion of Australian types which are not seen in India. The liquidambar and nutmeg may be noticed among the former; the first is one of the most conspicuous trees in Java, on the mountains of the eastern part of which the casuarina, one of the characteristic forms of Australia, is also abundant. Rhododendrons occur in Borneo and Sumatra, descending to the level of the sea. On the mountains of Java there appears to be no truly alpine flora; *Saxifraga* is not found. In Borneo some of the temperate forms of Australia appear on the higher mountains. On the other islands similar characteristics are to be observed, Australian genera extending to the Philippines, and even to Southern China.

China.

93. The analysis of the Hong Kong flora by Mr Bentham indicates that about three-fifths of the species are common to the Indian region, and nearly all the remainder are either Chinese or local forms. The number of specie common to Southern China, Japan, and Northern Asia is small. The cultivated plants of China are, with a few exceptions, the same as those of India. South China, therefore, seems, botanically, hardly distinct from the great Indian region, into which many Chinese forms penetrate, as before noticed. The flora of North China, which is akin to that of Japan, shows manifest relation to that of the neighbouring American continent, from which many temperate forms extend, reaching to the Himalaya, almost as far as Kashmir. Very little is known of the plants of the interior of Northern China, but it seems probable that a complete botanical connection is established between it and the temperate region of the Himalaya.

Central Asia.

94. The vegetation of the dry region of Central Asia is remarkable for the great relative number of *Chenopodiaceæ*, *Salicornia* and other salt plants being common; *Polygonaceæ* also are abundant; leafless forms being of frequent occurrence, which gives the vegetation a very remarkable aspect. Peculiar forms of *Leguminosæ* also prevail, and these, with many of the other plants of the southern and drier regions of Siberia, or of the colder regions of the desert tracts of Persia and Afghanistan, extend into Tibet, where the extreme drought and the hot (nearly vertical) sun combine to produce a summer climate not greatly differing from that of the plains of Central Asia.

ZOOLOGY.

95. The zoological provinces of Asia correspond very closely with the botanical. The northern portion of Asia, as far south as the Himalaya, is not zoologically distinct from Europe, and these two areas, with the strip of Africa north of the Atlas, constitute the Palæarctic region of Dr Sclater, whose zoological primary divisions of the earth have met with the general approval of naturalists. The south-eastern portion of Asia, with the adjacent islands of Sumatra, Java, Borneo, and the Philippines, form his Indian region. The extreme south-west part of the continent constitutes a separate zoological district, comprising Arabia, Palestine, and Southern Persia, and reaching, like the hot desert botanical tract, to Baluchistan and Sindh, it belongs to what Dr Sclater calls the Ethiopian region, which extends over Africa, south of the Atlas. The Celebes,

Papua, and the other islands east of Java beyond Wallace's line (see par. 6), fall within the Australian region.

A few words may be said about the characteristic animals of each of these divisions.

Palæarctic region. Mammals.

96. Nearly all the mammals of Europe also occur in Northern Asia, where, however, the Palæarctic fauna is enriched by numerous additional species. The characteristic groups belong mostly to forms which are restricted to cold and temperate regions. Consequently the Quadrumana or monkeys, are nearly unrepresented, a single species occurring in Japan, and one or two others in Northern China and Tibet. Insectivorous bats are numerous, but the frugivorous division of this order is only represented by a single species in Japan. Carnivora are also numerous, particularly the frequenters of cold climates, such as bears, weasels, wolves, and foxes. Of the Insectivora numerous forms of moles, shrews, and hedgehogs prevail. The Rodents are also well represented by various squirrels, mice, and hares. Characteristic forms of this order in Northern Asia are the marmots (*Arctomys*) and the pikas, or tailless hares (*Lagomys*). The great order of Ungulata is represented by various forms of sheep, as many as ten or twelve wild species of *Ovis* being met with in the mountain chains of Asia; and more sparingly by several peculiar forms of antelope, such as the saiga (*Saiga tartarica*), and the *Gazella gutturosa*, or yellow sheep. Coming to the deer, we also meet with characteristic forms in Northern Asia, especially those belonging to the typical genus *Cervus*. The musk deer (*Moschus*) is also quite restricted to Northern Asia, and is one of its most peculiar types.

Birds.

97. The ornithology of Northern Asia is even more closely allied to that of Europe than the mammal fauna. Nearly three-fourths of the well-known species of Europe extend throughout Siberia into the islands of the Japanese empire. Here again we have an absence of all tropical forms, and a great development of groups characteristic of cold and temperate regions. One of the most peculiar of these is the genus *Phasianus*, of which splendid birds all the species are restricted in their wild state to Northern Asia. The still more magnificently clad gold pheasants (*Thaumalea*), and the eared pheasants (*Crossoptilon*), are also confined to certain districts in the mountains of North-eastern Asia. Amongst the *Passeres*, such forms as the larks, stone chats, finches, linnets, and grosbeaks, are well developed, and exhibit many species.

Indian region. Mammals.

98. The mammal fauna of the Indian region of Asia is much more highly developed than that of the Palæarctic. The Quadrumana are represented by several peculiar genera, amongst which are *Semnopithecus*, *Hylobates*, and *Simia*. Two peculiar forms of the Lemurine group are also met with. Both the insectivorous and frugivorous divisions of the bats are well represented. Amongst the Insectivora very peculiar forms are found, such as *Gymnura* and *Tupaia*. The Carnivora are likewise numerous; and this region may be considered as the true home of the tiger, though this animal has wandered far north into the Palæarctic division of Asia. Other characteristic Carnivora are civets, various ichneumons, and the benturong (*Arctictis*). Two species of bears are likewise restricted to the Indian region. In the order of Rodents squirrels are very numerous, and porcupines of two genera are met with. The Indian region is the home of the Indian elephant—one of the two sole remaining representatives of the order Proboscidea. Of the Ungulates, four species of rhinoceros and one of tapir are met with, besides several peculiar forms of the swine family. The Bovidæ, or hollow-horned ruminants, are represented by several genera of antelopes, and by species of true *Bos*—such as *B. sondaicus*, *B. frontalis*, and *B. bubalus*. Deer are likewise numerous, and the peculiar group of Chevrotains (*Tragulus*) is characteristic of the Indian region. Finally, this region affords us representatives of the order Edentata, in the shape of several species of *Manis*, or scaly ant-eater.

Birds.

99. The assemblage of birds of the Indian region is one of the richest and most varied in the world, being surpassed only by that of tropical America. Nearly every order, except that of the Struthiones, or ostriches, is well represented, and there are many peculiar genera not found elsewhere, such as *Buceros*, *Harpactes*, *Lophophorus*, *Euplocamus*, *Pavo*, and *Ceriornis*. The Phasianidæ (exclusive of true *Phasianus*) are highly characteristic of this region, as are likewise certain genera of barbets (*Megalæma*), parrots (*Palæornis*), and crows (*Dendrocitta*, *Urocissa*, and *Cissa*). The family *Eurylæmidæ* is entirely confined to this part of Asia.

Ethiopian region. Mammals.

100. The Ethiopian fauna plays but a subordinate part in Asia, intruding only into the south-western corner, and occupying the desert districts of Arabia and Syria, although some of the characteristic species reach still further into Persia and Sindh, and even into Western India. The lion and the hunting-leopard, which may be considered as, in this epoch at least, Ethiopian types, extend thus far, besides various species of jerboa and other desert-loving forms.

Birds.

101. In the birds, the Ethiopian type is shown by the prevalence of larks and stone-chats, and by the complete absence of the many peculiar genera of the Indian region.

Australian region. Mammals.

102. The occurrence of mammals of the Marsupial order in the Molucca Islands and Celebes, while none have been found in the adjacent islands of Java and Borneo, lying on the west of Wallace's line, or in the Indian region, shows that the margin of the Australian region has here been reached. The same conclusion is indicated by the absence from the Moluccas and Celebes of various other Mammals, Quadrumana, Carnivora, Insectivora, and Ruminants, which abound in the western part of the Archipelago. Deer do not extend into New Guinea, in which island the genus *Sus* appears to have its eastern limit. A peculiar form of baboon, *Cynopithecus*, and the singular ruminant, *Anoa*, found in Celebes, seem to have no relation to Asiatic animals, and rather to be allied to those of Africa.

Birds.

103. The birds of these islands present similar peculiarities. Those of the Indian region abruptly disappear at, and many Australian forms reach but do not pass, the line above spoken of. Species of birds akin to those of Africa also occur in Celebes.

Marine mammals.

104. Of the marine orders of Sirenia and Cetacea the Dugong, *Halicore*, is exclusively found in the Indian Ocean; and a dolphin, *Platanista*, peculiar to the Ganges, ascends that river to a great distance from the sea.

Sea fish.

105. Of the sea fishes of Asia, among the Acanthopterygii, or spiny-rayed fishes, the *Percidæ*, or perches, are largely represented; the genus *Serranus*, which has only one species in Europe, is very numerous in Asia, and the forms are very large. Other allied genera are abundant, and extend from the Indian seas to Eastern Africa. The Squamipennes, or scaly-finned fishes, are principally found in the seas of Southern Asia, and especially near coral reefs. The *Mullidæ*, or red mullets, are largely represented by genera differing from those of Europe. The *Polynemi*, which range from the Atlantic through the Indian Ocean to the Pacific, supply animals from which isinglass is prepared; one of them, the mango-fish, esteemed a great delicacy, inhabits the seas from the Bay of Bengal to Siam. The *Sciænidæ* extend from the Bay of Bengal to China, but are not known to the westward. Horse mackerel are numerous. The *Stromateidæ*, or pomfrets, resemble the dory, a Mediterranean form, and extend to China and the Pacific. The sword fishes, *Xiphiidæ*—the lancet fishes, *Acanthuridæ*

—and the scabbard fishes, *Trichuridæ*, are distributed through the seas of South Asia. Mackerels of various genera abound, as well as gobies, blennies, and mullets.

106. Among the Anacanthini, the cod family so well known in Europe shows but one or two species in the seas of South Asia, though the soles and allied fishes are numerous along the coasts. Of the Physostomi, the siluroids are abundant in the estuaries and muddy waters; the habits of some of these fishes are remarkable, such as that of the males carrying the ova in their mouths till the young are hatched. The small family of *Scopelidæ* affords the gelatinous *Harpodon*, or bumalo. The gar-fish and flying-fishes are numerous, extending into the seas of Europe. The *Clupeidæ*, or herrings, are most abundant; and anchovies, or sardines, are found in shoals, but at irregular and uncertain intervals. The marine eels, *Murænidæ*, are more numerous towards the Malay Archipelago than in the Indian seas. Forms of sea-horses (*Hippocampus*), pipe-fishes (*Syngnathus*), fife-fishes (*Sclerodermus*), and sun-fish, globe-fish, and other allied forms of *Gymnodontes*, are not uncommon.

107. Of the cartilaginous fishes, Chondropterygii, the true sharks and hammer-headed sharks, are numerous. The dog-fish also is found, one species extending from the Indian seas to the Cape of Good Hope. The saw-fishes, *Pristidæ*, the electrical rays, *Torpedinæ*, and ordinary rays and skates, are also found in considerable numbers.

Freshwater fishes.

108. The fresh waters of Southern Asia are deficient in the typical forms of the Acanthopterygii, and are chiefly inhabited by carp, siluroids, simple or spined eels, and the walking and climbing fishes. The *Siluridæ* attain their chief development in tropical regions. Only one *Silurus* is found in Europe, and the same species extends to Southern Asia and Africa. The *Salmonidæ* are entirely absent from the waters of Southern Asia, though they exist in the rivers that flow into the Arctic Ocean and the neighbouring parts of the Northern Pacific, extending perhaps to Formosa; and trout, though unknown in Indian rivers, are found beyond the watershed of the Indus, in the streams flowing into the Caspian. The *Cyprinidæ*, or carp, are largely represented in Southern Asia, and there grow to a size unknown in Europe; a *Barbus* in the Tigris has been taken of the weight of 300 lb. The chief development of this family, both as to size and number of forms, is in the mountain regions with a temperate climate; the smaller species are found in the hotter regions and in the low-lying rivers. Of the *Clupeidæ*, or herrings, numerous forms occur in Asiatic waters, ascending the rivers many hundred miles; one of the best known of Indian fishes, the hilsa, is of this family. The sturgeons, which abound in the Black Sea and Caspian, and ascend the rivers that fall into them, are also found in Asiatic Russia, and an allied form extends to Southern China. The walking or climbing fishes, which are peculiar to South-eastern Asia and Africa, are organised so as to be able to breathe when out of the water, and they are thus fitted to exist under conditions which would be fatal to other fishes, being suited to live in the regions of periodical drought and rain in which they are found.

Insects.

109. The insects of all Southern Asia, including India south of the Himalaya, China, Siam, and the Malayan Islands, belong to one group; not only the genera, but even the species, are often the same on the opposite sides of the Bay of Bengal. The connection with Africa is marked by the occurrence of many genera common to Africa and India, and confined to those two regions, and similarities of form are not uncommon there in cases in which the genera are not peculiar. Of Coleopterous insects known to inhabit East Siberia, nearly one-third are found in Western Europe. The European forms seem to extend to about the 30th parallel of N. lat., south of which the Indo-Malayan types are met with, Japan being of the Europeo-Asiatic group. The northern forms extend generally along the south coast of the Mediterranean up to the border of the great desert, and from the Levant to the Caspian.

Domesticated animals.

110. Of the domesticated animals of Asia may first be mentioned the elephant. It does not breed in captivity, and is not found wild west of the Jumna river in Northern India. The horse is produced in the highest perfection in Arabia, and the hot and dry countries of Western Asia. Ponies are most esteemed from the wetter regions of the east, and the hilly tracts. Asses are abundant in most places, and two wild species occur. The horned cattle include the humped oxen and buffaloes of India, and the yak of Tibet. A hybrid between the yak and Indian cattle, called zo, is commonly reared in Tibet and the Himalaya. Sheep abound in the more temperate regions, and goats are universally met with; both of these animals are used as beasts of burden in the mountains of Tibet. The reindeer of Northern Siberia call also for special notice; they are used for the saddle as well as for draught.

Ethnology.

111. Among the later results of scientific research, the demonstration of man's existence on the earth at a period vastly anterior to any of which we have any knowledge through existing records, is one of the most important in giving a solid foundation to the study of ethnology. We have learned that man was the contemporary of many extinct animals, at a time when the main outlines of the land within the area of the present continent of Europe were wholly different from what they now are; and that human societies have been advancing towards their present condition during a series of ages for the extent of which our ordinary conceptions of time afford no adequate measure. Such facts have given an altogether different direction to the current of opinion as to the manner in which the great groups of mankind have become distributed over the areas where they are now found. So, too, the knowledge of the want of stability of forms of human speech has had an important bearing on these same subjects; for the evidence of the modifications which the chief spoken languages have undergone during the historic period shows that there is probably no country in which the tongue in use a thousand years ago would now be intelligible, and leads to the conclusion that even a radical diversity of language need not imply difference of race. In short, the science of ethnology being, like all others, built up on facts only to be obtained by actual observation, requires that these shall be interpreted by an intelligent and constantly repeated review of the whole series of available data as precise knowledge advances.

Mongolian group.

112. Asia, including its outlying islands, has become the dwelling-place of all the great families into which the races of men have been divided. By far the largest area is occupied by the *Mongolian* group. These have yellow-brown skins, black eyes and hair, flat noses, and oblique eyes. They are short in stature, with little hair on the body and face. In general terms they extend, with modifications of character probably due to admixture with other types and to varying conditions of life, over the whole of Northern Asia as far south as the plains bordering the Caspian Sea, including Tibet and China, and also over the Indo-Malayan peninsula and Archipelago, excepting Papua and some of the more eastern islands.

Melanochroic. Xanthochroic.

113. Next in numerical importance to the Mongolians are the races which have been called by Professor Huxley *Melanochroic* and *Xanthochroic*. The former includes the dark-haired people of Southern Europe, and extends over North Africa, Asia Minor, Syria to South-western Asia, and through Arabia and Persia to India. The latter race includes the fair-haired people of Northern Europe, and

extends over nearly the same area as the Melanochroi, with which race it is greatly intermixed. The Xanthochroi have fair skins, blue eyes, and light hair; the others have dark skins, eyes, and hair, and are of a slighter frame. Together they constitute what were once called the Caucasian races. The Melanochroi are not considered by Professor Huxley to be one of the primitive modifications of mankind, but rather to be the result of the admixture of the Xanthochroi with the Australioid type, next to be mentioned.

Australioid. 114. The third group is that of the *Australioid* type. Their hair is dark, generally soft, never woolly. The eyes and skin are dark, the beard often well developed, the nose broad and flat, the lips coarse, and jaws heavy. This race is believed to form the basis of the people of the Indian peninsula, and of some of the hill tribes of Central India, to whom the name Dravidian has been given, and by its admixture with the Melanochroic group to have given rise to the ordinary population of the Indian provinces. It is also probable that the Australioid family extends into South Arabia and Egypt.

Negroid. 115. The last group, the *Negroid*, is represented by the races to which has been given the name of *Negrito*, from the small size of some of them. They are closely akin to the negroes of South Africa, and possess the characteristic dark skins, woolly, but scanty beard and body hair, broad flat noses, and projecting lips of the African; and are diffused over the Andaman Islands, a part of the Malay peninsula, the Philippines, Papua, and some of the neighbouring islands. The Negritos appear to be derived from a mixture of the true Negro with the Australian type.

Distribution of Mongolians. 116. The distribution of the Mongolian group in Asia offers no particular difficulty. There is complete present, and probably previous long-existing, geographical continuity in the area over which they are found. There is also considerable similarity of climate and other conditions throughout the northern half of Asia which they occupy. The extension of modified forms of the Mongolian type over the whole American continent may be mentioned as a remarkable circumstance connected with this branch of the human race.

Tartars. 117. The Mongolians of the northern half of Asia are almost entirely nomadic, hunters and shepherds or herdsmen. The least advanced of these, but far the most peaceful, are those that occupy Siberia. Further south the best known tribes are the Mánchus, the Mongols proper, the Moguls, and the Turks, all known under the name of Tartars, and to the ancients as Scythians, occupying from east to west the zone of Asia comprised between the 40th and 50th circles of N. lat. The Turks are Mahometans; their tribes extend up the Oxus to the borders of Afghanistan and Persia, and to the Caspian, and under the name of Kirghis into Russia, and their language is spoken over a large part of Western Asia. Their letters are those of Persia. The Mánchus and Mongols are chiefly Buddhist, with letters derived from the ancient Syriac. The Mánchus are now said to be gradually falling under the influence of Chinese civilisation, and to be losing their old nomadic habits, and even their peculiar language. The predatory habits of the Turkish, Mongolian, and Mânchu population of Northern Asia, and their irruptions into other parts of the continent and into Europe, have produced very remarkable results in the history of the world, to which further reference will be made hereafter.

Chinese. 118. The Chinese branch of the Mongolian family are a thoroughly settled people of agriculturists and traders. They are partially Buddhist, and have a peculiar monosyllabic, uninflected language, with writing consisting of symbols, which represent words, not letters.

Indo-Chinese. 119. The countries lying between India and the Mongolian area are occupied by populations chiefly of the Mongolian and Chinese type, having languages fundamentally monosyllabic, but using letters derived from India, and adopting their religion, which is almost everywhere Buddhist, from the Indians. Of these may be named the Tibetans, the Burmese, and the Siamese. Cochin-China is more nearly Chinese in all respects.

Malays. 120. The Malays, who occupy the peninsula and most of the islands of the Archipelago called after them, are Mongols apparently modified by their very different climate, and by the maritime life forced upon them by the physical conditions of the region they inhabit. As they are now known to us, they have undergone a process of partial civilisation, first at the hands of the Brahminical Indians, from whom they borrowed a religion, and to some extent literature and an alphabet, and subsequently from intercourse with the Arabs, which has led to the adoption of Mahometanism by most of them.

Aryans & Semites. 121. The name of *Aryan* has been given to the races speaking languages derived from, or akin to, the ancient form of Sanskrit, who now occupy the temperate zone extending from the Mediterranean, across the highlands of Asia Minor, Persia, and Afghanistan, to India. The races speaking the languages akin to the ancient Assyrian, which are now only represented by Arabic, have been called *Semitic*, and occupy the countries south-west of Persia, including Syria and Arabia, besides extending into North Africa. Though the languages of these races are very different they cannot be regarded as physically distinct, and they are both without doubt branches of the Melanochroi, modified by admixture with the neighbouring races, the Mongols, the Australioids, and the Xanthochroi.

Language and religion. 122. The Aryans of India are probably the most settled and civilised of all Asiatic races. This type is found in its purest form in the north and north-west, while the mixed races and the population referred to the Australioid type predominate in the peninsula and Southern India. Among the hill tribes of Central India are some which appear to have a Mongolian origin, and to have come in from the north-east, such as the Koles and Bhils. The spoken languages of Northern India are very various, differing one from another in the sort of degree that English differs from German, though all are thoroughly Sanskritic in their vocables, but with an absence of Sanskrit grammar that has given rise to considerable discussion. The languages of the south are Dravidian, not Sanskritic. The letters of both classes of languages, which also vary considerably, are all modifications of the ancient Páli, and probably derived from the Dravidians, not from the Aryans. They are written from left to right, exception being made of Urdu or Hindustaní, the mixed language of the Mahometan conquerors of Northern India, the character used for writing which is the Persian. From the River Sutlej and the borders of the Sindhian desert, as far as Burmah and to Ceylon, the religion of the great bulk of the people of India is Hindu or Brahminical, though the Mahometans are often numerous, and in some places even in a majority. West of the Sutlej the population of Asia may be said to be wholly Mahometan, with the exception of certain relatively small areas in Asia Minor and Syria, where Christians predominate. The language of the Punjab does not differ very materially from that of Upper India. West of the Indus the dialects approach more to Persian, which language meets Arabic and Turki west of the Tigris, and along the Turkoman desert and the Caspian. Through the whole of this tract the letters are used which are common to Persian, Arabic, and Turkish, written from right to left.

Distribution of Negroids. 123. The presence of the Negroid type in isolated Asiatic areas, so far removed from the existing Negro region, appears to require for its explanation the former extension of dry land from Africa across the area now occupied by the Indian Ocean, and the later disappearance of such land by changes of level of the earth's surface. If, again, the relation of the Dravidian (non-Aryan) population of Southern and Central India to that of Australia be real,—and the relationship seems to be sufficiently established,—the presence in India of this race seems also to require the former occurrence of great alterations in the distribution of sea and land across the equatorial region of the Indian Ocean, and probably an alternation or repetition of movements such as our better knowledge of other parts of the earth shows us to have been normal rather than abnormal. That changes on a very great scale have taken place in Southern Asia in the very latest geological periods is well established, and as was before observed (par. 44), these hypotheses are supported by direct geological evidence, and corroborated by the facts of botanical and zoological distribution.

HISTORY. 124. In looking back on the materials at our command for ascertaining how the existing condition of the earth and its inhabitants has been brought about, we are generally forced to the conclusion that they are but fragmentary and disappointing; this is more especially the case in dealing with our own race. Of historical records there are hardly any that extend to seven centuries before the Christian era, except those in the form of monuments and of fragmentary and obscure inscriptions. What is left of more remote antiquity is little more than the material wreck of human societies; the living forces that carried them forward have necessarily escaped us, except as matter of conjecture.

Prehistoric man. 125. Of prehistoric man little has yet been discovered in Asia; but a sufficient number of stone and bronze implements or weapons has been found in various parts of India to show that the first steps of the human race in civilisation are everywhere almost identical.

Aryans and Semites. 126. The feeble light thrown on the earliest history of the Aryan race exhibits it as a pastoral people occupying the valleys and mountains along the Oxus. In its proximity to the south were the Semitic races, distributed from Syria to the Euphrates and Persia, and perhaps further east. These two races are seen to have spread across Southern Europe, North Africa, and South-western Asia; the Aryans supplying their language to the greater part of Europe and of the temperate zone of Asia, from the Mediterranean to India; the Semites giving theirs to Arabia, Syria, and North Africa. It is supposed that the population of the

Their migrations. area referred to was thus distributed by reason of migrations caused by pressure from Mongolian tribes on the north, such as is known to have arisen since the historical period. Possibly the movements may have been due to changes in the climate, and the gradual diminution of the rain-fall (of which there is evidence), which might have rendered the area originally occupied by the Aryans unable to support them. But it may be regarded as certain that the Brahminical race, formerly dominant in Upper India, entered that country from the north-west as invaders. The ascertained connection of the languages of India and of the intermediate tract with the ancient Aryan or Vedic language, the fact that the founders of the Brahminical faith fixed themselves in or near the mountains of Northern India, the greater predominance of the Aryan type in this region, the separation of a privileged higher from a servile lower class or caste, and the general evidence of the diffusion of Indian civilisation from west to east, with many other circumstances, tend to corroborate such a view. An intrusion of Aryans into the countries originally occupied by the Semites seems also to have taken place in

Languages. Iran or Persia. As the Aryan language developed into the Sanskrit in India, so in Persia it gave birth to the Zendic or Pehlvi, the language of the sacred books of the Fire-worshippers; and as the Aryans seem to have borrowed the Dravidian letters in the former country, so they adopted those of the Semites, or ancient Assyrians, in the other. The European branch of the Aryans, the Hellenic races, likewise appear to have had no letters of their own, and to have borrowed a Semitic alphabet from the Phœnicians. The Bactrian Aryans used an archaic quasi-Phœnician alphabet in North India till 250 B.C., about which time the Pali letters, on which the Devanagari alphabet was based, are known to have been current.

127. The races that formerly occupied the plains of Mesopotamia and the neighbouring mountains—the Babylonians and Assyrians—are, next to the Egyptians, those whose monuments and inscriptions supply the earliest definite records of mankind, going back possibly nearly 4000 years from the present time. These, and the corresponding remains of the Egyptians, which are of even greater antiquity, taking us back perhaps 6000 years or more, indicate that powerful kings then ruled over these countries, with frequent changes in the boundaries of the separate states, under conditions not very greatly different from those that continued until the kingdoms disappeared before the progress of Roman or Mahometan power. How long these races may have taken to arrive at the state of civilisation in which they were as they first become known to us it is impossible to say; but there is nothing to suggest that their condition is to be accounted for otherwise than by prolonged gradual transformations, such as they and all other races are known to have undergone in the time subsequent to that from which our historical records commence. Earliest civilisation.

128. The task of tracing from these remote epochs to more recent times the mutual relations that have arisen between the people of the several parts of Asia and the surrounding countries, leads us to a review of the history of the continent, of which a very brief outline will be attempted. From this we shall see how the progressive races of Europe appear to have had their origin in Asia; how in Asia and Egypt were taken the first steps in human civilisation and learning; how in Asia arose all the forms of religion which have so greatly influenced the history of man,—the Vedantic, the Buddhist, the Hebrew, and, more especially, Christianity and Mahometanism; how the movements of the population of Central Asia have affected the surrounding regions; and lastly, how the condition of almost the whole continent has, from the earliest ages to the present day, been one to invite foreign conquest, and to lead to the supremacy of foreign races over all its parts. General view.

129. The earliest event in Hindu chronology which has any pretence to being called historical is the war of the Máhábhárat. The account of this is contained in a poem, written about 500 B.C., which is one of the Vedas. It seems to have been a contest between two branches of the house reigning in Northern India, and to have occurred about 1400 B.C. The accounts of antecedent periods are manifestly mythical, and merely indicate the probability of the gradual progress of the conquering Brahminical race from west to east. The Vedas are a collection of hymns and heroic poems, containing the religious doctrines of the Aryans at that remote period, and embodying the earliest system of philosophy which we possess. The inroad of Alexander the Great to the Sutlej (Hyphasis) in 350 B.C. affords a landmark in a very obscure past. The Greek colony left in Bactria survived nearly to the Christian era. In 550 B.C. was born, in Northern India, Sakya, the founder of Buddhism. This was a development of the Vedic theology; in the course of two or three centuries it became dominant in India, whence it was carried into Tibet and China, and at length became, and still remains, the religion of the greater part of Asia, though it eventually declined in India, and has now almost entirely disappeared from the Hindu chronology.

country of its origin. Asoka, one of the Hindu kings of whom memorials exist in inscriptions found in various parts of India, lived when Buddhism was triumphant, in 250 B.C. The subsequent annals consist of little more than lists of kings of various dynasties settled in various parts of the country, until we reach the period of the Mahometan conquests.

Western Asia.

130. Of the western parts of Asia it will suffice to say that about 600 B.C. the kingdoms known under the names of Babylonia, Assyria, Media, and Persia, began to coalesce, and were at length united under Cyrus, the Persian; the "Great King," whose territories are said to have extended from the Mediterranean to the Indus.

During this period the civilisation and learning of Egypt and Western Asia had penetrated into Greece, where was developed, from the branch of the Aryan race which occupied that country, the most extraordinarily intellectual community which has ever existed. The successful resistance of Greece to the advance of the Persians probably prevented the spread of the western-Asiatics over Europe, and left that continent open to the evolution of the far higher type of civilisation which is its characteristic. The destruction of the Persian monarchy by Alexander took place about 330 B.C. After the Indian expedition and death of the great Greek conqueror, his Asiatic kingdom fell to pieces, and numerous petty sovereignties were formed out of it. About fifty years before the Christian era, the Romans for the first time appeared on the arena of Asia, took possession of Syria, and soon after occupied a large part of Asia Minor, and at length established themselves on the Tigris. During this interval the more eastern part of the old Persian kingdom, called by the Romans Parthia, had again acquired an independent existence, and its monarch, once more assuming the title of the "Great King," fruitlessly attempted to drive the Romans out of Asia. In the year 274 A.D. later successes of the Romans in the East were celebrated by the famous triumph of the Emperor Aurelian, in which, it is said, ambassadors appeared from all parts of Asia, even from China. The conflicts between the Persians and Romans continued long after the division of the Roman empire, 395 A.D., without any material change of the boundaries of the contending parties. The Romans or Byzantines never advanced beyond Armenia or the Tigris; nor could the Persians permanently retain possessions to the west of those limits, though once (620) they had penetrated to the walls of Constantinople.

Greece and Persia.

Rome and Persia.

Origin of Christianity.

131. While these conflicts were in progress, events of an altogether different character had arisen, which have brought a small portion of Western Asia into prominent notice in the world's history. Christianity had its origin in Syria, among the Jews, a tribe of Semitic race, whose sacred writings and history are of extreme antiquity, and have been preserved and are well known by reason of the special interest created in them. The Christian faith spread rapidly over Asia Minor, and soon extended to all parts of the Roman empire, in which it was at length accepted as the state religion about 320 A.D.

Its influence.

132. Among the efficient agencies of Western progress no doubt can exist that Christianity was one of the most active. It necessarily happened that the religion which established itself on the ruins of the superstitions of the Old World should have an important influence on the new forms of society that arose; and as the Christian faith gradually became the dominant and at length the only religion of Europe, it shared greatly, both through its doctrines and its organisation, in bringing about the intellectual and social advance that has there taken place.

Origin of Mahometanism.

133. But Christianity, though it had its origin in Western Asia, has produced no such consequences there. The progress which it had made to the eastward during the first six centuries was very soon after cut short by the founding of a rival proselytising religion by Mahomet, 620 A.D., whose followers and successors effectually arrested the spread of the Christian faith in this direction.

Its spread.

134. The Arabs, under the influence of the fanatical preachings of their prophet, now burst forth upon the countries around them; in less than a century, 730 A.D., they had possessed themselves of Persia and Transoxiana, penetrated to the Indus, driven the Byzantine armies out of Asia Minor and Syria, overcome Egypt, advanced along Northern Africa to the Atlantic, had conquered Spain, and even entered France. Nor was this a mere temporary success. Though the Arabs were at once repelled from France, the Mahometans held their ground in Spain for more than seven centuries, and have not only been dominant to the present day in all other parts of their earliest conquests, but have since added largely to the area in which the religion of Mahomet has been adopted.

Its influence.

135. It was to the immediate successors of Mahomet that our race is indebted for the impulse given to science, which was so long wholly neglected or deliberately condemned by Christian authority in Europe. But although it is not possible to say that Mahometanism has been without beneficial tendencies or results, yet the general history of Mussalman races has been marked by horrible barbarities and utter disregard of human life. The annals of Asiatic kingdoms present us, for the most part, with a succession of unscrupulous tyrants, among whom have appeared, at most, two or three sovereigns under whom anything like real progress towards civilisation was possible. And, admitting that rulers of all races and religions have in turn exhibited qualities which can only be regarded with reprobation, and that it is not easy to discriminate between what is due to the influence of race and what to that of religion, it is certain that the Mahometan Mongols to whom Asia was for centuries a prey far outstripped, in the violation of the principles on which civilisation is based, all other communities in any part of Europe or Asia.

Successors of Mahomet.

136. The Arab empire, under the khalifs of Baghdad, culminated about 800 A.D., but hardly maintained its integrity fifty years more. On its disruption a Turki dynasty established itself in Ghazni, from which sprung Mahmúd, who first invaded India in 1001, and extended his rule to the Oxus and Persia. His successors (not descendants) established the Mahometan kingdom of Delhi in 1200, which gradually extended over all Northern India in the next two centuries. After Mahmúd's death another Turki house, that of the Seljuks, established itself in Persia, Asia Minor, and Syria, about 1050, extended its authority to Egypt 1170, and retained its vitality till 1300. The Crusades, between 1100 and 1300, set up a small Christian power in Syria, with which the Seljuk Turks were in a state of almost constant conflict, the famous Saladin (Sálah-u-din) having been one of their chiefs. In the wars between the followers of the crescent and the cross, it is hard to say which party inflicted the greatest atrocities on the unfortunate inhabitants of the country around the Holy Sepulchre.

Chenghiz Khán.

137. Two centuries before the Christian era the Mongolian races of Central Asia are known to have begun the series of predatory incursions on their neighbours, which so long made them the terror of all parts of the Old World less barbarous than their own. The most important of these irruptions took place about 1220. Chenghiz Khán, a Mongolian chief, having made himself master of Central Asia, established his capital at Kárakorum, the precise site of which is doubtful. In 1215 he took possession of Northern China, and then turned westward; he overran the whole of Turkistan, the countries along the Oxus, Afghanistan, and Persia, and

added them to his empire. After his death, in 1227, his successors, dividing his kingdom among them, continued their advance to the west. They swept away the remains of the Arab khalifs of Baghdad in 1258; and overthrew the Seljuks in Asia Minor in 1300; several of their expeditions for plunder reached India; and they spread themselves over South-eastern Europe, into Russia, Hungary, and Poland, and entered Siberia. During this interval, as they became settled, they abandoned the simple deistical faith of their fathers, and adopted the religion of the races they had conquered.

Timur. 138. In the year 1370 there rose, above the ordinary level of the successors of Chenghiz, another chief, who claimed descent from the great khan, but was more indebted for his position to his own force of character. From an obscure position in Samárkhand, Timúr, commonly spoken of as Tamerlane by European writers, had acquired in the course of twenty years the sovereignty of Afghanistan, Transoxiana, of Persia as far as the Euphrates, and of Eastern Turkistan to Káshgar. His armies reached to Siberia, and he carried his devastations into the heart of Russia, almost to the walls of Moscow. In the years 1398–99, excited by fanaticism and the love of rapine, he made his celebrated march into India, an account of which, with his other exploits, exists, written by himself. He plundered and burnt Delhi, which city was surrendered under a solemn promise of protection; he carried off innumerable captives, ravaged the neighbouring country, and massacred the Hindu inhabitants to wash out the stains of Mussulman blood spilt by his sword; and finally quitted India, leaving anarchy, famine, and pestilence behind him, having in four short months overwhelmed the provinces of Northern Hindustan by calamities which prostrated the kingdom of Delhi for nearly a century. From these ruins the ruthless barbarian turned to the extreme west of Asia, which he ravaged with greater ferocity, if possible, than India. After the overthrow of the Seljuk Turks in 1300, the descendants of Chenghiz ruled in Asia Minor for some years. Amid the disorders that accompanied the successions of this dynasty, there started up another adventurer, Osmán or Othman, who established himself in the north-western region of Asia Minor, overlooking the Euxine and Sea of Marmora. The descendants of Osman had already become important chiefs, in 1360, when they had driven the Byzantines out of Asia and, under Amurath, established themselves in Europe in the provinces adjoining Constantinople, and had also extended their sway eastward to the Euphrates. It was against Bajazet, the successor of Amurath, that Timur turned his arms (1400). Aleppo and Damascus were utterly destroyed by him. From Syria, passing the plains of Mesopotamia, where it is said he erected a pyramid of 90,000 heads on the ruins of Babylon, he pursued the Osmanlis into Anatolia; there Bajazet was defeated and made prisoner. Timúr having established his supremacy throughout Western Asia and made the Greek emperor his tributary, turned back to Samárkhand, and died in 1405, on his way to attack China. The successors of Bajazet soon recovered their hold on Asia Minor and Syria, and in 1453 took Constantinople, and put a final end to the Byzantine power, establishing in its place the Ottoman empire, extending over Greece, the Danubian provinces, and Asia Minor.

King's of Delhi. Babar. 139 Turning once more to India, we find the kings of Delhi still in a feeble condition in 1526, when Bábar, the sixth descendant of Timúr, and on his mother's side of the family of Chenghiz Khan, who had established himself at Cabul, marched upon Delhi, defeated the king at Paniput, and made himself master of Northern Hindustan. On this occasion cannon were first used in war in India. On his death, Cabul with the Punjab were separated from the kingdom of Delhi, and after some years of disorder in the succession, the Indian sovereignty came into the hands of his grandson Akbar, 1556, who has been justly spoken of as taking a place among that rarest order of princes whose reigns have been a blessing to mankind. He died in 1605, having re-established the Mogul kingdom of Delhi over all Northern India, from Candahar to Bengal, and as far south as the Deccan. He was remarkable alike for his learning, his tolerance, his justice, the excellence of his personal character, and his administrative capacity; and it may truly be said that the foundations of the present system of government in Northern India were laid by this great man, who for the first time really consolidated the kingdom, and established an organised administration. Akbar.

140. Akbar's successors, among whom may be named Shah Jehan as being but little less eminent than his grandfather, ruled in India till 1748, extending their power further south, over nearly the whole of the peninsula, but with various reverses and a gradual decay of strength. The Mogul dynasty dragged on a feeble existence, till it virtually fell before the Mahrattas; after this it maintained for a few years a sovereignty little more than nominal, and finally disappeared on the establishment of the British power in Northern India. Among the more notable incidents in this interval are the establishment of the Mahratta government in the Deccan under Sevaji in 1647, and that of the Sikhs at Lahore in 1708 (the founders of the religion having lived, Nanuk in 1419, and Gurú Govind in 1675), and the third sacking of Delhi by Nadir Shah, the king of Persia, in 1739. Later Indian history.

141. Nothing is more remarkable in the history of human societies than the manner in which the ancient civilisation of India has maintained itself through the centuries which have elapsed since the inroads from the West began, the records of which form so large a part of Indian history. Long before the time to which the annals of any part of Europe go back, India had made considerable material and intellectual progress, and the fundamental characteristics of the community at present are probably but little different from what they were 2000 or 3000 years ago. The natural wealth of the country, its open character, and the smaller energy and physical force of its inhabitants, have made it a continual prey to the more warlike nations without, and constant internal wars have completed its political disorganisation, so that the remains of any truly national governments have, with few fragmentary exceptions, long ceased to exist. But probably few countries that have been subjected to such vicissitudes have changed so little. The well-being of the indigenous population has been preserved in a remarkable degree by that inaptitude to change which appears to be inherent in their race, and which suggests the necessity of the efflux of a very long period of time for the growth of those customs, which have been so little modified since they became fixed in the form described in the ancient Sanskrit writings. Inaptitude of Indian races to change.

142. The early history of China offers little to call for remark in such a review as the present. The date of the writings of Confucius is fixed at 550 B.C. The great wall, constructed to oppose the inroads of Mongols from the north, was a work of the Hán dynasty about 200 B.C. About 585 A.D., the whole of China was united into one empire, having previously been governed by many petty chiefs. The first successful invasion of the Mongols under Chenghiz Khan took place in 1234 A.D., and he retained possession of the northern half of the empire, handing it to his son, Kublai-Khan, in 1260, who completed the conquest of the whole country in 1279, and founded the Mongolian dynasty. In his reign Marco Polo, the Venetian traveller, visited China.

China, having traversed the whole of Asia, and from him are derived our first authentic accounts of those countries. The Mongolian dynasty fell, from internal insurrection, in 1366 A.D., when a national government was again set up, once more to be overthrown by an invasion of the Mânchus from the north, about 1643, when commenced the Manchu dynasty, which has existed till the present time, and from the establishment of which the political importance of the Chinese empire began. The supremacy of the present dynasty of China over Central Asia, and the neighbouring states of Eastern Turkistan, dates apparently from about 1680; but it has recently been thrown off in the extreme west by the Turkish races, and is very doubtfully maintained in other distant provinces, and has further been seriously limited in late years by the advances of Russia.

Japan. Formosa.

143. The islands of Japan have maintained an independent position from remote antiquity. Formosa is half occupied by the Chinese, half in possession of indepeudent tribes. The whole island has quite recently, after a threatened conflict with Japan, been recognised as subject to China.

Indo-Chinese nations.

144. Of the earlier history of the Indo-Chinese nations little is known. The kingdoms are politically insignificant, and the physical peculiarities of the territories on which they are established make foreign invasion by land almost impossible, and internal communication and intercourse with the rest of the world, except by sea, difficult.

Malays.

Similar remarks apply to the Malay Archipelago.

Review of history of Asia.

145. The history of Asia thus far is the record of events brought about by the conflict of forces almost wholly developed within the continent itself. But external influences came into operation by which an altogether new set of conditions was created, leading to consequences among the most remarkable of any in the world's history. The germs of civilisation, which had their origin in Western Asia and Egypt, were thence carried by the Greeks into Europe. In Asia arose the first systems of religion and conceptions of philosophy, which have given scope and food to man's intellectual development; and in it were taken the first steps in the formation of the sciences of observation. But it is to Greeks, instructed in Asiatic learning, that the world is indebted for its further advances. And as Asia no more contributed to this movement which she had started, so she had but little share in its results, or in the benefits it conferred on mankind. Her history presents an unceasing repetition of barbaric invasions, instigated by the love of plunder, which swept, wave after wave, over the most fertile and populous provinces where civilisation and wealth had begun to appear, and left ruin and demoralisation in their departing track.

Backward civilisation.

It may well be doubted whether Asia, speaking generally, had made any permanent advance in the arts of civilisation since the disruption of the Roman empire, until those events occurred which have brought her under the immediate influence of the powers of the West, and which may prove to have given the whole continent a lasting impulse towards progress. These events are the establishment, little more than a century ago, of British supremacy in the south, and still later of that of Russia in the north.

Russian power in Asia.

146. The extension of Russian authority into Northern Asia began about the year 1700, and by the end of the century Russian settlements extended across Siberia to Kamchatka. The advance of this power on the west of Asia into the borders of Turkey, Persia, and Turkistan, and on the east into the outlying provinces of China, is of much later date, and must be regarded as a natural and necessary consequence of the position of a powerful and civilised state brought into contact with barbarous neighbours.

Maritime discoveries.

147. The first introduction and subsequent growth of European power and influence in Eastern and Southern Asia have been almost wholly the result of maritime discovery and enterprise. Under the stimulus of expected commercial gain, and guided by the intelligence of mariners who, like Columbus, were acquainted with the astronomical teachings of the Arabs, and who, in defiance of the Christian church, believed in the sphericity of the earth, the first of a great series of voyages of discovery was undertaken, which in 1492 gave to Europe its knowledge of America.

Their effect.

A few years later the discovery of the passage round the Cape of Good Hope by Vasco di Gama, in 1498, opened out Asia to the commercial enterprise of the maritime nations of Europe. The trade with the East, which had hitherto found a route overland along the Black Sea and Caspian, or up the Red Sea by Egypt, or by the Persian Gulf to Syria, and had been seriously affected by the irruptions of the Mongols, had been centred with the merchants of Genoa and Venice. The opening of the sea route destroyed the monopoly previously established by the Italians, and the Portuguese naturally were the first to benefit by their discovery. The other maritime nations soon followed in their track. A new impetus was thus given to intercourse with Asia, which in a short time altogether changed the current of events in that continent.

Progress of Portuguese.

148. The Portuguese landed on the Malabar coast of Hindostan in 1498, and speedily made themselves masters of the Indian Ocean, which they swept with their fleets from Arabia to China. They took Ormuz and Aden, became supreme on the Malabar and Coromandel coasts, in Ceylon and the Malayan islands, and established powerful settlements at the mouth of the Ganges. They first reached China in 1516, and were permitted to establish about twenty years later a factory at Macao, which they still maintain. From that time the intercourse between China and Europe by sea has been regularly and gradually extended. The power of the Portuguese in India, after lasting nearly a century, fell into insignificance, partly by the arms of the Mahometans, partly by the efforts of the Dutch and English—to which latter nation they ceded the island of Bombay in 1661, on the treaty of marriage of Charles the Second.

Other nations.

149. The Dutch, the Danes, the Spaniards, the French, and the British, all acquired in a similar manner, and (excepting the Danes) still retain settlements of various degrees of importance in India, the Malay peninsula and Archipelago, and China, of which those of the British in India, Ceylon, and China, of the Dutch in Java and the neighbouring islands, of the French in Camboja, and the Spaniards in the Philippine Islands, alone call for mention. The celebrated Jesuit missionaries, who were long the only authorities on China, first reached Canton in 1579, though Christian teachers had penetrated into the country several centuries before, even, it is said, as early as 635 A.D., and churches were built and converts made in 1274, as reported by Marco Polo. The Jesuits, from their superior knowledge, soon made themselves a powerful body in the state, and their influence was great till about 1700, after which, owing at first apparently to conflicts regarding the limits of the Pope's jurisdiction over Chinese, they lost favour, and eventually were subjected to positive persecution. They have never regained their former authority. The later intercourse of Europeans with China has introduced some of the forms of Western progress, and opened the empire to commerce.

East India Company

150. The history of the British settlements in India calls for more detailed notice. The English East India Company was founded in the reign of Queen Elizabeth, in 1599, with a purely commercial aim. For 150 years the Company confined itself to extending its trade, but the difficulties of protecting the operations of commerce in the midst of such anarchy as prevailed in the provinces in which their settlements were, at length forced them to arm

in defence of their factories. The example and rivalry of a powerful foe, the French East India Company, first led them to take an active part in the political intrigues of the numerous native chiefs, and from this, step by step, a simple body of traders has been transformed into a recognised branch of the British Government, exercising supreme authority over the whole of India from the Indus to the Malay peninsula.

French India Company.

151. The French Company, established in 1664, had existed side by side with that of the English in complete harmony for 70 or 80 years, though the two nations had been repeatedly at war in Europe. But in 1744 the war which then broke out was carried into India by the French, with consequences which the most far-seeing could not have predicted. The French governor of Pondicherry, Dupleix, a man of genius and ambition, formed the project of founding a French empire in the Deccan, a project which, under the efforts of a succession of able men, at one time seemed about to be realised. But after a struggle of fifteen years, during which both sides formed alliances among the more powerful native states, the English finally defeated the French in 1760, and destroyed their settlements. Two years later, on the restoration of peace, the French were permitted to re-occupy their former factories. But the opportunity of taking a place as the paramount political power in India was gone, nor were their later efforts, which were continued till 1802, more successful.

Ruin of French influence.

Growth of power of British.

152. On the other hand, the English Company, with the military aptitudes and experience developed among its servants in these contests, was brought more and more into contact with the many self-constituted chiefs who with more or less pretence of a nominal allegiance to the puppet emperor of Delhi, had carved out for themselves kingdoms from the ruins of the Mogul empire, and subjected all parts of India to rapine and violence. The results of the conflicts that ensued were to add fresh strength to the Company. The battle of Plassy, in 1757, gained by the British under the celebrated Clive over the viceroy of Moorshedabad, made them masters of Bengal and its dependencies. From that date the history of the Company is a record of the gradual subjugation of all their opponents. The Delhi sovereignty had already entirely fallen to pieces, and the British became by the force of events the paramount power in India, and on them have devolved all the duties and responsibilities of that position.

British become paramount.

Character of government.

153. From the commencement of the present century the main scope of the action of the East India Company was the introduction of order and good government into the countries that had fallen under its rule; and since the final destruction of the predatory armies of the Pindarees in 1817–18, India has enjoyed, with few and short exceptions, a condition of internal peace such as had never been approached in any part of its previous history. Under such circumstances the wealth of the country has enormously increased, and the progress of civilisation in all its branches has been great and continued; and it may be truly affirmed that nowhere has there been established by any race of foreigners a rule more beneficent and unselfish, or better designed to advance the best interests of the subject population, than that which has now existed under Great Britain for upwards of a century over a large part of Southern Asia.

(R. S.)

Alphabetical Index.

(The numerals refer to the paragraphs.)

ASIA MINOR

See Plate II. vol. xv

ASIA MINOR is the name commonly given by geographers to the portion of Western Asia which projects from the main mass of the continent towards the west, between the Black Sea and the eastern basin of the Mediterranean, and which at its north-western extremity approaches so closely to Europe as to be separated from it only by the two narrow straits of the Bosphorus and the Dardanelles. It is situated between 36° and 42° of N. lat., and between 26° and 40° of E. long., and is about equal in superficial extent to France, while it is but little inferior to the peninsula of Spain and Portugal, with which it offers some striking analogies. But while its boundaries on three sides—the Black Sea on the N., the Ægean Sea or Archipelago on the W., and the Mediterranean on the S.—are clearly defined by nature, its eastern boundary is wholly arbitrary and uncertain. The ranges of mountains which extend from the Gulf of Scanderoon, at the north-eastern extremity of the Mediterranean, across to the Black Sea near Trebizond, are so far from forming a continuous range like the Pyrenees, that they are broken into a number of irregular groups and masses, some of which may be regarded as continuations of the Taurus on the south, while others are connected with the highlands and mountain ranges of Armenia on the north; and the great river Euphrates forces its way through the central mass of mountains, nearly at right angles to the general direction of the chain. Hence it is impossible to separate Asia Minor on this side from the adjoining regions of Armenia and Mesopotamia by any real or physical boundary, and for this very reason the political limits have in all ages been very vague and fluctuating. For the purpose of geographical description it may suffice to take a line roughly drawn along the mountain ranges from the Gulf of Scanderoon or Issus to the Euphrates, between Samosata and Malatiyeh, thence to follow the line of that river to the point near Erzinjan where it first turns to the south, and thence to draw an imaginary line to the Black Sea, a little to the eastward of Trebizond. The tract extending along the coast eastwards from the latter city to Batoum, though included within the limits of Turkey in Asia, belongs in a geographical sense to Armenia rather than to Asia Minor. But whatever line of demarcation be assumed, it must be carefully borne in mind that it does not correspond to any natural boundary.

The term Asia Minor, notwithstanding its ancient form, is of comparatively modern introduction, and was unknown to the principal Greek and Roman geographers. Orosius, who wrote early in the 5th century, was the first writer who employs the term in this sense, and he introduces it in a manner that shows it was not yet in general use. The name of Asia was, indeed, specially applied from a much earlier period by the Romans to the province which they constituted out of the Greek kingdom of Pergamus, and which was extended by subsequent additions till it comprised a large portion of the peninsula, but it was never at any time coextensive with the geographical region we are considering, nor do we find the distinctive epithet of Minor applied to it before the time of Orosius.

The name of Anatolia, which is not unfrequently used by modern geographers as synonymous with Asia Minor, is obviously a Greek term derived from ἀνατολή, the sunrise, and thus corresponding exactly to the modern term of "*the Levant*." It appears to have first come into use under the Byzantine empire, and is first found in the works of Constantine Porphyrogenitus in the 10th century. It has been retained in general usage by the Turks, but is employed very irregularly, being sometimes applied in an administrative sense only to the portion of the peninsula westward of the Halys, at other times extended even beyond the limits which we have assigned to Asia Minor. The use of the latter appellation is therefore decidedly preferable as a geographical term.

The territory comprised within the limits above proposed is about 650 English miles in length, from Malatiyeh on the Euphrates to the promontory opposite the Island of Scio; but if the line be drawn from Cape Sigeum, at the entrance of the Dardanelles, to the boundary beyond Trebizond, the distance amounts to more than 720 miles. Its greatest breadth from Cape Anamur (Anemurium) on the south coast, to Cape Kerembeh (Carambis) on the north, is just about 6° of latitude, or 420 English miles; but a line drawn from the head of the Gulf of Scanderoon to the nearest point of the Black Sea (at Ordu) does not exceed 300 miles. This may, therefore, be considered as the isthmus by which the peninsula of Asia Minor is joined to the main continent. But very erroneous notions prevailed in ancient times, and even down to a comparatively recent date, with regard to the width from sea to sea, so that the peninsular character of the region to the west of it was greatly exaggerated. Herodotus stated that it was only five days' journey for an active man from the east of Cilicia to Sinope on the Euxine; other authors extended this to seven days; and Pliny gives the distance from Amisus to the Gulf of Issus at only 200 Roman miles (about 185 English miles). Even in the last century the great geographer D'Anville diminished the width of the isthmus between the two seas by a whole degree, or about 70 English miles.

Asia Minor, therefore, can only be termed a peninsula in the same vague and general sense in which that expression is applied to the peninsula of Spain and Portugal. It has been already observed that there are several points of analogy between the two, not only from their forming respectively the westernmost portions of the two continents of Europe and Asia, and occupying much the same position in latitude, but still more in regard to their general conformation and structure. In both cases the interior of the country is occupied by a vast table-land, which forms, as it were, the nucleus of the whole, while ranges of mountains border this elevated tract on all sides, and these again are separated from the sea by valleys or plains at a low level, which are in many cases regions of surpassing fertility. The central plateau of Asia Minor is, however, more extensive than that of the Spanish peninsula, and occupies a much greater portion of the whole country. Beginning on the east with Cappadocia, the whole of which extensive province is more than 3000 feet above the sea, it is continued to the foot of Mount Taurus, by the high table-lands of Lycaonia and Isauria, the former of which is even superior in elevation to Cappadocia; while to the north of these two districts it comprises the whole of Galatia, and by far the greater part of Phrygia, together with portions of the adjoining provinces of Mysia and Bithynia. No part of this extensive region is situated less than 2000 feet above the sea, except where it is occasionally cut into by deep valleys on its northern or western borders.

A tract of such great extent naturally presents great diversity of surface, and is not only varied by extensive undulations, and occasionally by deep valleys, but is traversed in different directions by numerous ranges of mountains, some of them rising to a considerable altitude above the ordinary level of the surrounding plains. These ranges separate the different portions of the great central plateau from one another, and thus divide them into several basins, the waters of which have no direct communication with each other. One of the most remarkable features in the physical geography of the interior is the fact, that one of the basins thus parted off from the rest, extending nearly 250 miles in length and 150 in breadth, from the sources of the Sangarius and Halys on the north to the great chain of Mount Taurus, has no communication with the sea,—the streams by which it is watered having no outlet, and consequently forming a chain of lakes extending from near Synnada in Phrygia through the whole of Lycaonia, to beyond Tyana in Cappadocia. The most considerable of these lakes is that called, by Strabo, Tatta, and by the Turks, Tuzlah, or the Salt Pan,—an epithet well deserved from its extreme saltness, which exceeds even that of the Dead Sea. It is about 45 miles in length by 18 in breadth, but varies much with the season, being very shallow, so that a considerable portion of its surface is dry in summer and covered with incrustations of salt.

North of the region of these lakes lies a dry and naked tract, consisting principally of undulating downs, traversed by the branches and tributaries of the Sangarius and Halys, but otherwise scantily supplied with water, and almost wholly destitute of trees. A portion of this region was in ancient times specially designated as Axylus, or the woodless; but the same epithet might with almost equal propriety be applied to the whole tract extending from Dorylæum and Cotiæum, through the north of Phrygia and Galatia, to the confines of Pontus and Cappadocia, a distance of nearly 300 miles. These vast treeless downs afford pasturage at the present day, as they did in the time of Strabo, to numerous flocks of sheep, but they are for the most part uncultivated, and in many places utterly barren and desolate. The few towns that are found within their limits are, however, sometimes surrounded by luxuriant gardens and fruit-trees in great variety.

Mountains.—The orography of Asia Minor is extremely complicated, and is still but imperfectly known, though the researches of recent travellers, especially of Hamilton and Tchihatcheff, have of late years thrown much light on the subject. But very few of the highest ranges have as yet been accurately measured, and the barometrical determinations of the altitudes of numerous points in the interior, which have been made by Hamilton, Ainsworth, and Tchihatcheff, often differ so much from one another, as to render it doubtful how far we can place reliance upon them. At the same time, we are now able, in a general way, to describe and distinguish the more important mountain ranges of the peninsula—a task for which there existed no sufficient materials down to a late period.

By far the most important of these mountain ranges, and that which constitutes one of the leading geographical features of Asia Minor, is the great chain known to modern as well as ancient geographers by the appellation of Mount Taurus. Beginning at the south-western extremity of the peninsula, in the province of Lycia, it extends in a direction nearly parallel with the south coast as far as the south-eastern angle at the confines of Cilicia with Syria,—a distance, as measured on the map, of more than 7° of longitude, or above 400 English miles. Throughout this extent it forms a continuous range of very considerable elevation, constituting a complete natural barrier between the Mediterranean and the great upland plains of the interior; while in some parts, as in Lycia and the western portions of Cilicia, it sends down numerous arms and branches quite to the sea-shore: in others, on the contrary, leaving a broad strip of alluvial plain between the foot of the mountains and the sea. Its positive elevation is very imperfectly known, none of the summits of the great central range having as yet been measured with any degree of accuracy, and the numbers given in the best maps resting only on the more or less vague estimates of different travellers. It is probable, however, that throughout the greater part of its extent the summits of the main range attain to an elevation of from 7000 to 8000 feet, while many of the higher summits are estimated to exceed 10,000, and in some instances, at least, to approach to 11,000 feet.

The only portion of the Taurus which has yet been examined with much care is that contained within the ancient province of Lycia. Here, as is observed by Strabo, the whole country is occupied by the ramifications of the great chain, which descend in numerous arms and branches quite to the sea, leaving between them only narrow valleys and alluvial plains of very small extent at the mouths of the different rivers. In this instance, as in many similar cases, several of these offshoots and outliers of the main chain attain to a greater elevation than the summits of the central range itself. Thus it is stated, that while the peaks of the Lycian Taurus, which walls off the great mountain table-land of Asia Minor, do not much exceed 7000 feet, the mountain mass of Massicytus (Ak-dagh), which forms the eastern boundary of the Xanthus valley, attains to 10,000 feet; Soosoos-dagh, east of the preceding, rises to between 8000 and 9000 feet, and the highest point of Mount Solyma (Bai-dagh), which rises immediately to the west of the Gulf of Adalia, attains to 10,500 feet (Spratt and Forbes's *Lycia*). It is obviously impossible to fix precisely the natural termination of the Taurus in this part of Asia, these various ridges expanding from the central chain much in the form of a fan. The Gulf of Macri (the Glaucus Sinus of the ancients) is often taken as marking its limits to the west, but in reality, the ridges which descend from the central table-land to the sea opposite Rhodes, as well as to Cnidus and Halicarnassus, are all ramifications of the Taurus, and any one of these headlands might with equal propriety be chosen as the first commencement of the great mountain chain. The popular notion among the ancients, which regarded Cape Chelidonia (the south-eastern promontory of Lycia) as the termination of the Taurus, is deservedly censured by Strabo, who regards the chain as prolonged to the Peræa of the Rhodians.

One of the characteristic features of the Lycian Taurus, which is found also throughout the whole range, is that of the frequent occurrence of basin-shaped valleys, called by the inhabitants "yailahs," sometimes containing mountain plains of considerable extent, walled in on all sides by limestone mountains, and having no outlet for their waters, which in consequence pour themselves into the precipitous cliffs that surround them. These yailahs vary in elevation from 2000 to 6000 feet, and afford excellent pasturage, on which account they are the summer resorts of the wandering tribes of Turcomans and Yourouks. Almost the whole mass of the Taurus is composed of limestone, belonging to the same great formation which constitutes the greater part of the Apennines, as well as of the mountains of Greece, and is generally known to geologists by the name of scaglia, or Apennine limestone. The streams which descend from thence to the sea, and which in many cases have had subterranean courses of considerable extent, are so strongly charged with carbonate of lime that they form vast deposits of travertine; and the level plains intervening between the foot of the mountains and the sea, instead of being composed, like ordinary alluvial plains, of loose detritus and soil, consist of solid deposits of travertine rock of an extent unknown elsewhere. The whole plain of Pamphylia, at the foot of the mountains of Pisidia and Isauria, is thus constituted, and a considerable part of the plains of Cilicia is composed of similar materials.

The principal passes across the chain of the Taurus which are deserving of notice, are the following:—1. That which crosses the chain from the plain of Cibyra (a portion of the great upland tract of Phrygia, at an elevation of 3500 feet above the sea) into the valley of the Xanthus in Lycia, and descends to the city of the same name. 2. That which leads from Afiom Kara Hissar, in the centre of Phrygia, by Isbarta and the ruins of Sagalassus, to Adalia on the Mediterranean. This is one of the most important lines of route in Asia Minor, being the high road from Constantinople to the flourishing seaport of Adalia, at the present day one of the chief ports on the south coast of Asia Minor. 3. A route leading from Konieh (Iconium) by Karaman (Laranda) to Mout, in the valley of the Calycadnus, and thence to Kelenderi (Celenderis) on the coast of Cilicia. This was the route followed by Colonel Leake in 1800, and is the most direct line of communication with Cyprus. 4. The celebrated pass called the Cilician Gates (Pylæ Ciliciæ), which is not only the direct route from Konieh and Kaisariyeh on the north, to Tarsus and Adana on the south of the Taurus, but has been in all ages the great highway from Asia Minor into Syria and the valley of the Euphrates. It is a narrow gorge or defile between two lofty mountain masses, and derives great military importance from its being easily defensible, while it absolutely commands the entrance into Asia Minor on this side. Hence it is mentioned as a point of special interest during the march of the younger Cyrus towards the Euphrates, as well as in the advance of Alexander previous to the battle of Issus. In modern times it was strongly fortified by Ibrahim Pasha, during the short period for which the Egyptians held possession of Syria (1833–1840); but these fortifications have since been abandoned.

This celebrated pass, which crosses the central ridge at an elevation of only about 3300 feet, marks the line of separation between two of the loftiest masses of the mountain chain, the Bulghar-dagh on the west and the Ala-dagh on the east, both of which are estimated to attain to a height of from 10,000 to 11,000 feet. Thus far the mountain range of the Taurus may be considered as forming a continuous chain, the boundaries and direction of which may be readily described. But from this point its character is altogether changed, and it is very difficult to determine, among the numerous mountain masses which are found on the borders of Asia Minor and Syria, which is most properly entitled to be regarded as the main chain of the Taurus. Strabo, the only ancient writer who appears to have had any clear ideas on the subject, describes the Taurus as sending forth two distinct branches,—the one called Mount Amanus to the south, which bounds the Gulf of Issus, and forms the limit between Cilicia and Syria; the other, to which he gives the name of Anti-Taurus, striking off in a north-easterly direction through the eastern portion of Cappadocia, and gradually sinking into the plain. This last chain is clearly the one which forms the continuation of the Ala-dagh towards the north-east, between the valley of the Sarus and that of the Halys, and is continued, though at a lower elevation, till it joins the mountains that separate Pontus from Armenia. The name of Taurus is given by the Greek geographer to the mountain masses which extend more towards the east, between the districts of Melitene and Commagene, and are prolonged across the Euphrates into Armenia, where they are connected with the more lofty ranges and high tablelands of that country. All this mountain region is still very imperfectly known, and it will require much investigation before its orographical relations are fully understood; but it is clear that there is such a mountain mass as that supposed by Strabo, and which may be regarded as continuous, though cut through by deep and narrow gorges, through which the rivers Sarus and Pyramus force their way from the elevated valley of Cataonia to the low plains of Cilicia. Just in the same manner th Euphrates, further east, forces its way through the same mountain range by a channel so narrow and tortuous as to afford no means of communication, so that travellers proceeding south from Malatiyeh (Melitene) to Samosata on the Euphrates, have to cross a pass over the mountains known as the pass of Erkenek. The range here traversed, which is of very considerable elevation, appears to be continuous with that which forms the boundary of Commagene on the west, and is continued under the name of Mount Amanus to the Gulf of Issus. Strabo is also certainly correct in regarding it as connected with the mountains of Armenia, but these lie beyond the limits which we are at present considering.

At a short distance from the chain of the Taurus and Anti-Taurus to the west, but wholly unconnected with them geologically or in a true geographical sense, is a remarkable series of volcanic peaks or groups, extending in a direction from N E. to S.W., through an extent of more than 150 miles. The northernmost and most elevated of these was known to the ancients as Mount Argæus, and is still called by the Turks Erdjish-dagh. It is the highest mountain in Asia Minor, attaining to very nearly (if it does not exceed) 13,000 feet, and its base is upwards of 60 miles in circumference. About 60 miles S.W. of this rises the volcanic mass of Hassan-dagh, the highest peak of which attains an elevation of above 8000 feet, and which has covered the whole country to the north-east with a vast extent of volcanic deposits. Beyond this, towards the S.W., is situated the volcanic group of Karadja-dagh, of very inferior altitude, but interesting as exhibiting a well-marked series of volcanic cones, having in some instances very well preserved craters, extending through a range of above 35 miles, as far as the village of Kara Bounar. About 25 miles S.W. of this rises the insulated mass of Kara-dagh, of similar volcanic character, and estimated to attain to a height of about 8000 feet. All these volcanic mountains are composed principally of trachyte, and though separated by intervening spaces, either of level plain or gently undulating country, may be regarded as forming part of the same line of volcanic action, the axis of which has a direction nearly from N.E. to S.W. It is remarkable that this is almost precisely parallel with the line of the Anti-Taurus, as formed by the Ala-dagh and its continuation towards the north.

Nearly at right angles with the series just described is the range called the Sultan-dagh, which extends through a space of more than 120 miles from the neighbourhood of Afiom Kara Hissar to that of Konieh. It has a general direction from W.N.W. to E.S.E., and is separated from the neighbouring portions of the Taurus by a broad valley having an average elevation of over 3000 feet, as well as by the three upland lakes of Egerdir, Kereli, and Soghla Its central and highest portion rises to more than 6000 feet in height, and forms a continuous barrier between the valley above described and that known to the ancients as Phrygia Paroreios, through which lay the high road from the central plain of Phrygia to Iconium and the passes of the Taurus. Nearly parallel with the chain of the Sultan-dagh, and of about equal altitude, is that now known as the Emir-dagh, which forms the boundary of Phrygia Paroreios on the north, separating it from the great open plains of Galatia and Lycaonia, the latter of which extend without interruption to the great salt lake of Tatta.

We now come to consider the numerous mountain chains that branch off from the borders of the great central plateau to the west, and descend to the shores of the Ægean, leaving between them valleys of surpassing beauty and fertility, which were in ancient times thickly studded with towns and cities of Greek origin. As these valleys widen out in approaching the sea, the mountain chains that separate them become clearly marked, and can be readily distinguished; but as we attempt to trace them back towards the interior, it will be found that they often arise in the same knot or cluster of mountain masses, and are in fact only branches radiating from the same point. But as there is no great central chain from which they can be regarded as emanating, it is convenient to describe them separately,—the more so as, from the familiarity of the Greek writers with this portion of Asia Minor, almost every range has some distinctive appellation by which it is well known to scholars.

It has been already shown that there is no natural limit between the ranges that form the termination of the chain of Taurus on the west, and those that branch off to the Ægean through Caria. The lofty range of Baba-dagh (known to the ancients as Mount Cadmus) in the interior, on the confines of Phrygia and Caria, is certainly closely connected with the mountains that separate Lycia from the upland valley of the Cibyratis, as well as with the high range now called Boz-dagh (the ancient Salbacum), which descends in a S.W. direction, and forms the boundary between the Cibyratis and Caria. The lower ranges that spread out from thence through the province of Caria, known in ancient times by the appellations of Lida, Grium, and Latmus, may be regarded as only offshoots of this central mass. The ridge of Latmus is, however, in great measure detached, and may be considered as beginning on the south bank of the Mæander, and terminating towards the S.E. in the elevated plain or plâteau on which stand the ruins of Stratonicea.

The mountain ranges north of the Mæander are more clearly marked. That which Strabo describes under the name of Messogis arises on the borders of the great central table-land in the neighbourhood of the town of Buladun, and stretches from thence nearly due west for about 75 miles, till it approaches the neighbourhood of Ephesus, where it makes a sudden turn to the S.W., and ends in the bold mountain range and promontory of Mycale (now called Samsoun-dagh), just opposite to the island of Samos. It nowhere rises to any great elevation, but forms a continuous barrier (from 3000 to 4000 feet in height) on the N. side of the valley of the Mæander, which it separates from the parallel valley of the Cayster Beyond this latter again rises the chain of Mount Tmolus, now known as Boz-dagh, which branches off from Mount Messogis near the point of their common origin, and after sweeping round the sources of the Cayster, holds a course towards the west, till it sinks to the sea in the neighbourhood of Smyrna. Through the greater part of its range it forms the southern boundary of the valley of the Hermus, but near its western extremity there arises a subordinate range of inferior importance and elevation, which separates it from the course of that river. It is this inferior range, which is a mere offshoot of Mount Tmolus, of very little importance in a geographical point of view, that bore in ancient times the name of Sipylus, so celebrated from its connection with the fables of Tantalus and Niobe.

North of the valley of the Hermus arise a succession of ranges of no great elevation or importance, which separate it from the valley of the Caïcus, and that again from the Gulf of Adramyttium. All these masses, constituting a very broken and irregular country, may be regarded as connected in an orographical point of view with the interior range of the Demirdji-dagh, which extends through the whole of Mysia from near the Gulf of Adramyttium to the frontiers of Phrygia. It is apparently the Mount Temnus of Strabo, and is connected at its S.E. extremity with the more lofty groups called Ak-dagh and Murad-dagh, which rise out of the elevated plains of Phrygia to a height of about 8000 feet. The last of these mountains contains the sources of the Hermus, and the chain thus described forms the boundary separating that river, and the other streams which flow to the Ægean, from the Macestus and Rhyndacus, which flow northwards into the Sea of Marmora.

The north-western angle of Asia Minor, bounded by a line drawn from the Gulf of Adramyttium to the mouth of the Æsepus, so as nearly to coincide with the limits of the district known in ancient times as the Troad, is occupied almost entirely by the mountain system of which Mount Ida constitutes the centre. The highest summit—the ancient Gargarus, now known to the Turks as Kaz-dagh—rises to a height of 5750 feet, and sends out its arms and underfalls in all directions: the most lofty ridge being that which extends westward to Cape Lectum, while subordinate ranges fill up the space that spreads northwards to the Dardanelles and the Sea of Marmora.

Almost the whole of the northern provinces of Asia Minor, extending along the coast of the Black Sea—Bithynia, Paphlagonia, and Pontus—are extremely mountainous, and occupied through the greater part of their extent by successive ranges of mountains, filling up the space between the sea-coast and the borders of the great table-land of the interior. In a general view these may be characterised as forming a series of vast undulations, more or less parallel with the line of coast, which preserves a general direction from west to east. But when examined more in detail, they will be found to be complicated and broken in a manner that renders their description very difficult, while few of them have any historical importance or special geographical interest. It will suffice here to mention a few of the most important.

The most westerly of these ranges is that known as the Mysian Olympus, which rises on the borders of Mysia and Bithynia, immediately south of the city of Broussa, and extends in a direction from N.W. to S.E., between the valley of the Rhyndacus and the head-waters of the Gallus, one of the principal tributaries of the Sangarius. It attains a height of about 6400 feet, and is a conspicuous object in the view from Constantinople, as well as from the plains of the interior. After a range of about 60 miles it sinks to a comparatively low level, where it joins the table-land of Phrygia, but may be considered as continued by subordinate masses which connect it with the range of Demirdji-dagh on the one side, while other elevations branch off from it to the valley of the Sangarius, which separates it from the chain of Ala-dagh, sometimes known as the Galatian Olympus. This is a lofty range which extends pretty continuously from the valley of the Sangarius to that of the Halys, constituting during a considerable part of its course the frontier between Galatia and Paphlagonia. The highest and central portion of the chain rises to between 6000 and 7000 feet, and almost the whole province of Paphlagonia is filled up with the subordinate ranges and offshoots that may be considered as connected with it. From thence it is continued under the name of Kuseh-dagh, quite to the left bank of the Kizil Irmak or Halys. That river is indeed, in one part of its course, so closely hemmed in between two opposite ranges of mountains as to afford no passage for a road.

East of the Halys, again, the central and maritime portions of Pontus are traversed by a succession of mountain ranges, for the most part of no great elevation, but rising progressively as they approach to the great table-land of the interior. Throughout the whole line of coast, from near Samsoun (Amisus) to Trebizond, these mountains descend so close to the sea as to render the coast line extremely picturesque and varied. But the most important range appears to be that which extends from the neighbourhood of Trebizond, where it attains to an elevation of more than 8000 feet, in a direction towards W.S.W., so as to pass between the towns of Tokat and Sivas. It is here called Chamla Bel, and the passes by which it is crossed from one of these towns to the other attain to above 5000 feet. It is apparently this range to which Strabo gives the name of Paryadres, and which he describes as continuous with another mountain chain called Scydises, and connected also with the mountains of the Moschians, which occupied the sea-coast from Trebizond to the borders of Colchis. But though the great geographer was himself a native of Amasia, his ideas of the orography of his native country were apparently very vague, and he certainly has not supplied us with any definite ideas on the subject, while in modern times the region has still been very imperfectly explored. The whole tract on the borders of Pontus and Armenia is very rugged and mountainous, and is still, as in the days of Strabo, inhabited by wild and lawless tribes, which render it very difficult of access to strangers.

Rivers.—The rivers of Asia Minor are of very little importance in comparison with those of countries of similar extent in Europe. This is owing principally to the existence of the great table-land in the interior, the climate of which is remarkably dry, and a considerable part of which, as has already been pointed out, does not discharge its waters to the sea. The much steeper inclination of the river-beds, resulting from the high elevation of their sources, tends, moreover, to give them the character of mere torrents, rather than of placid and navigable streams, while at the same time none of them are fed, like the Rhine and the Rhone, by the unfailing supply of glaciers. The want of navigable rivers is, indeed, one of the great defects of the country, and one which, so far as the interior is concerned, must always remain a disadvantage not to be surmounted.

Much the largest river of the peninsula is the Halys, called by the Turks the Kizil Irmak, or "Red River," which derives additional interest from its having formed in early ages the boundary between the kingdoms of Lydia and Persia. It takes its rise in the mountains on the borders of Cappadocia and Pontus, in the district called by Strabo Camisene, about 70 miles above the modern town of Sivas, and flows in a direction nearly S.W. for above 200 miles, till it passes within 20 miles of the city of Kaisariyeh; soon after which it turns to the N.W., and then makes a vast bend round till it assumes a north-easterly direction, which it pursues as far as the town of Osmandjik. Here it makes a sharp and sudden turn, caused by its encountering the range of mountains which extends from Paphlagonia into Pontus, and which it traverses by a winding course through narrow gorges, between precipitous cliffs, until it emerges into the level country near the sea, which it enters about half way between Amisus (Samsoun) and Sinope. Its whole course (as measured on the map, without taking account of the minor windings) is not less than 560 miles, though, from its describing so great a curve, the direct distance from its sources to its mouth is only about 180 miles. In length of course, therefore, it is about equal to such rivers as the Elbe and the Loire, but it is far inferior to them in body of water, in which respect it scarcely equals the second class rivers of France. Even in the lower part of its course its breadth frequently does not exceed 100 yards.

The Halys has but few tributaries of importance. The most considerable are—the Delidji Tchai, which traverses the great upland plains of Galatia, and after flowing near the town of Yuzgat, joins the Kizil Irmak about 70 miles above Osmandjik; (2), the Gök Irmak ("Blue River"), which rises in the mountains of Paphlagonia, a short distance above the town of Kastamuni, and flows through a deep and narrow valley till it joins the Kizil Irmak in the midst of the narrow gorges above described.

At a short distance east of the mouth of the Halys is that of another of the most considerable streams that fall into the Black Sea—the Iris of ancient geographers, now known as the Yeschil Irmak, or "Green River." This has its source in the same range of mountains as the Halys, but flows from thence towards the N.W. It passes within a short distance of the town of Tokat, and under the walls of Amasia, the birth-place of Strabo, near which it bends abruptly to the N.E., as far as the site of the ancient Eupatoria, where it receives a tributary stream from the E., and thence pursues a course nearly due north for about 40 miles, till it enters the Black Sea about 15 miles east of Samsoun. It has a course altogether of about 200 miles. Its most important tributary is the one above noticed, the Lycus of Strabo, now called the Ghermeli Tchai, which is nearly equal to the main stream. It rises in the mountains on the borders of Armenia, nearly due S. of Trebizond, and flows under the walls of Niksar (the ancient Neo-Cæsarea). But great part of its course is still very imperfectly known.

The most important of the northern rivers of Asia Minor, after the Halys, is the Sangarius, which still retains its ancient name in the corrupted form of Sakaria. It falls into the Black Sea, W. of Heraclea, about 80 miles from the mouth of the Bosphorus. It has its sources in the uplands of Phrygia, not far to the N. of Afiom Kara Hissar, and flows by a very winding course through the great table-land of Galatia, as far as a place called Bei Bazar, about 50 miles W. of Angora, where it turns abruptly to the west, and traverses the mountainous regions of Phrygia and Bithynia, till, after approaching within a short distance of the Sea of Marmora, it again turns to the N.E., and pursues its course to the Black Sea. Its course has a length of more than 320 miles, while its sources, which are situated almost due south of its mouth, are distant from it only about 160 miles. Its two chief tributaries are the Enguri Su, or river of Angora, which flows past the city of that name, and the Pursak (the Thymbres of ancient writers), which passes near the towns of Kiutahia (Cotiæum) and Eski Shehr (Dorylæum), and falls into the Sakaria about 20 miles below the latter place.

The most considerable rivers which have their outlet to the Sea of Marmora are the Rhyndacus and Macestus, which unite their waters at a distance of about 15 miles from the sea. They both take their rise in the range of mountains known as the Demirdji-dagh, the Macestus having its source in a small lake called the Simau Göl, a few miles north of Simau (Synnaus), the Rhyndacus in the neighbourhood of Æzani, about 25 miles further east. They flow at first in widely divergent directions, but ultimately both turn towards the north; and the Rhyndacus (now called Adranas Tchai), which is the most considerable of the two, after forming the Lake of Apollonia (an extensive sheet of water), receives the waters of the Macestus a few miles lower down.

The streams which flow from the mountain mass of the Ida are of little importance in a geographical point of view, but two of them are of the highest interest from historical associations—the Granicus, so celebrated for Alexander's first victory over the Persians, and the still more famous Scamander, which flowed beneath the walls of Troy The first of these rivers rises in the northern slopes of Mount Ida, and flows northwards to the Sea of Marmora, after a course of little more than 40 miles. It is now called the Khodja Tchai, but it is a very inconsiderable stream. The Scamander has its sources in Kaz-dagh, the highest part of Ida (Mount Gargarus), and flows at first towards the west, but then turning northwards, pours its waters into the Dardanelles, near the point of Kum Kaleh, which marks the entrance into that remarkable strait.

The western portion of Asia Minor, between the Gulf of Adramyttium and the frontiers of Caria, is traversed by four considerable streams, which flow through parallel valleys from the uplands of the interior to the Ægean Sea. The most northern of these is the Caicus, now called the Bakyr Tchai, which rises in the chain of the Demirdji-dagh (Mount Temnus), and flows through the whole of Mysia, passing within about 5 miles of the city of Pergamus, and falling into the sea about 20 miles below that city, between the sites of Pitane and Elæa. Much more important, as well as more celebrated, is the Hermus, now known as the Ghediz Tchai, from the town of Ghediz, the ancient Cadi, in Phrygia, near its sources. These are derived from the two mountain masses called Ak-dagh and Morad-dagh, the latter being the more considerable stream. After their junction the river flows in a S.W. direction for about 30 miles, and then turns due west; it traverses the volcanic district of the Katakekaumene, and emerges below Adala into the broad and fertile valley, through which it continues to flow to the sea. It passes only about 5 miles to the north of the celebrated city of Sardis, and almost close to that of Magnesia. It appears to have in ancient times pursued its westerly course to the sea, which it entered near Phocæa; but at the present day it makes a turn abruptly to the S., and enters the Gulf of Smyrna about 10 miles from that city. Its only important tributary is the Hyllus, called also the Phrygius, which joins it at Magnesia from the N.E., having its sources above Thyatira. The Pactolus, so famous for its golden sands, which flows under the walls of Sardis, is a very trifling stream.

Next in order, proceeding south, comes the Cayster, a stream very inferior in magnitude to the Hermus and Mæander, which rises in the knot of mountains at the junction of Mount Messogis and Tmolus, and flows through a broad, fertile valley for above 70 miles, till it enters the sea just below Ephesus. It is now called the Kutschuk Mender or Little Mæander. The true Mæander (now called Bojûk Mender, or Great Mæander) is much the most considerable of the four rivers. It takes its rise at Apamea (previously called Celænæ) in Phrygia, above 175 miles in a direct line from its mouth, and is derived from abundant sources of water, so as to form a deep and clear stream almost immediately below its origin. Thence it flows for some distance to the N.W. as far as the site of Peltæ, where it receives a tributary called the Sandukli Tchai (the ancient Obrimas), sometimes erroneously regarded as the main stream, and there, turning to the S.W., pursues a course a little to the southward of west to the sea. It preserves this general direction with no great change, the numerous windings for which it was famous in antiquity being of no great magnitude or extent, but after passing through a series of mountain gorges between Peltæ and Tripolis, it emerges into a broad and rich alluvial valley, through which it holds its winding course to the sea. This valley is bounded immediately on the north by the lofty range of Mount Messogis, the streams descending from which have only a very short course, and the Mæander, in consequence, receives no affluents of any importance from this side. From the south, on the contrary, it receives several considerable tributaries, which have their sources in the mountains of Caria. The most important of these are the Tchoruk Su, which flows by Colossæ and Laodicea, the Arpas Su (the ancient Harpasa), and the Tchinar Tchai (the Marsyas of ancient writers), which rises in the mountain mass of Boz dagh, on the confines of Caria and Lycia, and flows by the site of Alabanda at Arab Hissar. The total course of the Mæander is estimated at about 240 miles.

All these rivers which we have just been considering are remarkable for the great amount of alluvial matter which they bring down, and the extensive deposits which they in consequence form where they enter the sea. Thus the Cayster, though the least considerable of the four, has not only filled up the port of Ephesus, but has pushed forward the shore for more than two miles beyond its site. The Mæander has blocked up the deep gulf formerly extending inwards from near Miletus to the foot of Mount Latmus, so as to convert the inner portion of the gulf into a lake, while it has entirely filled up the port of Miletus, united the island of Lade with the mainland, and formed a broad space of alluvial marshes extending thence to the foot of Mount Mycale. At the present day the alluvial deposits are advancing with such rapidity in the Gulf of Smyrna as to threaten Smyrna with the same fate as has befallen Miletus.

Of the rivers of Lycia the only one which deserves notice is the Xanthus, which rises in Mount Taurus, and falls into the sea about 12 miles below the city of the same name. But a much more considerable stream is that now known as the Gerenis Tchai, which rises on the northern side of Mount Taurus, at a short distance from the sources of the Xanthus, and flows in a northerly direction through the upland district of Cibyra, then turns suddenly round, and pursues a course about S.S.W., traversing the whole of the mountain region on the borders of Caria and Lycia, until it falls into the sea between Caunus in Caria and the Gulf of Macri. It was called Calbis in the lower part of its course, and Indus in the upper, but ancient geographers were apparently not aware that the two were in fact the same river.

The rivers which flow from the main chain of Taurus to the Mediterranean are very numerous, and many of them in winter bring down a large body of water. But they have necessarily but short courses, and few of them have much geographical importance. Of those which traverse the plain of Pamphylia it will be sufficient to mention the Cestrus and the Eurymedon, both of them considerable streams, pursuing parallel courses to the sea, which they enter within less than 20 miles of one another. The one flows beneath the ruins of Perge, the other by those of Selge and Aspendus. The rugged and mountainous country of Cilicia, which adjoins Pamphylia on the east, is furrowed by numerous streams flowing through deep and narrow valleys, the largest of which is the Calycadnus (now called the Gök Su, or "Blue River"), which has a direction nearly from W. to E., taking its rise in a lofty spur of Mount Taurus that advances close to the sea, so that its sources are not more than about 20 miles from the sea at Alaja, while it has a course of more than 100 miles (in a direct line) from thence to its mouth. It falls into the sea about 12 miles below Seleucia (still called Selevke), and is a deep and rapid stream of considerable magnitude.

The broad alluvial plain which forms the eastern portion of Cilicia is traversed by several rivers, two of which, the Sarus and Pyramus, now known as the Sihun and Jihun, are among the most important rivers of Asia Minor. Both of them alike take their rise far in the interior, in the high lands beyond the Taurus, and force their way across that great chain through deep and narrow gorges. The Sarus is indeed formed by the junction of two branches, both of which descend from the ranges of the Anti-Taurus through two parallel valleys, and after traversing for a long distance the mountain gorges, pour their united waters into the plain about 20 miles above the town of Adana. The Pyramus takes its rise in the upland district called Cataonia, near the modern town of Albistan, flows by Marasch, where it receives a considerable tributary from the east, bringing with it the waters of some small lakes on the reverse of the mountains of Commagene, and after passing near the ruins of Anazarbus, falls into the Gulf of Issus or

Scanderoon. Both these rivers have formed great alluvial deposits at their mouths, and it is probable that they have repeatedly altered their channels in flowing through the plain. Hence the accounts of them found in ancient authors are very contradictory. The Cydnus, which flowed by Tarsus, is a very inferior stream to those just described, though its name is perhaps better known than either of them. It rises in the mass of Mount Taurus called the Bulghar-dagh, and has a course of not more than 50 miles to the sea, but is a clear and rapid river.

Lakes.—The lakes of Asia Minor are numerous, but of no great importance. The most extensive is the great salt lake already noticed, on the borders of Lycaonia and Cappadocia, which is bounded on the east by a considerable range of mountains called Khodja-dagh, while on the west it is separated only by some low hills from the broad upland plains, or steppes, of Lycaonia. Beyond these to the west, but separated from them by the range of the Emir-dagh, is a string of three lakes of no great extent, having a general direction from N.W. to S.E., and following the line of the valley of Phrygia Paroreios. They bear the names of Eber Göl, Ak-Shehr Göl, and Ilgun Göl, and are all basins of fresh water passing into mere marshy pools during the dry season. Much more important than these are the two lakes now known as the Egerdir Göl and Kereli Göl (from towns of those names built upon their banks), which are situated between the range of the Sultan-dagh and the northern offshoots of the Taurus, and are both of them extensive mountain lakes of not less than 30 miles in length. The northernmost of the two (the Egerdir Göl, which is described as the most picturesque and beautiful of the lakes of Asia Minor) is situated at an elevation of about 2800 feet above the sea, while the level of the neighbouring Kereli Göl, which is separated from it by an intervening range of mountains, is at least 800 feet higher. Both are perfectly fresh, and their waters clear and deep, though the one has no outlet, and the other communicates only by a small rivulet with the much smaller lake called Soghla Göl, the waters of which occasionally disappear altogether. They are without doubt carried off by subterranean channels. About 30 miles S.W. of the Egerdir Göl is the Lake of Buldur, adjoining the town of that name, and at a short distance north of this lies the Tchoruk Su Gol, or Lake of Chardak, the waters of which are extremely salt, so that large quantities of salt are collected there, and sent from thence to Smyrna.

In the north western portion of Asia Minor, within the confines of Mysia and Bithynia, are situated three lakes of a wholly different character from the preceding, but havin much the same features in common. These are the Lake of Nicæa (still called Isnik Göl), the Lake of Apollonia (Aboulonia Gol), and the Lake of Miletopolis (Manyas Gol) All these are within a few miles of the Sea of Marmora, into which they discharge their waters. The Lake of Apollonia (which is rather the largest of the three) is formed principally by an expansion of the river Rhyndacus, which may be considered as flowing through it. The Lake of Nicæa, on the contrary (called also Lake Ascania), is a mere basin formed by the streams which descend from the surrounding mountains, and discharging its waters into the neighbouring Gulf of Moudania by a channel only about 10 miles long. The lake itself does not exceed 20 miles in length.

Climate and Natural Productions.—The climate of Asia Minor necessarily presents great differences. All travellers have remarked on the striking contrast as they passed from the warm and fertile regions of the west and south to the cold and bleak uplands of the interior. The great central plateau, which constitutes so large a part of the country, is not only much colder than regions in corresponding latitudes in Europe, but is characterised by a great dryness, in consequence of the moisture from the Mediterranean being in great part intercepted by the continuous mountain chain of the Taurus. The result of this, combined with its great elevation above the sea, is to render the summers excessively hot, and the winters extremely cold. In both these respects the climate of the central parts of Asia Minor presents a close analogy with that of Central Spain, as well as with the still more extreme case of the neighbouring Armenia. On the other hand, the plains and low valleys on the south coast, which are in a latitude corresponding to that of Sicily and the south of Spain, have a mean temperature considerably higher than those countries, and the summer heat at Tarsus is said greatly to exceed that of Cadiz or Gibraltar, and to be nearly equal to that of Cairo. Systematic observations for any length of time are, however, almost wholly wanting. The north coast, on the contrary, is subject to the depressing influence of the cold winds and fogs of the Euxine, which, as is well known, bring down the mean temperature of Constantinople (and still more its winter temperature) far below that of places in corresponding latitudes on the Mediterranean. This effect is, however, found to diminish as one proceeds eastward along the shores of the Euxine; and the climate of Trebizond, which is situated almost exactly in the same latitude with Constantinople, is much milder than that of the capital, or of the neighbouring city of Broussa,—a result, doubtless, produced by the sheltering action of the great range of the Caucasus, which prevents the cold winds from the steppes of Russia to the N. and N.E. from sweeping down on the eastern angle of the Black Sea. The western districts of Asia Minor are in all respects the most favoured, and the coasts of Ionia and Caria may be considered as enjoying one of the finest climates to be found in any part of the Mediterranean. The action of the cold north winds from Thrace and the Bosphorus is, however, still felt as far south as Smyrna, and the winters at that place are somewhat colder than those in corresponding latitudes in Spain and Sicily.

The vegetation of the different parts of the peninsula naturally varies with the climate and the soil. The southern coasts present most of the plants and shrubs characteristic of the southern portions of the Mediterranean, with the exception of the prickly pear and American aloe (both of them originally exotics imported into Europe), which form so important a feature in the landscape of Sicily and the south of Spain, as well as of Syria, but are very rare in Asia Minor, while the dwarf palm (*Chamærops humilis*) is wholly wanting. The date palm is occasionally found, but does not ripen its fruit even at Tarsus, where the summer temperature is almost tropical. The vegetation of Lycia, which occupies an intermediate position between the hot plains of Pamphylia and Cilicia and the comparatively temperate western provinces, is thus described by Forbes:—

"The wild olive covers the hills, wherever the pine (*Pinus maritima* and *halepensis*) and the arbutus leave room The valonea oaks (*Quercus Ballota, Ægilops*, and *infectoria*) afford ample shade. The mastic, the fig, and the mulberry are not unfrequent, both cultivated and wild. The Oriental planes afford abundant shade near every village; and the dark and towering cypress is planted by the place of burial, but grows wild in the ravines The pomegranate flourishes in great abundance, and its wild fruit supplies a grateful refreshment under the warm sun of autumn The almond and manna ash grow wild among the rocks, and the bay and Judas-tree in the ravines The orange and the lemon are cultivated. Melons, cucumbers, sesame, maize, cotton, capsicum, lentils, kidney-beans, and balmias (*Hibiscus esculentus*), are the common cultivated vegetables "—(Spratt and Forbes's *Lycia*, vol. ii. p. 152.)

Higher up on the mountain slopes and the uplands facing the sea is the chief realm of the oak and pine forests, with which a large part of the chain of Taurus is covered. The walnut is the most plentiful and conspicuous tree around the villages, while vineyards and tobacco fields yield rich produce. The high upland plains, on the contrary, are generally bare and treeless, but the villages are frequently surrounded with walnut trees, Lombardy poplars, apples, apricots, and willows. The vine is still grown in many spots in these elevated regions, though in others it will not thrive. Large tracts of the table-land of the interior, as has been already mentioned, are either quite barren and desolate, or open treeless downs, affording pasture only to sheep. But it is probable that they would be capable of producing abundant crops of corn (like the similar tracts of Central Spain) if properly cultivated, except in a few districts, such as the steppes of Lycaonia, where the soil is strongly impregnated with salt.

The northern coast districts present a wholly different climate, and from the influence of the Black Sea and the cold of Russia, have much more of the character of the temperate regions of Europe than of that of Rome or Naples which correspond to them in latitude. But the mountains are covered with extensive forests of oaks, chestnut, beech, box, and other trees, while the valleys produce fruit trees in extraordinary abundance and variety. This is the case especially in the province of Pontus, extending eastward from near Sinope to Trebizond, which is a country of singular beauty and great fertility, notwithstanding its mountainous character. This region is supposed to be the native land of many of our well-known fruits, especially cherries and apricots. The hills also are covered with medlars, apple, pear, and plum trees, all growing wild, but cultivated also with great success in the neighbourhood of the villages and towns. The olive also thrives in sheltered situations, though it is not found west of Sinope. At the same time, the luxuriant undergrowth of rhododendrons and azaleas, besides bay, myrtle, arbutus, and other flourishing shrubs, gives a special charm to the scenery of this beautiful region.

Among the vegetable productions that are of importance in a commercial point of view may be mentioned saffron, which is so largely cultivated at a town in Bithynia as to have given it the name of Safaranboli; opium, which has in like manner given name to Afiom Kara Hissar; madder, extensively grown at Ak Shehr; the orchis called salep; and cotton, of which considerable quantities are now produced in the warmer districts near the sea. Mulberries also are extensively cultivated, and large quantities of silk produced in the neighbourhood of Broussa, where there are now established large silk manufactories, as well as at Tokat, Amasia, and other places. The dried figs and raisins for which Smyrna is so celebrated are grown principally in the valley of the Mæander near Aidin.

The wild animals of Asia Minor are in general the same as are found in most parts of Europe, though a few mark its connection with the more eastern parts of Asia. Wolves, wild boars, bears, foxes, are abundant; but with them is associated the jackal, which is found in large troops in all parts of the country. The lion, which was certainly an inhabitant of Asia Minor in ancient times, is no longer found in any part of the peninsula, and though the tiger is said to exist in the Cilician Taurus, the fact does not rest on any good authority. But leopards still occur not unfrequently in the mountain country of the Taurus, and from thence range along the mountains to the west, so that they have been occasionally shot even in the neighbourhood of Smyrna. The high mountains are frequented by the ibex and chamois, while the true wild goat (*Capra Ægagrus*) is found on those of Cappadocia and Cilicia. The moufflon, also, is not uncommon in Cappadocia; but the wild ass, which existed there in the time of Strabo is no longer found within the limits of the peninsula The gazelle abounds in the plains of Cilicia, while both fallow and roe deer are found in the forests in large numbers. In regard to the domestic animals, the remark of Professor Forbes, that in Lycia the introduced camel and buffalo, both unknown to the country in ancient times, now play a more important part than the aboriginal quadrupeds, may be extended to the greater part of Asia Minor. Enormous numbers of sheep are, however, reared on the vast plains of the interior, as well as in the level parts of Cilicia, though they no longer retain the celebrity they enjoyed in antiquity for the fine quality of their wool. This, however, supplies the material for the celebrated Turkish carpets, the principal manufactory of which is at Ushak in Phrygia. Not less celebrated is the breed of goats peculiar to the neighbourhood of Angora, the hair of which is worked up into shawls but little inferior to those of Cashmere. No trace is found of the existence of any such peculiar race in ancient times, or even in the Middle Ages, and the period of its introduction is unknown. In comparison with the sheep and goats, cattle occupy but a subordinate position in Asia Minor; and though the plains of the interior, and still more those of Cilicia, were celebrated in ancient times for the number and beauty of the horses reared on them, nothing of the kind is now to be found, and the horses of Asia Minor are generally of an inferior description.

The geology of Asia Minor is still very imperfectly known, very few districts having been as yet examined in detail; but the researches of Hamilton, Ainsworth, and Tchihatcheff, and of Edward Forbes in Lycia, have thrown much light on the subject, and enabled us to form a general notion of the structure of the country. The great mass of the chain of Mount Taurus, and of the subsidiary ranges connected with it, consists, as has been already noticed, of the formation known as Apennine limestone, which is generally referred by geologists to the Cretaceous period. No sedimentary formations of older date are known to exist in the southern parts of the peninsula, but in the northern districts this is replaced by saccharine limestones and mica schists, with other metamorphic rocks, which are probably to be assigned to a much earlier period. The great table-land of the interior is composed for the most part of a vast lacustrine or fresh water formation belonging to the Tertiary period; and large portions of similar fresh water tertiaries, detached from the great central mass, are found scattered between its borders and the coasts, in some instances descending quite to the sea, as in the neighbourhood of Smyrna. But in the interior the lacustrine limestones and marls are frequently intermixed with extensive deposits of volcanic tuffs, the soft materials of which are rent by water-courses into deep and narrow glens, often studded with cones and pinnacles, presenting a great variety of picturesque and singular forms, and constituting one of the most peculiar features of the scenery of Asia Minor. Igneous rocks are found scattered through almost all parts of the peninsula, and the remarkable chain of volcanic mountains extending from Mount Argæus to the Kara-dagh near Karaman has been already noticed. All these mountains are of a trachytic character, and apparently belong to the Tertiary period; but there is a district on the borders of Phrygia and Lydia which presents volcanic phenomena of a much later date. It was known in ancient times as the Katakekaumene, or Burnt country, and its volcanic character was fully recognised by Strabo, though we may infer from his silence that there was no record of any eruption within the historical period. It has been fully described by Mr Hamilton, and presents three conical black hills of scoriæ and ashes, with well-defined craters, from which have flowed broad streams of rugged black vesicular lava, the surfaces of which are as barren and as little influenced by atmospheric action as the latest products of Vesuvius, so that if it were not for the negative evidence to the contrary, they might be well supposed to belong to a recent historical period. Igneous rocks of an older character are found in many parts of Asia Minor; those in Lycia are principally serpentine, while in the north-western districts various forms of trachyte prevail, and several of the minor ranges which rise out of the great central table-land are of granitic character.

Towards the sources of the River Halys is an extensive formation of saliferous red sandstones with gypsum, which would doubtless yield abundance of salt, were not that article more readily procured from the salt lakes already mentioned. Coal is found in the neighbourhood of Heraclea on the Black Sea, and was worked to some extent during the Crimean War. There is little doubt that Asia Minor is rich in minerals, but they are nowhere worked to much purpose. Iron ores of very good quality are still found in abundance in the country of the Chalybes, so celebrated among the Greeks for their skill as workers of iron, and they are still worked in a very primitive fashion by the inhabitants. The district of Cibyra, also, which was noted in the days of Strabo for its iron manufactories, still produces iron ores in plenty, of the same kind as those of Elba, but they are altogether neglected. The copper and silver mines of the north, though partially worked, are of very little importance. The same neglect has befallen the numerous quarries of marble, which attracted so much attention in the time of the Romans, and among which those of Proconnesus (the island of Marmora) and those near Synnada (Afiom Kara Hissar), producing the kind known as Phrygian marble, were the most celebrated.

Though Asia Minor had no active volcanoes it was subject in all ages to frequent and severe earthquakes. The most remarkable of these was one which occurred in 17 A.D., during the reign of Tiberius, and which almost entirely destroyed twelve considerable cities, including Magnesia and Sardis. Laodicea, also, was peculiarly subject to these visitations, which Strabo sagaciously connects with the evidences of recent volcanic action in the Katakekaumene. Thermal springs are found in many parts of the peninsula, but the most remarkable are those of Broussa, which from their proximity to Constantinople are still much frequented, and those at the ancient Hierapolis, the site of which is now utterly deserted.

Ancient Divisions and Ethnography.—The division of Asia Minor which is commonly adopted by geographers, and which is followed in the present article, is that given by Strabo, which coincides in the main with those of Ptolemy and Pliny. According to this the whole peninsula is considered as comprising—1. Pontus, on the Euxine, adjoining the frontiers of Armenia, and extending west as far as the Halys; 2. Paphlagonia, from the Halys to the Parthenius; 3. Bithynia, from the Parthenius to the Rhyndacus; 4. Mysia, which, with the subordinate districts of the Troad and Æolis, or the land occupied by the Æolian Greek colonists, comprised the north-western angle of the peninsula; 5. Lydia, of which Ionia in like manner formed the sea coast; 6. Caria, including the Dorian Greek colonies; 7. Lycia; 8. Pamphylia; 9. Cilicia—the last three provinces extending along the southern coast, from the Gulf of Macri to the frontiers of Syria; while in the interior were—10. Pisidia, comprising only the rugged mountain country above Pamphylia; 11. Phrygia, forming the western portion of the great table-land; 12. Galatia; 13. Cappadocia; 14. Lycaonia and Isauria, two barren and mountainous regions on the north side of Mount Taurus. (For farther particulars as to the extent and limits of these different regions the reader must be referred to the respective articles.)

The system thus adopted by Strabo, and which appears to have been already generally received in his time, was, properly speaking, merely a geographical one. It did not coincide with the political or administrative divisions of the country, either in his time or for at least three centuries earlier. Though some of the countries enumerated—as Bithynia and Cappadocia—had continued down to a late period to form independent sovereignties, the limits of which were well established, the greater part of the peninsula had undergone many fluctuations and changes, the different provinces passing at one time under the kings of Syria, at others under those of Pergamus, and being transferred by the Romans in an arbitrary manner from the rule of one potentate to another. And when the Romans had established their own dominion over the greater part of the peninsula, it was long before the division of it into provinces had assumed a definite and settled form. But the Roman province of Asia, as it existed from the days of Cicero to those of Strabo, may be regarded as comprising Mysia, Lydia, Caria, and Phrygia, but excluding Lycia, Pisidia, Galatia, and Bithynia, so that it contained much less than half of Asia Minor, with which it is sometimes erroneously supposed to have been identical.

The divisions of the country thus generally recognised were in fact (with one exception) ethnographical ones, or at least had been so originally. Herodotus, the earliest writer from whom we have any information on the subject, describes Asia within the Halys, as containing fifteen different races or nations, including the Greek settlers; and of these the Cilicians, Pamphylians, Lycians, Carians, Lydians, Mysians, Bithynians, Paphlagonians, and Phrygians undoubtedly then occupied the countries which long after retained their names. East of the Halys lay the Cappadocians, who in his time occupied the whole country from the frontiers of Cilicia to the Euxine. It was not till a later period that the northern portion of this extensive country came to be known and distinguished from the rest as Cappadocia on the Pontus, and eventually under the designation of Pontus alone. Galatia, on the other hand, derived its name from the Gauls, who established themselves in that country about two centuries B.C., and continued to retain their language and nationality down to a late period of the Roman empire. The Lycaonians, Isaurians, and Pisidians are not noticed by Herodotus; probably the names of these obscure mountain tribes had never yet reached the ears of the Greeks.

Our information concerning the origin and ethnographical relations of the nations that we thus find occupying the peninsula at the earliest period is very imperfect, and rests almost wholly on the vague statements of ancient authors, none of the nations in question, with the exception of the Lycians, having left any trace of their language. But according to the distinct and uniform assertion of ancient writers, the Bithynians were of Thracian origin, and identical with the people who were separated from them by the narrow strait of the Bosphorus—a statement in accordance with the natural probability of the case. The same probability may be alleged also in favour of the Thracian origin of the Mysians, which is asserted both by Herodotus and Strabo, though they would appear to have settled in the peninsula at a much earlier period than the Bithynians. Much less value can be attached to the traditions concerning the original connection between the Mysians, Lydians, Phrygians, and Carians, which would assign a common Thracian origin to all these nations. The Carians indeed were, according to the more prevalent opinion among the Greeks, later immigrants from Crete and the adjoining islands—a theory certainly not supported by internal probability. But there seem strong reasons for regarding the Carians, like their neighbours the Lycians, as a peculiar people, distinct from all who surrounded them. The Lycians, as already mentioned, are the only people of Asia Minor who have left us the means of judging of their ethnic affinities by the remains of their language. From these we learn that they were an Aryan race, apparently more nearly connected with the Persians than with the Greek or other Pelasgic races. But besides the Lycians, there existed within the province of Lycia a tribe called the Solymi, who were generally considered as of Syrian or Semitic origin. The fact does not appear in their case to rest upon any sufficient authority, but the connection of the Cilicians, who held so large a part of the south coast, with the Syrians and Phœnicians, may be considered as well established. All ancient writers, moreover, agree in describing the Cappadocians, who originally extended from Mount Taurus and the frontiers of Cilicia to the Euxine, as a Syrian race, so that they were at first called by the Greeks Leucosyri, or White Syrians, to distinguish them from their darker brethren farther south. Whether the mountain tribes of the Pisidians, Isaurians, and Lycaonians were connected with the Cappadocians or with the Phrygians, or to what other race they belonged, we have no information whatever.

The population of Asia Minor at the present day can hardly be said to retain any traces of the earlier nations that composed it, though, according to some writers, the Zeybeks,—a race presenting some marked peculiarities, who occupy the south-western corner of the peninsula—are the lineal representatives of the ancient Carians. They, however, speak only Turkish. The bulk of the population is composed of Turks, Greeks, and Armenians, among whom the Turks preponderate greatly in numbers, and (unlike what is the case in European Turkey) compose the mass of the agricultural and rural population, while the Greeks and Armenians are found principally in the towns, where almost all the trade is in their hands. But besides these elements, which constitute the fixed and permanent population of the peninsula, there is a considerable portion consisting of nomad and half nomad tribes, which are known under the names of Turcomans, Yourouks or Eurnques (the name is very variously written), and Kurds. The last of these are found principally in the eastern and south-eastern districts, the Turcomans in the north-eastern and central provinces, and the Yourouks in the west and south-west of the peninsula. They are all exclusively pastoral races, but the Turcomans have in general their villages in which they spend the winter months, wandering over the great plains of the interior with their flocks and herds during the summer months. The Yourouks, on the contrary, are a truly nomad race, dwelling all the year round in tents, and removing from place to place according to the season. Their tents are made of black goats' hair, and their principal covering is a heavy cloak of the same material. Besides large flocks of sheep and goats, they breed many camels, and one of their principal occupations is burning charcoal, in the course of which they do enormous injury to the forests. They are by no means limited to the wilder districts of the interior, but when the harvest is over descend into the rich plains and valleys near the coast, through which they wander almost without restraint, and their black tents are often to be seen within a few miles of Smyrna. Though distinguished at the present day by certain peculiarities from the Turcomans, the Yourouks are apparently of Turkish origin, and speak a Turkish dialect. The Kurds, on the contrary, who are merely a wandering offshoot of the race that occupies the great mountain tract called Kurdistan, extending from the borders of Cappadocia between Armenia and Mesopotamia into Persia, speak a wholly different language, and belong altogether to a different race. They are, however, confined to the border districts on the eastern frontier of Asia Minor, and to Cilicia, where the tribes that have their summer encampments in the neighbourhood of Cæsarea descend to pasture their flocks in the winter.

History.—It is remarkable that a country like Asia Minor, possessing such great natural advantages, and to a great extent so clearly limited by nature, can hardly be said to have any history of its own. It was never at any period united under one independent sovereign, but was always either divided among a number of minor potentates, or, as under the Roman, Byzantine, and Turkish rule, constituted merely a subordinate portion of a more extensive empire. Its western and northern shores were from a very early period occupied by Greek colonies, which gradually formed an almost unbroken chain of settlements along its coasts and islands from Rhodes to Trebizond. But these exercised comparatively little influence upon the nations of the interior; and the first historical event that can be considered as affecting the fortunes of the peninsula in general, was the rise of the Lydian monarchy, which attained to so great a predominance that for a short time Crœsus, the last monarch of the dynasty (560–546 B.C.), had subdued the whole of Asia Minor west of the Halys with the exception of Lycia. But having, unfortunately, engaged in war with Cyrus, king of Persia, he was entirely defeated, and his dominions conquered by the Persian monarch. From this time the whole of Asia Minor, from the frontiers of Syria to the Hellespont and the Bosphorus, continued for more than two centuries to form part of the Persian monarchy, until its overthrow by Alexander the Great, 333 B.C. It was during this period divided into satrapies, the boundaries of which were, however, very uncertain and fluctuating, like those of the Turkish governments in modern days. In the division of the Macedonian empire after the death of Alexander, Asia Minor became a chief object of contention among his generals, but was ultimately included in the dominions of Seleucus, and the greater part of the peninsula continued for a considerable period to be subject to the Seleucidan kings of Syria. A small independent monarchy had, however, been established at Pergamus, soon after 280 B.C., and when the Romans entered Asia, and defeated Antiochus III. at the battle of Magnesia (190 B.C.), they transferred a considerable part of his dominions to Eumenes, king of Pergamus, whose kingdom was thus extended to the Taurus. The monarchy of Pergamus thus constituted continued to subsist till after the death of Attalus III., when it was annexed to the Roman dominions under the name of the province of Asia (130 B.C.) Bithynia, however, still continued a separate kingdom, as did also Pontus, which for a short period rose under the great Mithridates to be a really formidable power. But after the defeat and death of Mithridates, in 63 B.C., the greater part of his kingdom, as well as that of Bithynia, was annexed to the Roman dominion; and though some petty dynasties were allowed to linger on till after the Roman empire, the whole of Asia Minor was virtually subject to Rome from the time of Augustus. There ensued a long period of tranquillity and prosperity under the Roman and Byzantine empires, during which it suffered less than almost any other part of the empire from the inroads and ravages of barbarians. Even after the rise of the Mahometan power, though Asia Minor was repeatedly traversed by the armies of the Arab conquerors, who twice laid siege to Constantinople, it was never permanently annexed to the dominion of the caliphs, like the adjoining provinces of Syria and Mesopotamia, and the whole country, as far as the passes of Mount Amanus, continued subject to the Byzantine empire, until it was overrun by the Seljukian Turks in 1074 A.D.

The conquest of Asia Minor by the Turks was not a mere passing inroad, but a permanent occupation of the country, in which they established themselves in such numbers that they have ever since formed the predominant element in the population, and have to a great extent supplanted or absorbed all the previously existing races. But the dynasty of the house of Seljuk, established by the first conqueror Soliman, who had fixed his capital at Nice, within 100 miles of Constantinople, did not long retain its undivided sovereignty, and its power was broken by the armies of the first Crusade (1097 A.D.), which took Nice, defeated the Turks in a great battle at Dorylæum, and then swept over the land almost without opposition, up to the very walls of Antioch. The Byzantine emperor recovered possession of the whole circuit of the coast, from Trebizond to the Syrian gates; and the Seljukian sultans of Roum, as they termed themselves, who had removed their capital to Iconium, in the heart of the interior, found themselves cut off from the sea on all sides. Their dominion was gradually broken up, and divided among a number of small independent chieftains, until the rise of the Ottoman dynasty at the commencement of the 14th century once more consolidated the power of the Turks in Asia. The history of Asia Minor from this period is inseparably connected with that of the Turkish empire, and will be given under the head of TURKEY. To the same article we must refer our readers for the modern division of the country and the present system of administration, as well as for such statistical information concerning its present state as it is possible to collect in the absence of all official or trustworthy authorities.

At the commencement of the present century our information concerning Asia Minor was extremely imperfect. The survey of the southern coast by Captain Beaufort (published in his *Karamania*, 4to, Lond. 1817), was the first contribution to a sound knowledge of any part of the country; and the work of Colonel Leake (*Journal of a Tour in Asia Minor*, 8vo, Lond. 1824), in which he embodied a careful review of all the information then existing, and applied it to the comparative geography of the peninsula, became the basis of all subsequent researches. Since then the labours of successive travellers have thrown a great deal of light upon the subject, and most parts of the peninsula have been visited and described, though the materials for a good map are still wanting, and there exists no satisfactory geographical or geological description of many parts of the country. For further information and details our readers may consult Arundel's *Visit to the Seven Churches*, 8vo, Lond. 1828, and his *Discoveries in Asia Minor*, 1834; Hamilton's *Researches in Asia Minor, Pontus, and Armenia*, 2 vols. 8vo, Lond. 1842; Fellows's *Excursion in Asia Minor*, Lond. 1839, and his *Discoveries in Lycia*, Lond. 1841; Ainsworth's *Travels in Asia Minor*, 2 vols., Lond. 1842; Spratt and Forbes's *Travels in Lycia*, 2 vols., Lond. 1847; Langlois's *Voyage dans la Cilicie*, 8vo, 1861; C. T. Newton, *Travels and Discoveries in the Levant*, 2 vols., Lond. 1867.

The work of M. Tchihatcheff (*Asie Mineure—Description Physique, Statistique, et Archéologique*, 3 vols., 8vo, Paris, 1853–60), the result of several years' explorations in different parts of the country, and the first attempt at a systematic description of Asia Minor, has unfortunately never been completed. The first volume (published in 1853) contains by far the best description that has yet appeared of the physical geography of the whole peninsula; the second and third are devoted to the meteorology, zoology, and botany; but those which should have contained the geology and the archæology have never been published. (E. H. B.)

Alphabetical Index.

ASKEW, or ASCUE, ANNE, one of the numerous sufferers for the cause of the Reformation in the reign of Henry VIII., was a lady of great worth and beauty, of a good family in Lincolnshire, and in correspondence with Queen Catherine Parr and the chief ladies of the court. At first a Roman Catholic, she had gradually become convinced of the falsity of transubstantiation; and her husband, irritated at her change of religious opinions, compelled her to leave his house. On coming to London to seek for a divorce she was arrested, and interrogated by Chancellor Wriothesley and Bishop Bonner, at the instigation of whom, under threats of torture, she signed a qualified recantation. She was imprisoned, and wrote to the king, says Hume, "that as to the Lord's Supper she believed as much as Christ himself had said of it, and as much of His divine doctrine as the Catholic church had required." But while she could not be brought to acknowledge the king's explications, this declaration availed her nothing, and was rather regarded as a fresh insult. She was cruelly racked in the presence, and it was said by the hand, of the chancellor himself, in order to extort confession of those ladies about court with whom she corresponded. Her fortitude and fidelity probably saved the lives of the queen and others. She disclosed nothing, although her limbs were so dislocated by the rack that, when condemned to be burnt alive she could not stand, and was carried in a chair to Smithfield, where on 16th July 1546, she and four others underwent this terrible mode of execution with undaunted courage.

ASMAI or ASMAYI (full name, ABU SAÏD ABD-EL-MELEK IBN KORAÏB EL-ASMAÏ), is one of the most important representatives of Arabic literature in the 8th century of the Christian era. He was born at Basra 740 or 741 A.D, and attained, by his extensive erudition, to the high rank of preceptor to Harun al-Rashid, whose court was in that generation the great focus of intellectual activity in the East. Asmai was, as has been happily remarked by Barbier de Meynard, the almost perfect type of those nomadic devotees of literature who, after they had grown pale on the benches of Basra or Kufa, went to complete their education in the desert, in possession of boundless stores of learning, and yet animated by an enthusiasm for further acquisition, which made them willing to travel across the sands for hundreds of leagues, if only they might preserve an ancient tradition or pick up the fragments of an ancient song. Of the results of his labours he was no niggard, and a long list might be drawn up of his various productions. It is sufficient, however, to mention his synchronous history of the kings of Persia and Arabia previous to Islam—a work which Sir Henry Rawlinson has described as "perhaps the most valuable and authentic historic volume in the whole range of Arabian literature"—and his wonderful romance of *Antar*, which might almost be called the *Iliad* of the desert. He attained a good old age, dying, as is generally supposed, about 830 A.D., and left behind him a number of pupils, such as Thâlab, Ibn-el-Anberi, and Sukkari, who proved themselves worthy of their master.

ASMODEUS or ASCHMEDAI, an evil demon who appears in later Jewish tradition, and concerning whom there has been much vague and fanciful speculation. The name, probably, means the destroying angel or the tempter, but the etymological grounds for neither of these are quite certain. He is sometimes called the prince of demons, and identified with Beelzebub, but there are many other fables regarding his origin. In the apocryphal book of *Tobit* occurs the well-known story of his love for Sara, the beautiful daughter of Raguel, whose seven husbands were slain in succession by him on their respective bridal nights. At last Tobias, by burning the heart and liver of a fish, drove off the demon, who fled to Egypt. From the part played by Asmodeus in this story, he has been often familiarly called the genius of matrimonial unhappiness or jealousy. Le Sage makes him the principal character in his novel *Le Diable Boiteux*.

ASMONEUS, or ASSAMONEUS, the first of the dynasty or family of the Asmoneans, who ruled over the Jews for about 130 years. His great-grandson was the celebrated Mattathias (died 167 B.C.), the first of the Maccabees; and the direct line of princes descended from him was closed in 37 B.C. by the execution of Antigonus. Agrippa Herodes I. and II. were connected with the Asmoneans through their ancestress, Mariamne, wife of Herod the Great.

ASOLO, the ancient *Acelum*, a fortified town of Northern Italy, in the province of Treviso, about 19 miles distant from the city of that name. It is built in a beautiful and healthy situation, and possesses a cathedral and the ruins of a Roman aqueduct. In the neighbourhood is the former palace of Catharine Cornaro, queen of Cyprus, now turned into a dairy. Not far off is the quarry of Rocca. Population, 5437.

ASP (*Vipera aspis*), a species of venomous snake, closely allied to the common adder of this country, which it represents throughout the southern parts of Europe, being specially abundant in the region of the Alps. The term "Asp" (ἀσπίς) seems to have been employed by Greek and Roman writers, and by writers generally down to comparatively recent times, to designate more than one species of serpent, thus the asp, by means of which Cleopatra is said to have ended her life, and so avoided the disgrace of entering Rome a captive, is now generally supposed to have been the cerastes, or horned viper (*Vipera Hasselquistii*), of Northern Africa, a snake about fifteen inches long, exceedingly venomous, and provided with curious horn-like protuberances over each eye, which give it a decidedly sinister appearance. The species, however, to which the word "asp" has been most commonly applied, is undoubtedly the haje (*Naja haje*) of Egypt, a poisonous snake, from three to four feet long, with the skin of its neck loose, so as to render it dilatable at the will of the animal, as in the cobra di capello of India, a species from which it differs only in the absence of the spectacle-like mark on the back of the neck. Like the cobra, also, the haje has its fangs extracted by the jugglers of the country, who afterwards train it to perform various tricks. The asp (*Pethen*, פֶּתֶן) is mentioned in various parts of the Old Testament. This name is twice translated "adder," but as nothing is told of it beyond its poisonous character and the intractability of its disposition, it is impossible accurately to determine the species which the sacred writers had in view.

ASPARAGUS. The young shoots of *Asparagus officinalis* (Nat. Ord. *Liliaceæ*) have from very remote times been in high repute as a culinary vegetable, owing to their delicate flavour and diuretic virtues. The plant grows wild on the south coast of England; and on the waste steppes of Russia it is so abundant that it is eaten by cattle like grass. In common with the marsh mallow and some other plants, it contains a chemical principle called asparagin, to which it owes its medicinal qualities. The roots of asparagus were formerly used as an aperient medicine, and the fruits were likewise employed as a diuretic. Under the name of Prussian asparagus, the spikes of an allied plant, *Ornithogalum pyrenaicum*, are used in some places.

ASPASIA, a beautiful *hetæra* of Athens, celebrated in history by her connection with Pericles, was a native of Miletus, and settled in Athens, following the example of her countrywoman, Thargelia, who had become very famous during the time of the Persian wars. Her beauty, but still more her remarkable accomplishments, gained for her an extraordinary reputation, which was increased after her association with Pericles, who, having divorced his wife, united himself to Aspasia as closely as was possible under Athenian law, according to which marriage with a barbarian was illegal and impossible. Much of the administration of Pericles has been ascribed to her eloquent instruction and political sagacity, and her enemies did not scruple to lay to her charge the Samian and Peloponnesian wars. Although this exaggerates her power, yet her talents must have been extraordinary, for she drew to her house the most noble and learned in Athens, who were willing to learn from her. Even Socrates was not exempt from her influence. The political supremacy of Pericles, which exposed him to many assaults, attracted enmity to Aspasia. She was accused of impiety and other base crimes, and would probably have been condemned, had not the judges been swayed by the tears and entreaties of Pericles himself. After the death of that statesman's two sons by his lawful wife, he procured the passing of a law, by which the children of irregular marriages might be rendered legitimate. His son by Aspasia was thus allowed to assume his father's name. After the death of Pericles, Aspasia is said to have formed a similar connection with one Lysicles, wealthy, but of ignoble birth, whom she raised by her instructions to a prominent place in the state. This episode is somewhat obscure, especially as Lysicles seems to have fallen in battle in 428, the year after the death of Pericles. Nothing further is known of the history of Aspasia.

ASPASIUS, a Peripatetic philosopher, and one of the most prolific commentators on Aristotle, flourished probably towards the close of the 1st century A.D., or perhaps during the reign of Antoninus Pius. His commentaries on the *Categories*, *De Interpretatione*, *De Sensu*, and other works of Aristotle, are frequently referred to by later writers, but have not come down to us. Certain commentaries on Plato, mentioned by Porphyry in his life of Plotinus, have also been lost. Commentaries on the 2d, 4th, 7th, and 8th books of the *Nicomachean Ethics*, which pass under his name, were printed along with those of Eustratius and others by Manutius at Venice in 1536. They were translated into Latin by Felicianus in 1541, and have been frequently republished. The authenticity of part, and even of the whole, of these ethical commentaries has been disputed, and recently some fragments of another commentary by Aspasius on the *Ethics* have been printed. See *Classic. Jour.*, vols. xxviii., xxix.

ASPASIUS, a celebrated rhetorician and sophist, was born at Ravenna, and flourished during the early part of the 3d century A.D. He was the son (or, according to Suidas, the scholar) of the rhetorician Demetrianus; and, after a careful training in all the branches of a rhetorician's art, began to teach at Rome. For many years he filled the chair of rhetoric which had been founded by Vespasian. He travelled extensively in the suite of the emperor, as whose secretary he acted for some time. His orations, which are praised for their style, have been lost.

ASPEN TREE, called also the trembling-leaved poplar (*Populus tremula*), is a native of Britain, and is found generally in moist places, sometimes at a considerable elevation, 1600 feet or more, in Scotland. It flowers in Britain in March and April. The name "trembling" is applied to it on account of the constant movement of the leaves even with a gentle breeze. This mobility depends on the leaves being suspended by leaf-stalks flattened laterally, and when subjected to a slight wind, by their friction on each other they give rise to a rustling sound. It is supposed that the mulberry trees (*Becaim*) mentioned in 1st Chronicles xiv. 14, 15, were really aspen trees. The wood of the tree is white, and is made use of by turners. In France sabots are made of it; and the charcoal made from the wood is used in the manufacture of gunpowder. The leaves are in some countries of Europe employed as food for cattle, sheep, and goats.

ASPENDUS (or, as the name appears on the more ancient coins, ESTFENDYS), a city of Pamphylia, in Asia Minor, situated on an isolated hill near the river Eurymedon (*Capri-su*) at the extremity of the plain of Perga. It was founded by a colony from Argos, five centuries before the Christian era, and attained to great prosperity, as is attested, not only by the statements of Greek and Roman writers, but also by the noble ruins that still occupy the site. Of these the most remarkable is the theatre, which is regarded as more perfect than any other in Asia Minor, requiring but little restoration to render it fit once more for its ancient use. In the first precinct there are twenty-one rows of seats, and in the second eighteen, nearly all of them entire. The date of the building is assigned by an inscription to the time of Antoninus and Lucius Verus. An aqueduct of magnificent proportions, built, like the theatre, of the silicious conglomerate of the neighbourhood, still stretches across the plain; and the ruins of an agora and other erections are found on the hill. That the city was rich in valuable statues is mentioned by Cicero, who rhetorically accuses Verus of having plundered it of them all. It only appears occasionally in ancient history, as when its inhabitants surprised and assassinated Thrasybulus, and again when they surrendered to Alexander; but the populousness of the place is proved by the fact that it was able to furnish 4000 hoplites.

ASPER, HANS, a Swiss painter, was born in 1499 at Zürich, where he died on the 21st March 1571. He wrought in a great variety of styles, but excelled chiefly in flower and fruit pieces, and in portrait painting. Many of his pictures have perished, but his style may be judged from the illustrations to Gessner's *Historia Animalium*, for which he is said to have furnished the designs, and from portraits of Zwingle and his daughter Regula Gwalter, which are preserved in the public library of Zürich. It has been usual to class Asper among the pupils and imitators of Holbein, but an inspection of his works is sufficient to show that this is a mistake. Though Asper was held in high reputation by his fellow-citizens, who elected him a member of the Great Council, and had a medal struck in his honour, he seems to have been frequently in embarrassed circumstances, and there is reason to believe that he died a pauper.

ASPHALT, or ASPHALTUM (ἄσφαλτος, Aristotle, *Bitumen*, Pliny), the German *Bergpech*, or mineral pitch, so called from the Lacus Asphaltites or Dead Sea, where it was found in ancient times, is a product of the decomposition of vegetable and animal substances. It is usually found of a black or brownish-black colour, externally not unlike coal, but it varies in consistency from a bright pitchy condition, with a sharp conchoidal fracture, to thick viscid masses of mineral tar. Asphalt melts at or a little below the boiling point of water, and it burns with a rather smoky flame. It is regarded as the ultimate result of a series of changes which take place, under certain conditions, in organised matter, producing—1st, naphtha; 2d, petroleum; 3d, mineral tar; and 4th, asphalt or hard bitumen. The whole of these substances merge into each other by insensible degrees, so that it is impossible to say at what point mineral tar ends and asphalt begins. Naphtha, which is the first of the series, is in some localities found flowing out of the earth as a clear, limpid, and colourless liquid. As such it is a mixture of hydrocarbons, some of which are very volatile and evaporate on exposure; it takes up oxygen from the air, becomes brown and thick, and in this condition it is called petroleum. A continuation of the same process of evaporation and oxidation gradually transforms the material into mineral tar, and still later into solid glassy asphalt. Asphalts are very variable in composition, and their proximate constituents have not been subjected to a thorough examination. Traces of naphtha or light oils are usually found in them, and they always contain a percentage of the heavier hydrocarbons not vaporisable below boiling point. Resins soluble in alcohol, and solids, some soluble in ether, and some resisting the solvent action of both ether and alcohol, are found in varying porportions. According to Dana "asphalt may consist of either—(1), unoxygenated, or (2), partly unoxygenated and partly oxygenated (the usual fact), or (3), solely of oxygenated hydrocarbons (very rarely, if ever, true in nature). The state of solidity is not proof that any part of the bitumen is oxygenated." Asphaltic deposits exist widely diffused throughout the world, more especially in tropical and sub-tropical regions. It is found in a state of great purity in the interstices of the older rocks, but its occurrence is not characteristic of any particular formation or period. The most remarkable deposit of asphalt exists in Trinidad, where it forms a lake 99 acres in extent, and of unknown depth, intersected with rivulets of water. At two or three places on the surface of the lake an emission of semi fluid tar may still be seen in progress, accompanied with an evolution of sulphuretted hydrogen. At these points the substance is still soft and viscid, but by exposure it gradually obtains the consistency of the rest of the mass. In addition to the lake deposit, asphalt occurs in the surrounding country—named La Brea, on account of this peculiarity—in detached patches, or in sheets of considerable size, at one point protruding into the sea, and pieces of asphalt are frequently cast up on the neighbouring shore. A considerable quantity of a fine asphalt is also derived from Cuba under the name "Chapapote," or Mexican asphalt; and from Caxatambo in Peru, a very pure variety of high lustre is exported. The asphalt of the Dead Sea is more a tradition than a reality, it being now found there in very small quantities; but the source of the supply of ancient Babylon, the fountains of Is, on a tributary of the Euphrates, still yields asphalt. It occurs in many localities throughout Europe, but not to any considerable extent. The following table gives the ultimate composition of specimens from several localities:—

	Carbon.	Hydrogen.	Oxygen.	Nitrogen	Ash.
Auvergne, France	77·64	7·86	8·35	1·02	5·13
Cuba	82·34	9·10	6·25	1·91	0·40
Caxatambo, Peru	88·66	9·69	1·65		

Of greater importance industrially than simple asphalt is asphalt stone,—a limestone impregnated with bituminous matter, which occurs in large quantities at several European localities. The most valuable deposits are in the Val de Travers, canton of Neufchatel; in the neighbourhood of Seyssel, department of Ain; at Bechelbronn in Alsace, Limmer near the city of Hanover, and Hölle in Ditmarschen; in Holstein, &c. These bituminous stones contain from 7 or 8 to about 20 per cent. of asphalt in their composition, that from Val de Travers being richest in bituminous matter and of most value in its industrial applications. The asphalt beds of the Val de Travers were first discovered and utilised by Eirinus, a Greek physician, in 1712, who recommended the material as being "peculiarly suitable for covering all kinds of constructions; to protect wood and stone work against decay, worms, and the ravages of time, rendering them almost indestructible even when exposed to wind, wet, and extreme variations of temperature." Eirinus was aware that asphaltic mortar had been used in the building of ancient Babylon, and he himself succeeded in using it with great effect for the lining of cisterns and walls as a cementing material, and for the flooring of warehouses, &c. After some time the material fell into disuse; the quarries of Val de Travers were even forgotten, and it was not till the year 1832 that the material was again prominently and successfully re-introduced, the credit on this occasion being due to the Count Sassenay. Under his direction asphaltic stone came to be extensively used in France for pavements and roadways, and for protecting floors and walls from the effects of damp. From France the application of the material for such purposes extended to other countries, and there is now a wide-spread demand for asphaltic pavements. Two principal methods are adopted in laying asphalt pavements,—1st, the mastic process; 2d, the hot compressed process. The mastic process is essentially as follows:—The bed of the road-way is prepared with a smooth level foundation of concrete, which must be thoroughly dry before the application of the asphalt. The mastic is prepared for application by heating the asphaltic stone and breaking it into small pieces, which are then melted up with a quantity of mineral tar, to which some sand is added. The molten mass is then poured over a section of the prepared concrete uniformly to the requisite depth; the surface is smoothed, and covered with a coating of fine sand which is stamped into the asphalt. The proportions of tar and sand used vary with the composition of the asphaltic stone employed and the position occupied by the pavement. The other mode of laying pavements, now extensively adopted, consists in spreading hot powdered asphaltic stone on the prepared surface, which is then heavily pressed till it forms a homogeneous elastic coating. Roadways so prepared are very durable, smooth, cleanly, and noiseless, but the material is not well adapted for other than level streets on account of the difficulty of foothold. Complaints are also made against such pavement, to the effect that accidents to horses from slipping and falling are much more frequent than is the case on ordinary stone pavement. An artificial asphalt is prepared by boiling up the pitch of gas-tar with chalk and sand, but such a substitute, though much cheaper, has not the durability of the natural compound. Gas-tar asphalt is also applied for other purposes in which the natural product is used. Asphalt was used by the ancient Egyptians in their process of embalming bodies. It is the principal ingredient in black Japan varnish. It is distilled in large quantities for the illuminating and lubricating oil which it yields, but the bituminous shales from which paraffin and paraffin oils are distilled must not be confounded with asphaltic deposits. It is also used for preparing roofing felts; paper water-proofed with asphalt has been used, and drain-pipes of compressed asphalted paper are manufactured.

ASPHYXIA (α priv., σφύξις, a pulse), a term in medicine which, though literally signifying loss of pulsation, is applied to describe the arrestment of the function of respiration from some hindrance to the entrance of air into the lungs. (See PHYSIOLOGY and MEDICAL JURISPRUDENCE.)

ASPINWALL, or COLON, a city and free port on the northern coast of Panama, one of the united states of Colombia. It is built on the well-wooded coral island of Manzanilla, in lat. 9° 22′ 53″ N., and long. 79° 52′ 58″ W., owes its origin to the Panama Railway Company, who founded it (1850) for the convenience of their traffic, and derives its more usual name from W. H. Aspinwall, one of their principal shareholders. In spite of the unhealthiness of its situation,—now, indeed, largely diminished,—and the dangerous winds from the north to which it is at some seasons exposed, it has quite superseded the neighbouring port of Chagres, and become the centre of a considerable local trade. The banana, especially, is cultivated in the neighbourhood and largely exported to New York. The population, composed mainly of Jamaica and Spanish negroes, was stated at 6500 in 1872. A telegraph line extends from Aspinwall to Kingston in Jamaica.

ASS, The DOMESTIC—*Asinus vulgaris*, Gray,—differs chiefly from the horse in its smaller size, in the presence of long hair, forming a tuft, only at the extremity of the tail; and in the absence of warts on its hind legs. Its fur, usually of a gray colour, is characteristically marked with a longitudinal dorsal streak of a darker hue, with a similar streak across the shoulders, but white and black varieties also occur. The ass has been from time immemorial under the dominion of man, and it is doubtful whether the original wild stock is anywhere to be found at the present day,—the specimens that have been described as wild being probably the descendants of individuals that have escaped from the domestic state. A wild variety of ass (*Asinus tæniopus*), found in Abyssinia, has the long acute ears and the bray peculiar to the domestic kinds. It is said also to have cross bands on its legs, a feature occasionally met with in our tame breeds; and this fact has led Darwin and others to conclude that, in the wild ass of Abyssinia the original of the domestic animal is to be found; the stripes which occasionally appear on the legs of the latter being regarded as instances of reversion to the ancestral type (*Proceedings of Zool. Society*, 1862). The marked aversion of the domestic ass to cross the smallest streamlet, an aversion which it shares with the camel, and the evident delight with which it rolls itself in the dust, seem to point to arid deserts as its original home. The ass has generally been the object of neglect and ill treatment; and attempts have seldom been made to improve the breed by selecting and matching the finer specimens. It has thus gradually sunk into the dull and obstinate creature which we are accustomed to see. Its reputation for stupidity is not, however, of recent origin. The ancient Egyptians hated it, and symbolised an ignorant person by the head and ears, and the Romans thought it a bad omen to meet an ass (Fosbrooke's *Antiquities*). In the Middle Ages the Germans of Westphalia made the ass the symbol of St Thomas, the unbelieving apostle; and the boy who was last to enter the school on St Thomas' day was called the "Ass Thomas" (Gubernatis's *Zoological Mythology*, vol. i. p. 362). That the ass possesses qualities, which, if developed by careful selection and humane treatment, would make it a worthy companion of the horse as the servant of man, is seen in the too rare instances in which it has received proper attention. In Southern Europe—especially in Spain, Italy, and Malta—the ass is carefully bred, and has thus been greatly improved. No less than £200, it is said, is sometimes paid in Spain for a stallion ass. In the state of Kentucky, where mules are in great request as beasts of burden, asses, imported from the south of Europe, are reared with scrupulous care, and with such success, that from an average height of fourteen hands the Kentuckians have raised these animals to fifteen and even sixteen hands. That the diminutive size of the ass in cold countries is due as much to neglect as to rigour of climate seems proved by the fact, that in the north of India, where it is used by the lowest castes, the ass does not attain a height greater than that of a Newfoundland dog. It is, however, among the south-western nations of Asia and in Egypt that the ass has received that attention usually bestowed in this country on the horse, and it is there that it is to be seen in greatest perfection. The Arabs and Persians know the pedigrees of their asses, and by careful selection and interbreeding they have formed and perpetuate many useful races. Thus in Syria, according to Darwin, there are four distinct breeds:—"a light and graceful animal with agreeable gait used by ladies, an Arab breed reserved exclusively for the saddle, a stouter animal used for ploughing and various purposes, and the large Damascus breed with peculiarly long body and ears."[1]

The ass, there is little doubt, was first domesticated in Asia,—probably prior to the domestication of the horse,—whence it passed at a comparatively late period into Europe, for in the time of Aristotle it was not found in Thrace. In England there is evidence of its presence so early as the time of the Saxon Ethelred, but it does not appear to have been common till after the time of Queen Elizabeth. The koulan, or wild ass (*Asinus Onager*, Gray), differs from the domestic species in its shorter and more rounded ears, and in the greater length and finer form of its limbs. Its fur shows the dark streak along the back, but the streak across the shoulders does not appear to be a constant character. It is chiefly to be met with in the plains of Mesopotamia, in Persia, in Cutch, on the shores of the Indus, and in the Panjab, congregating in herds under a leader, and migrating southwards on the approach of winter. The adults are exceedingly shy, so that it is difficult to get within rifle range of them. According to Layard, who had ample opportunity for observing them during his researches around Nineveh, "they equal the gazelle in fleetness, and to match them is a feat which only one or two of the most celebrated mares have been known to accomplish." In the same region, over 2000 years ago, Xenophon, during the famous expedition of Cyrus, observed herds of wild asses so "fleet that the horsemen could only take them by dividing themselves into relays, and succeeding one another in the chase." The young are sometimes caught during spring by the Arabs, who feed them with milk in their tents. They are hunted chiefly by the Arabs and Persians, by whom their flesh is esteemed a delicacy. Their food, according to Dr Shaw, consists mainly of saline or bitter and lactescent plants; they are also fond of salt or brackish water. The leather known as shagreen, from the Turkish term *sagri*, is made from the skin of the ass; the ingrained aspect which it bears is not, however, natural to it, but is produced by a chemical process described by Pallas. The milk of the ass, containing more sugar and less caseine than that of the cow, closely resembles woman's milk, and has long been valued as a nutritious diet where the digestive organs are weak.

ASSAM, a province of British India. Until the beginning of 1874 Assam formed the north-east division of the territories under the Lieutenant Governor of Bengal. In that year it was erected into a separate administration, presided over by a Chief Commissioner, who acts directly under the Governor-General of India in council. The district of Cachar was added to the old division of Assam, and now forms part of the Chief Commissioner's jurisdiction. It lies between 24° and 28° N. lat., and between 90° and 98° E. long., and consists of the upper valleys of the Brahmaputra for a length of about 500 miles from where that river enters the north-eastern frontier of British India. These valleys vary in breadth, but generally occupy a space of about 60 miles between the Himálayas on the north, and the watershed which separates the Brahmaputra from the river system of Cachar. Assam, therefore, is bounded on the N. by the sub-Himálayan ranges of the Bhutiá, Aká, Daphlá, and Miri tribes; on the E. by the unsurveyed forests and mountains which separate British India from northern Burmah; on the S. by the hills inhabited by the Nágás, Jaintiyas, and Khásiás, which separate Assam from Silhet; and on the W. by the Gáro hills and Kuch Behar. Assam may be considered, however, either as a natural province or as an artificial political division. In its former aspect, in which it will be dealt with in this article, it has an area of 48,473 square miles, with a population in 1872 of 2,412,480 souls. It is the outlying province of India to the north-east, so that while the pressure of population in several of the inner divisions of Bengal varies from 500 to 573 persons per square mile, in Assam it is barely 50. Even deducting 12,058 miles of hill country in Lakhimpur and Cachar districts, the pressure of population is only 66 persons per square mile in the more cultivated parts of Assam. Taken as a political division, it is locally administered by a Chief Commissioner, with his headquarters at Gauhátí. It is subdivided into the ten following districts, each under a deputy commissioner:—

Table showing the Area, Population, and Land Revenue of the Assam Province

Name of District.	Area in square miles.	Total population.	Pressure of population per square mile.	Hindus.	Muhammadans.	Christians.	Others.	Land Revenue.
1. Goálpárá	4,433	444,761[2]	100	311,419	89,916	141	6,238	£13,045 0 0
2. Kámrúp	3,631	561,681	155	515,024	45,823	204	630	83,200 0 0
3. Dorang or Darang	3,413	236,009	69	221,389	13,859	256	505	36,665 8 0
4. Naogáon	3,648	256,390	70	245,615	10,066	179	530	36,146 8 0
5. Sibságar	2,413	296,589	123	282,969	12,619	283	718	46,829 14 0
6. Lakhimpur	3,145	121,267	39	115,638	3,826	316	1,487	14,383 6 0
7. Cachar	1,285	205,027	160	128,219	74,361	409	2,038	15,334 12 0
8. Nágá Hills	4,900	68,918	14	Not classified	Not classified	Not classified	Not classified	47 6 0
9. Khasiá and Jayantiyá Hills	6,157	141,838	23	Do.	Do.	Do.	Do.	307 16 0
10. Gáro Hills	3,390	80,000	23	Do.	Do.	Do.	Do.	...
	36,415	2,412,480	66	1,820,273	250,470	1,788	12,146	£315,959 10 0

The area given in this table is exclusive of 8343 square miles of hill country in Lakhimpur, and 3715 square miles of the Cachar hills, but it includes the two districts of Goálpára and the Gáro hills, which, although for political convenience placed under the commissioner of the Kuch Behar division of Bengal, belong physically and linguistically to Assam.

History.—Assam was the province of Bengal which remained

[1] *Animals and Plants under Domestication*, vol. i. p. 62.

[2] This includes the population of Eastern Duárs, 37,047, not classified according to religion.

most stubbornly outside the limits of the Mughul empire and of the Muhammadan polity in India. Indeed, although frequently overrun by Musalmán armies, and its western districts annexed to the Muhammadan vice-royalty of Bengal, the province maintained an uncertain independence till its invasion by the Burmese towards the end of the last century, and its final cession to the British in 1826. A full account of its ancient kings will be found in Mr William Robinson's *Assam*, chap. iv. (Calcutta, 1841). It seems to have been originally included, along with the greater part of north-eastern Bengal, in the old Hindu territory of Kámrúp. Its early legends point to great religious revolutions between the rival rites of Krishna and Siva as a source of dynastic changes. Its roll of kings extends deep into pre-historic times, but the first Rájá capable of identification flourished about the year 76 A.D. Kámrúp, the Prágjotishpur of the ancient Hindus, was the capital of a legendary king Narak, whose son Bhagadatta distinguished himself in the great war of the Mahábhárata. On the rise of the Koch power, the kings of Kuch Behar wrested a portion of Assam from the kings of the Pál dynasty to whom it belonged. In the early part of the 13th century the Ahams or Ahoms, from northern Burmah and the Chinese frontiers, poured into the eastern districts of Assam, founded a kingdom, and held it firmly for several centuries. A tradition relates that this race of conquerors were originally let down from heaven by iron chains, and alighted in a place called Mungbingram, supposed to be in the Pátkai range, in 567 A.D. Their manners, customs, religion, and language were, and for a long time continued to be, different from those of the Hindus; but they found themselves compelled to respect the superior civilisation of this race, and slowly adopted its customs and language. The conversion of their king Chuchengpha to Hinduism took place about the year 1611 A.D. and the whole Ahams of Assam gradually followed his example. In mediæval history, the Assamese were known to the Musalmán population as a warlike, predatory race, who sailed down the Brahmaputra in fleets of innumerable canoes, plundered the rich districts of the delta, and retired in safety to their forests and swamps. As the Muhammadan power consolidated itself in Bengal, repeated expeditions were sent out against these river pirates of the north-east. The physical difficulties which an invading force had to contend with in Assam, however, prevented anything like a regular subjugation of the country; and after repeated efforts, the Musalmáns contented themselves with occupying the western districts at the mouth of the Assam valley. The following details will suffice for the history of a struggle in which no great political object was attained, and which left the Assamese still the same wild and piratical people as when their fleets of canoes first sallied forth against the Bengal delta. In 1638, during the reign of the Emperor Sháh Jahán, the Assamese descended the Brahmaputra, and pillaged the country round the city of Dacca; they were expelled by the governor of Bengal, who retaliated upon the plunderers by ravaging Assam. During the civil wars between the sons of Sháh Jahán, the king of Assam renewed his predatory incursions into Bengal; upon the termination of the contest, Aurangzeb determined to avenge these repeated insults, and despatched a considerable force for the regular invasion the Assamese territory. His general, Mír Jumlá, defeated the Rájá, who fled to the mountains, and most of the chiefs made their submission to the conqueror. But the rains set in with unusual violence, and Mír Jumlá's army was almost annihilated by famine and sickness. Thus terminated the last expedition against Assam by the Muhammadans, whose fortunes in this country were never prosperous. A writer of the Muhammadan faith says:—"Whenever an invading army has entered their territories, the Assamese have sheltered themselves in strong posts, and have distressed the enemy by stratagems, surprises, and alarms, and by cutting off their provisions. If these means failed, they have declined a battle in the field, but have carried the peasants into the mountains, burned the grain, and left the country desert. But when the rainy season has set in upon the advancing enemy, they have watched their opportunity to make excursions and vent their rage; the famished vaders have either become their prisoners or been put to death. In this manner powerful and numerous armies have been sunk in that whirlpool of destruction, and not a soul has escaped." The same writer states that the country was spacious, populous, and hard to be penetrated; that it abounded in dangers; that the paths and roads were beset with difficulties; and that the obstacles to conquest were more than could be expressed. The inhabitants, he says, were enterprising, well-armed, and always prepared for battle. Moreover, they had lofty forts, numerously garrisoned and plentifully provided with warlike stores; and the approach to them was opposed by thick and dangerous jungles, and broad and boisterous rivers. The difficulties in the way of successful invasion are of course not understated, as it was the object of the writer to exalt the prowess and perseverance of the faithful. He accounts for their temporary success by recording that "the Musalmán hordes experienced the comfort of fighting for their religion, and the blessings of it reverted to the sovereignty of his just and pious majesty." The short-lived triumph of the Musalmáns might, however, have warranted a less ambitious tone. About the middle of the 17th century the chief became a convert to Hinduism. By what mode the conversion was effected does not clearly appear, but whatever were the means employed, it seems that the decline of the country commenced about the same period. Internal dissensions, invasion, and disturbances of every kind convulsed the province, and neither prince nor people enjoyed security. Late in the 18th century some interference took place on the part of the British Government, then conducted by Lord Cornwallis; but the successor of that nobleman, Sir John Shore, adopting the non-intervention policy, withdrew the British force, and abandoned the country to its fate. Its condition encouraged the Burmese, an aggressive people, to depose the Rájá, and to make Assam a dependency of Ava. The extension of their encroachments on a portion of the territory of the East India Company compelled the British Government to take decisive steps for its own protection. Hence arose the series of hostilities with Ava known in Indian history as the first Burmese war, on the termination of which by treaty in February 1826, Assam remained a British possession. In 1832 that portion of the province denominated Upper Assam was formed into an independent native state, and conferred upon Purandar Sinh, the ex-Rájá of the country; but the administration of this chief proved unsatisfactory, and in 1838 his principality was reunited with the British dominions. After a period of successful administration and internal development, under the Lieutenant-Governor of Bengal, it was erected into a separate Chief-Commissionership in 1874.

Physical Aspects.—Assam is a fertile series of valleys, with the great channel of the Brahmaputra (literally, *the Son of Brahmá*) flowing down its middle, and an infinite number of tributaries and water-courses pouring into it from the mountains on either side. The Brahmaputra spreads out in a sheet of water several miles broad during the rainy season, and in its course through Assam forms a number of islands in its bed. Rising in the Thibetan plateau, far to the north of the Himálayas, and skirting round their eastern passes, not far from the Yang-tse-kiang and the great river of Cambodia, it enters Assam by a series of waterfalls and rapids, amid vast boulders and accumulations of rocks. The gorge, situated in Lakhimpur district, through which the southernmost branch of the Brahmaputra enters, has from time immemorial been held in reverence by the Hindus. It is called the Brahmakunda or Parasurámkunda; and although the journey to it is both difficult and dangerous, it is annually visited by thousands of devotees. After a rapid course westwards down the whole length of the Assam valley, the Brahmaputra turns sharply to the south, spreading itself over the alluvial districts of the Bengal delta, and, after several changes of name, ends its course of 1800 miles in the Bay of Bengal. Its first tributaries in Assam, after crossing the frontier, are the Kundil and the Digaru, flowing from the Mishmi hills on the north, and the Tengápáni and Nawá Dihing, which take their rise on the Singpho hills to the south-east. Shortly afterwards it receives the Dibang, flowing from the north-east; but its principal confluent is the Dihang, which, deriving its origin, under the name of the Sanpu, from a spot in the vicinity of the source of the Sátlej, flows in a direction precisely opposite to that river, and traversing the table-land of Thibet, at the back of the great Himálaya range, falls into the Brahmaputra in 27° 48′ N. lat., 95° 26′ E. long., after a course of nearly 1000 miles. Doubts were long entertained whether the Dihang could be justly regarded as the continuation of the Sanpu; these, however, have been gradually removed by the additional testimony of more recent notices; and as it is now ascertained that the last-named river does not flow into the Irawadi, it appears impossible to account for its course to the sea, except by presuming it to discharge its waters into the Brahmaputra through the channel of the Dihang. Below the confluence, the united stream flows in a south-westerly direction, forming the boundary between the districts of Lakhimpur and Darang, situated on its northern bank, and those of Sadiyá, Sibságar, and Naogáon on the south; and finally bisecting Kámrúp, it crosses over the frontier of the province, and passes into Bengal. In its course it receives on the left side the Burí Dihing, a river having its rise at the south-eastern angle of the province; and lower down, on the opposite side, it parts with a considerable offset termed the Burí Lohit, which, however, reunites with the Brahmaputra 60 miles below the point of divergence, bearing with it the additional waters of the Subansiri, flowing from Thibet. A second offset, under the name of the Kalang River, rejoins the parent stream a short distance above the town of Gauhati. The remaining rivers are too numerous to be particularised. Of these, not less than 61 are distinguished by well-known names, of which 34 flow from the northern, 24 from the southern mountains, and the remainder from sources beyond the confines of Assam. The streams of the south are not rapid, and have no considerable current until May or June. Among the islands formed by the intersection and confluence of the rivers is Májuli, or the Great Island, as it is called by way of pre-eminence. This island extends 55 miles in length by about 10 in breadth, and is formed by the Brahmaputra on the south-east, and the Burí Lohit river on the north-west. A Persian writer, Muhammad Kázim, in describing Assam at the close of the 17th century, makes some observations on its general appearance. He thus speaks of Májuli two centuries ago:—

"An island well inhabited, and in an excellent state of agriculture; it contains a spacious, clear, and pleasant country. The cultivated part is bounded by a thick forest, which harbours elephants, and these animals may be caught here, as well as in four or five other forests in Assam. If there be occasion for them, five or six hundred elephants may be procured in a year."

Describing the country south of the Brahmaputra, the same native author observes:—

"Across the river on the side of Garhgáon is a wide, agreeable, level country that delights the heart of the beholder. The whole face of it is marked with population and tillage; and it presents on every side charming prospects of ploughed fields, harvests, gardens, and groves. From the village of Sálagirá to the city of Garhgáon, a space of about 50 *kos* (100 miles) is filled with such an uninterrupted range of gardens, plentifully stocked with fruit trees, that it appears as one garden. Within them are the houses of peasants, and a beautiful assemblage of coloured and fragrant herbs, and of garden and wild flowers blowing together. As the country is overflowed in the rainy season, a high and broad causeway has been raised for the convenience of travellers from Sálagirá to Garhgáon, which is the only uncultivated ground that is to be seen. Each side of this road is planted with shady bamboos, the tops of which meet and are entwined. Among the fruits which this country produces are mangoes, plantains, jacks, oranges, citrons, limes, and punialeh, a species of amleh, which has such an excellent flavour that every person who tastes it prefers it to the plum. There are also cocoa-nut trees, pepper-vines, areca trees, and the sadij (an aromatic leaf), in great plenty. Sugar-cane excels in softness and sweetness, and is of three colours, black, red, and white; there is ginger free from fibres, and betel vines. The strength of vegetation and fertility of the soil is such that whatever seed is sown, or slips planted, they always thrive. The environs of Garhgáon furnish small apricots, yams, and pomegranates; but as these are wild, and not assisted by cultivation and engrafting, they are very indifferent. The principal crop of this country consists in rice and mash. Ades, a kind of pea, is very scarce, and wheat and barley are never sown."

And in respect to the other great division of the province he remarks:—

"The country which is on the northern side of the Brahmaputra is in the highest state of cultivation, and produces plenty of pepper and areca nuts. It even surpasses the southern portion in population and tillage; but as the latter contains a greater tract of wild forests and places difficult of access, the rulers of Assam have chosen to reside in it for the convenience of control, and have erected in it the capital of the kingdom. The breadth of the northern division from the bank of the river to the foot of the mountains, which is a cold climate and contains snow, is various, but is nowhere less than 30 miles, nor more than 90. The inhabitants of these mountains are strong, have a robust and respectable appearance, and are of a middling size. Their complexions, like those of the natives of all cold climates, are red and white; and they have also trees and fruits peculiar to frigid regions."

This description, written two centuries ago, would apply at the present day. In the upper part of the valley, towards the gorge where the Brahmaputra enters, the country is varied and picturesque, walled in on the north and east by the Himálayas, and thickly wooded from the base to the snow-line. On either bank of the Brahmaputra a long narrow strip of plain rises almost imperceptibly to the foot of the hills. Gigantic reeds and grasses occupy the low lands near the banks of the great river; expanses of fertile rice-land come next; a little higher up, dotted with villages encircled by groves of bamboos and fruit trees of great size and beauty, the dark forests succeed, covering the interior table-land and mountains. The country in the vicinity of the large rivers is flat, and impenetrable from dense tangled jungle, with the exception of some very low-lying tracts which are either permanent marshes or are covered with water during the rains. Jungle will not grow on these depressions, and they are covered either with water, reeds, high grasses, or rice cultivation. On or near such open spaces are collected all the villages. As the traveller proceeds farther down the valley, the country gradually opens out into wide plains. In the western district of Kámrúp the country forms one great expanse, with a few elevated tracts here and there, varying from 200 to 800 feet in height.

Varieties of Soils.—The soil is exceedingly rich and well adapted to all kinds of agricultural purposes, and for the most part is composed of a rich black loam reposing on a gray sandy clay, though occasionally it exhibits a light yellow clayey texture. The land may be divided into three great classes. The first division is composed of hills, the largest group within the valley being that of the Mikir Mountains, which stand out upon the plain. Another set of hills project into the valley at Gauháti. But these latter are rather prolongations of spurs from the Khásiá chain than isolated groups belonging to the plains. The other hills are all isolated, and of small extent. The second division of the lands is the well-raised part of the valley whose level lies above the ordinary inundations of the Brahmaputra. The channels of some of the hill streams, however, are of so little depth that the highest lands in their neighbourhood are liable to sudden floods. On the north bank of the great river, lands of this sort run down the whole length of the valley, except where they are interrupted by the beds of the hill streams. The breadth of these plains is in some places very trifling, whilst in others they comprise a tract of many miles, according to the number and the height of the rocks or hills that protect them from the aberrations of the river. The alluvial deposits of the Brahmaputra and of its tributary streams may be considered as the third general division of lands in Assam. These lands are very extensive, and present every degree of fertility and elevation, from the vast *chars* of pure sand, subject to annual inundations, to the firm islands, so raised by drift-sand and the accumulated remains of rank vegetable matter, as no longer to be liable to flood. The rapidity with which wastes composed entirely of sand newly washed forward by the current during floods become converted into rich pasture, is astonishing. As the freshets begin to lessen and retire into the deeper channels, the currents form natural embankments on their edges, preventing the return of a small portion of water which is thus left stagnant on the sands, and exposed to the action of the sun's rays. It slowly evaporates, leaving a thin crust of animal and vegetable matter. This is soon impregnated with the seeds of the *Saccharum spontaneum* and other grasses that have been partly brought by the winds and partly deposited by the water. Such places are frequented by numerous flocks of aquatic birds, which resort thither in search of fish and mollusca. As vegetation begins to appear, herds of wild elephants and buffaloes are attracted by the supply of food and the solitude of the newly-formed land, and in their turn contribute to manure the soil.

Geology.—Limestone, coal, and petroleum are found; with oil springs, mineral springs, and brine springs. The mountains on the opposite sides of the valley are characterised by distinct systems, those on the north being composed of primitive formations, while those on the south partake largely of sandstone, shell-limestone, and coal. Some valuable minerals are met with. Gold-dust is found in all the rivers flowing from the northern mountains, but it differs in purity and colour, and also in malleability. That which is obtained in the Dikrang is purer than that found in the Brahmaputra, though it is more abundant in the bed of the latter river. Gold-dust is found most plentifully near the foot of the northern hills; it is never sought for in the southern rivers. Beds of iron-ore exist in various places, and tracings of former workings on a large scale remain; but the native article, being undersold by iron imported from England, is now driven out of the market. Coal has also been discovered in beds of considerable magnitude, and from the circumstance of its existence at the two extremities of the province, there appear grounds for the inference that the coal formations of Assam are co-extensive with the whole length of the valley. The extreme difficulty, however, of moving about in those districts, the absence of roads, and the jungly and almost uninhabited state of the country, have tended to prevent the opening up of the mineral deposits of the province. More recently, the largely-extended cultivation of tea, and the consequently increased demand for means of transport and communication, have directed attention to the local supplies of fuel for the river steamers which now navigate the Brahmaputra. In 1864-65, Mr H. B. Medlicott, Deputy-Superintendent of the Geological Survey, visited this province, and reported most favourably of the value and extent of the coal. To the north of the Brahmaputra no coal worth working was found. To the south, in Upper Assam, the principal localities are in the neighbourhood of Jaipur, in the Debrogarh sub-division of the Lakhimpur district, and in the vicinity of Mákum. The chief sites are the Terap, where a minimum thickness of 5 feet of bright clean coal, nearly horizontal, was seen; the Námchik, a tributary of the Dihang, where, within 200 feet in length, three thick beds of good sound coal were seen, one 8 feet thick; and at Jaipur, where a seam of 17 feet thick occurs, of which 10 feet is good bright coal. Several other seams also exist which have never been touched. The inaccessible nature of the country, however, and the want of a trustworthy map, render it quite impracticable at present to obtain even an approximate idea of the extent of area over which these beds range, and of the amount of fuel available. It can, however, be safely asserted that this amount is very large and most valuable. Assays of the Assam coals showed a proportion of ash not exceeding from 2 to 5 per cent. The survey of the country is now being pushed forward. Neither copper nor silver are found in the province. Rock-salt is dug out of the earth, and brine springs are not uncommon, from which salt is made; but the manufacture is costly, and the salt is as expensive as that imported from Liverpool.

Vegetable Products: Tea.—The most important article of commerce produced in Assam is tea. The rice crop covers a very great proportion of the cultivated land, but it is used for local consumption. The tea plantations occupy only a very small area, but they are the one great source of wealth to the province, and the necessities of tea cultivation are the chief stimulants to the development of Assam. The plant was discovered in 1823 by Mr Robert Bruce, who had proceeded thither on a mercantile exploration. The country, however, then formed part of the Burmese dominions. But war with this monarchy shortly afterwards broke out, and a brother of the first discoverer, happening to be appointed to the command of a division of gun-boats employed in some part of the operations, followed up the pursuit of the subject, and obtained several hundred plants and a considerable quantity of seed. Some specimens were ultimately forwarded to the superintendent of the botanic garden at Calcutta. In 1832 Captain Jenkins was deputed by the Governor-General of India, Lord William Bentinck, to report upon the resources of the country, and the tea plant was brought to his especial notice by Mr Bruce; in 1834 a minute was recorded by the Governor-General on the subject, to which it is stated that his attention had been called to it in 1827 before his departure from England. In accordance with the views of that minute, a committee was appointed to prosecute inquiries, and to promote the cultivation of the plant. Communications were opened with China with a view to obtain fresh plants and seeds, and a deputation, composed of gentlemen versed in botanical studies, was despatched to Assam. Some seeds were obtained from China; but they proved to be of small importance, as it was clearly ascertained by the members of the Assam deputation that both the black and the green tea plants were indigenous here, and might be multiplied to any extent; another result of the Chinese mission, that of procuring persons skilled in the cultivation and manufacture of black tea, was of more material benefit. Subsequently, under Lord Auckland, a further supply of Chinese cultivators and manufacturers was obtained—men well acquainted with the processes necessary for the production of green tea, as the former set were with those requisite for black. In 1838 the first twelve chests of tea from Assam were received in England. They had been injured in some degree on the passage, but on samples being submitted to brokers, and others of long experience and tried judgment, the reports were highly favourable. It was never, however, the intention of Government to carry on the trade, but to resign it to private adventure as soon as the experimental course could be fairly completed. Mercantile associations for the culture and manufacture of tea in Assam began to be formed as early as 1839; and in 1849 the Government disposed of their establishment, and relinquished the manufacture to the ordinary operation of commercial enterprise. In 1851 the crop of the principal company was estimated to produce 280,000 lb. Since then the enterprise has rapidly developed. The returns for 1871 show 11,475,398 lb of tea manufactured in Assam, against 9,511,517 in 1870, showing an increase of 1,963,881 lb in one year. There were 416 gardens open, and the whole extent of land held under the different tenures for this purpose was 474,939 acres, of which 54,384 were reported to be under cultivation. The average monthly number of labourers employed on the tea gardens of Assam during 1871 was 54,326, of whom upwards of 38,000 were imported under the Labour Transport Acts, chiefly from the western districts of Lower Bengal. It is to be remembered that Assam now includes Cachar, and these statistics are for the whole province as constituted in 1874. Tea cultivation is steadily progressing in Assam, and has firmly established itself as a staple of Indian trade. Besides rice and tea, the other principal crops of Assam are pulses, Indian corn, oil seeds, sugar-cane, *pán*, hemp and jute, rhea grass, mulberry, potatoes, and other vegetables.

Animals.—The zoology of Assam presents some interesting features. Wild elephants abound and commit many depredations, entering villages in large herds, and consuming everything suitable to their tastes. Many are caught by means of female elephants previously tamed, and trained to decoy males into the snares prepared for subjecting them to captivity. A considerable number are tamed and exported from Assam every year, but the speculation appears to be rather precarious, as it is said about twice the number exported are annually lost in the course of training Many are killed every year in the forests for the sake of the ivory which they furnish; and the supply must be very great which can afford so many for export and destruction without any perceptible diminution of their number. The rhinoceros is found in the denser parts of the forests, and generally in swampy places. This animal is hunted and killed for its skin and its horn. The skin affords the material for the best shields. The horn is sacred in the eyes of the natives. Contrary to the usual belief it is stated that, if caught young, the rhinoceros is easily tamed, and becomes strongly attached to his keeper. Tigers abound, and though many are annually destroyed for the sake of the Government reward, their numbers seem scarcely, if at all, to diminish. Their destruction is sometimes effected by poisoned arrows discharged from an instrument resembling a cross-bow, in which the arrow is first, fixed, and a string connected with the trigger is then carried across the path in front of the arrow, and fastened to a peg. The animal thus struck is commonly found dead at the distance of a few yards from the engine prepared for his destruction. Leopards and bears are numerous; and the *Arctonix Collaris* of Cuvier, a small animal somewhat resembling a bear, but having the snout, eyes, and tail of a hog, is found. Among the most formidable animals known is the wild buffalo, which is of great size, strength, and fierceness. Many deaths are caused by this animal, and a reward is given for its destruction. The fox and the jackal exist, and the wild hog is very abundant. Goats, deer of various kinds, hares, and two or three species of antelope are found, as are monkeys in great variety. The porcupine, the squirrel, the civet cat, the ichneumon, and the otter are common. The birds are too various to admit of enumeration. Wild game is plentiful; pheasants, partridges, snipe, and waterfowl of many descriptions make the country a tempting field for the sportsman. Vultures and other birds of prey are met with. Crocodiles (commonly called alligators) swarm in all parts of the Brahmaputra, and are very destructive to the fish, of which hundreds of varieties are found, and which supply a valuable article of food. The most destructive of the *feræ naturæ*, as regards human life, are, however, the snakes. Of these, several poisonous species exist, including the cobra and karait (*Naga tripudians* and *Bungarus cæruleus*). The bite of a fairly-grown healthy serpent of either of these species is deadly; and it is ascertained that more deaths occur from snake-bite than from all the other wild beasts put together. Among the non-poisonous serpents, the python ranks first. This is an enormous boa-constrictor, of great length and weight, which drops upon his prey from the branch of a tree, or steals upon it in the thick grass. He kills his victim by rolling himself round the body till he breaks its ribs, or suffocates it by one irresistible convolution round its throat. He seldom or never attacks human beings unless in self-defence, and loss of life from this cause is scarcely ever reported. Full details as to the botany and zoology of Assam will be found in Mr William Robinson's account of the province (Calcutta, 1841).

The Inhabitants of the entire province number nearly two and a half millions, of whom more than one million and three-quarters are Hindus; 250,490 are Muhammadans, 1788 are Christians, and the remaining third of a million are hill tribes, professing aboriginal faiths. The native population is so exceedingly sparse that the demand for labour on the tea gardens has given rise to a system of importing coolies from western Bengal. A series of laws, regulate the terms of the contract between the planter and the imported labourer, prevent abuses in recruiting coolies among the ignorant peasantry of the west, and provide for their health and comfort during their transit to the distant districts of Assam. Under these Acts 4988 labourers were imported into the tea districts of Assam (including Cachar) in 1871, the total number of imported labourers employed on the tea plantations at the end of that year being 39,426. A large proportion of the native inhabitants derive their origin from tribes who came from the Himálayan ranges, from Burmah, or from the Chinese frontier. The most important of these are the Ahams or Ahoms, an offshoot of the Shan race of Northern Burmah. They were the last conquerors of Assam before the Burmese, and they long preserved their ancient traditions, habits, and institutions. Hinduism first made its encroachments among their kings and nobility. Several generations ago they gave up eating beef, and they are now completely Hinduised, except in a few remote recesses of Assam. Hinduism has also impressed its language upon the province, and the vernacular Assamese possesses a close affinity to Bengali, with the substitution of *s* for the Bengali *ch*, of a guttural *h* for the Bengali *h* or *sh*, and a few other dialectic changes. Indeed, so close was the resemblance that during the last thirty years Bengali was used as the court and official language of the province under our rule. But with the development of the country the Assamese tongue has asserted its claims to be treated as a distinct vernacular, and a late resolution of Government (1873) re-established it as the language of official life and public business.

The Assam peasant, living in a half-populated province, and surrounded by surplus land, is indolent, good-natured, and, on the whole, prosperous. He raises sufficient food for his wants with very little labour, and, with the exception of a few religious ceremonies, he has no demand made upon him for money, saving the light rental of his fields. Under the peaceful influences of British rule, he has completely lost his ancient warlike instincts, and forgotten his predatory habits. In complexion he is a shade or two fairer than the Bengali. His person is in general short and robust, but devoid of the grace and flexibility of the Hindu. A flat face, with high cheek-bones, presents a physiognomy resembling the Chinese, and suggests no idea of beauty. His hair is abundant, black, lank, and coarse, but the beard is scanty, and usually plucked out, which gives him an effeminate appearance. The women form a striking contrast to the men; there is more of feminine beauty in them than is commonly seen in the women of Bengal, with a form and feature somewhat approaching the European. In most parts of the country the women of rank go about in public, without that artificial modesty practised by native ladies in other parts of India. Although the ancient ruling classes originally came to the province across the Himáláyas or from Burmah, a stream of immigration also went on from Bengal, and the Nadiyáls or Doms, who originally emigrated from the Delta, are said to be the most numerous tribe in Assam. Their original employment was that of fishermen. Although a very low caste, and indeed one of the outcastes among the Hindus of Bengal, they observe in Assam various rules of purity in eating and drinking, with a greater strictness than even the Bráhmans. They have not, however, taken a Bráhman as their spiritual guide, but follow the instructions of the Kalitás, the ancient priests of the Ahams. The habits of life of the Assamese peasantry are pre-eminently domestic. Great respect is paid to old age; when parents are no longer capable of labour they are supported by their children, and scarcely any one is allowed to become a burden to the public. They have also in general a very tender regard for their offspring, and are generous and kind to their relations. They are hospitable to people of their own caste, but to no others. The use of opium is very general among the Assamese.

Hill Tribes.—The hill and frontier tribes of Assam are the Nágás, Singphos, Daphlás, Miris, Khámptis, Mataks, Abars, &c., nearly all of whom, excepting the Nágás, are found near the frontiers of Lakhimpur district. The principal of these, in point of numbers, are the Nágás, who inhabit the hills and forests along the eastern and south-eastern frontier of Assam. They generally live in small scattered communities of about twenty houses each, and are divided into numerous clans or *khels*, of which the six most important residing in British territory are the following, viz., the Námsangiás, Bardwáriás, Paindwáriás, Laptangs, Kaimais, and Topigamaiás. Exclusive of the Nágá Hills district of Assam, the population of which is returned at 68,918, the Nágás of Lakhimpur count 2865 houses, with an estimated population of 14,353 souls. They cultivate rice, cotton, yams, and Indian corn, and prepare salt from the brine springs in their hills. The different tribes of Nágás are independent of and unconnected with one another, and are often at war with each other. The Singphos are the most powerful tribe bordering on the Assam valley, and are scattered over the largest extent of country. Their territory is bordered on the north by the upper reaches of the Brahmaputra; on the south by the Pátkai range; on the west by an imaginary line drawn south from the town of Sadiyá to the Pátkai mountains; on the east by the Langtung mountains. They are a wild, daring tribe; and in the early days of English rule in Assam they gave a good deal of trouble by their frequent raids. They are now, however, looked upon as peaceful and friendly neighbours. They have settled down to agriculture, and now do for themselves what formerly they depended on their Assamese slaves to perform for them. They only cultivate sufficient food for a portion of the year, and during the remaining months they live upon wild yams and other jungle products. The Government has no very definite relations with them; but they are generally obedient, and in a loose way recognise British supremacy. The settlements of the Singphos in or near the frontier of Lakhimpur are estimated to number about 3435 souls. The other tribes are the Khámtis, Abars, Miris, Mishmis, and Daphlás.

Slavery, which existed in a mild form until our acquisition of Assam, has ceased under British rule.

ADMINISTRATION.—The administrative statistics of the province will be given separately for each of the ten districts mentioned in the foregoing table under their alphabetical headings. Here it will suffice to say, that Assam as a whole is under a Chief Commissioner who is directly responsible to the Governor-General in council. The Assam districts form what is called a non-regulation province—*i.e.*, one to which it has not been found expedient to extend our system of government in its strict legal entirety. Each district, instead of being under a judge and a magistrate-collector, with their separate sets of subordinates, is managed by a deputy-commissioner, in whom both the executive and judicial functions are combined. It is essentially an outlying province, yielding very little revenue to Government, and administered as cheaply as practicable. With the exception of Goálpárá, the land revenue of Assam is at present under a light temporary settlement, the permanent settlement not having yet been extended to it on account of its sparse population and backward state. The population is essentially agricultural, and no tendency appears on their part to gather into trading centres or to develop city life. Throughout the whole province there are only two towns with a population of upwards of 5000 souls, viz., Gauhátí, population 11,492; and Sibságar, 5278. The various Government rules for granting waste lands in fee-simple or on long leases at easy rates, have brought a considerable number of English capitalists and speculators into the province. It is on these grants that many of the tea-gardens have been formed. The development of European enterprise has created a sudden and an urgent demand for roads, which the Government has hitherto not found itself in a position to meet. For all the ordinary purposes of the province, and for its heavy and bulky staples, such as timber, rice, food grains, and oil seeds, the Brahmaputra and its tributaries afford ample means of transit. The great trunk road, which the Muhammadans drove through Assam with a view to controlling the turbulent population, has long ago fallen into decay, and at many places is only recognisable as a line of fragmentary embankments. Each district, however, is now developing a system of roads, or at any rate of country tracks, of its own; and Sir George Campbell, the present Lieutenant-Governor of Bengal (1874), initiated a liberal policy towards the Assam communications, with the view rather to the future of the province than to the amount of expenditure which its revenue at present warrants. Now that it is erected into a separate administration, a still more rapid progress may be looked for. With its vast forests, its inexhaustible rice-grounds, its coal, iron, and tea, and the cheap means of transit which its rivers afford, Assam, although at present one of the most backward among Indian provinces, has capabilities of development such as no other part of Bengal possesses. (W. W. H.)

ASSAROTTI, OTTAVIO GIOVANNI BATTISTA, the founder of schools for the education of deaf-mutes in Italy, was born at Genoa in 1753. He received an excellent education; and after qualifying himself for the church, he entered the society of the Pietists, "Scuole Pie," who devoted themselves to the training of the young. His superior learning rendered his services very valuable, and he was appointed to lecture on theology to the students of the order. In 1801 he heard of the Abbe Sicard's experiments in the training of deaf-mutes, and resolved to try something similar in Italy. He began with one pupil, and had by degrees collected a small number round him, when, in 1805, Napoleon, hearing of his endeavours, ordered a convent to be given him for a school-house, and funds for supporting twelve scholars to be taken from the convent revenues. This order was scarcely attended to till 1811, when it was renewed, and in the following year Assarotti, with a considerable number of pupils, took possession of the new school. Here he continued, with the exception of a short interval in 1814, till his death in 1829. A pension, which had been awarded him by the king of Sardinia, he bequeathed to his scholars. Nothing definite is known as to the method of instruction pursued by Assarotti; he seems, in fact, to have followed no fixed plan.

ASSASSINS, a secret military and religious sect formed in Persia and Syria during the 11th century A.D. To understand clearly its nature and tenets, it is necessary to refer to the doctrines of the Ismaelites, of whom it was a branch, and who were themselves an offshoot from the great body of the Shiites. The Shiites, one of the two sects into which the Mahometans had separated, held in opposition to the Sunnites, or orthodox, that the true and only legitimate successor of the Prophet was his son-in-law, Ali. They did not succeed in establishing by force the claims of this family; and, under the dynasties of the Ommiade and Abbaside caliphs, they were compelled to keep their opinions secret. The large body of Shiites was further divided into several distinct parties, differing principally with regard to the recognised line of succession from Ali; of these the most powerful was that of the Ismaelites, so called because they held that the Imamat descended in an unbroken line from Ali to Ismael, his seventh successor. The adherents of this sect were most widely spread in Persia, and naturally the special object of their opposition was the Abbaside caliphate of Baghdad, but no active steps were taken by them, until under one of the Persian magi, Abdallah-ibn-Maimun Kadah, they had been organised into a secret society, with definite political objects and peculiar religious or philosophical views. Abdallah, like many of his countrymen, was a free-thinker, and he succeeded in establishing among the Ismaelites a faith, or rather a philosophy, wholly opposed to the doctrines of Islam. The fundamental principles of his creed appear to have been—(1.) The rejection of all fixed rules either of religion or morality; all actions were therefore indifferent, only the internal disposition was of any value; (2.) The belief that the Imams of the line of Ismael were at present invisible, and that, consequently, it was the duty of true believers to yield implicit obedience to the vicegerents on earth of these secret rulers; (3.) The allegorical interpretation of the Koran, whereby any doctrine might be either defended or rejected. He also established a regular system of grades or a hierarchy of ranks among the members of the society; only a few members were fully initiated into the philosophy of indifference, the others were kept in a state of profound ignorance, for the rulers knew how necessary this was in order to secure their obedience.

The first open attempt to put their principles into practice was made by one Ahmed, surnamed Karmath, whence his followers were called Karmathites. After a sanguinary struggle with the caliphs, lasting during many years, this revolt was quelled. But about the same time an adherent of the sect, named Abdallah, a lineal descendant of Ismael, escaped from prison, into which he had been thrown, and, making his way to Egypt, succeeded in placing himself upon the throne of that country. Under the name of Obeid-Allah-Mahdi, he founded the dynasty of the Fatimites, who took their title from their ancestress, the daughter of Mahomet. Ismaelism thus secured a firm footing in the west, and its doctrines were propagated there with great success. At Cairo a grand lodge was formed in which their philosophical principles were perfected, and the process of initiation carried on in its several grades. While this lodge was at the height of its prosperity there arrived in Egypt a learned *dai* or missionary of the Eastern

Ismaelites, called Hassan Ben Sabbah. The father of this man, a native of Khorassan, and an adherent of the Shiites, had been frequently compelled to profess Sunnite orthodoxy, and from prudential motives had sent his son to study under an orthodox doctor at Nishapur. Here Hassan made the acquaintance of Nizam-el-Mulk, afterwards vizier of the Sultan Malik-Shah. During the reign of Alp-Arslan he remained in obscurity, and then appeared at the court of Malik-Shah, where he was at first kindly received by his old friend the vizier. Hassan, who was a man of great ability, tried to supplant him in the favour of the sultan, but was outwitted and compelled to take his departure from Persia. He went to Egypt, and, on account of his high reputation, was received with great honour by the lodge at Cairo. He soon stood so high in the Caliph Mostansar's favour as to excite against him the jealousy of the chief general, and a cause of open enmity soon arose. The caliph had nominated first one and then another of his sons as his successor, and in consequence a party division took place among the leading men. Hassan, who adopted the cause of Nezar, the eldest son, found his enemies too strong for him, and was forced to leave Egypt. After many adventures he reached Aleppo and Damascus, and after a sojourn there, settled near Kuhistan. He gradually spread his peculiar modification of Ismaelite doctrine, and having collected a considerable number of followers, formed them into a secret society. In 1090 he obtained, it is said by stratagem, the strong mountain fortress of Alamut in Persia, and removing there with his followers, settled as chief of the famous society afterwards called the Assassins.

The speculative principles of this body were identical with those of the Ismaelites, but their external policy was marked by one peculiar and distinctive feature—the employment of secret assassination against all enemies. This practice was introduced by Hassan, and formed the essential characteristic of the sect. In organisation they closely resembled the western lodge at Cairo. At the head was the supreme ruler, the *Sheikh-al-Jebal, i.e.*, Chief, or, as it is commonly translated, Old Man of the Mountains. Under him were three *Dai-al-Kirbal*, or, as they may be called, grand priors, who ruled the three provinces over which the sheikh's power extended. Next came the body of *Dais*, or priors, who were fully initiated into all the secret doctrines, and were the emissaries of the faith. Fourth were the *Refiks*, associates or fellows, who were in process of initiation, and who ultimately advanced to the dignity of *dais*. Fifth came the most distinctive class, the *Fedavies*, or *Fedais* (*i.e.*, the devoted ones), who were the guards or assassins proper. These were all young men, and from their ranks were selected the agents for any deed of blood. They were kept uninitiated, and the blindest obedience was exacted from and yielded by them. When the sheikh required the services of any of them, the selected *fedais* were intoxicated with the *hashish*, an opiate made from the juice of hemp leaves, and from which the name Assassin is derived. When in this state they were introduced into the splendid gardens of the sheikh, and surrounded with every sensual pleasure. Such a foretaste of Paradise, only to be granted by their supreme ruler, made them eager to obey his slightest command; their lives they counted as nothing, and would resign them at a word from him. Finally, the sixth and seventh orders were the *Lasiks*, or novices, and the common people. Hassan well knew the efficacy of established law and custom in securing the obedience of a mass of people; accordingly, upon all but the initiated, the observances of Islamism were rigidly enforced. As for the initiated, they knew the worthlessness of positive religion and morality; they believed in nothing, and scoffed at the practices of the faithful. The Assassins soon began to make their power felt. One of their first victims was Hassan's former friend, Nizam-el-Mulk, whose son also died under the dagger of a secret murderer. The death by poison of the Sultan Malik-Shah was likewise ascribed to this dreaded society, and contributed to increase their evil fame. Sultan Sanjar, his successor, made war upon them, but he was soon glad to come to terms with enemies whose operations were invisible, and against whom no precaution seemed available. After a long and prosperous rule Hassan died at an advanced age in 1124. He had previously slain both his sons, one on suspicion of having been concerned in the murder of a *dai* at Kuhistan, the other for drinking wine, and he was therefore compelled to name as his successor his chief *dai*, Kia-Busurg-Omid.

During the fourteen years' reign of this second leader, the Assassins were frequently unfortunate in the open field, and their castles were taken and plundered; but they acquired a stronghold in Syria, while their numerous murders made them an object of dread to the neighbouring princes, and spread abroad their evil renown. A long series of distinguished men perished under the daggers of the *fedais*; even the most sacred dignity was not spared. The Caliph Mostarschen-ali-Mansur was assassinated in his tent, and not long after, the Caliph Rashid suffered a similar fate. Busurg-Omid was succeeded by his son Mahomet I., who, during the long period of 25 years, ruthlessly carried out his predecessor's principles. In his time Massiat became the chief seat of the Syrian branch of the society. Mahomet's abilities were not great, and the affections of the people were drawn towards his son Hassan, a youth of great learning, skilled in all the wisdom of the initiated, and popularly believed to be the promised Imam become visible on earth. The old sheikh prevented any attempt at insurrection by slaying 250 of Hassan's adherents, and the son was glad to make submission. When, however, he attained the throne, he began to put his views into effect. On the 17th of the month Ramadan, he assembled the people and disclosed to them the secret doctrines of the initiated; he announced that the doctrines of Islam were now abolished, that the people might give themselves up to feasting and joy, for he was the promised Imam, the Caliph of God upon earth. To substantiate these claims he gave out that he was not the son of Mahomet, but was descended from Nezar, son of the Egyptian Caliph Mostansar, and a lineal descendant of Ismael. After a short reign of four years Hassan was assassinated by his brother-in-law, and his son Mahomet II. succeeded. One of his first acts was to slay his father's murderer, with all his family and relatives; and his long rule, extending over a period of 46 years, was marked by many similar deeds of cruelty. He had to contend with many powerful enemies, especially with the great Atabeg Sultan Noureddin, and his more celebrated successor, Jusuf Salaheddin, or Saladin, who had gained possession of Egypt after the death of the last Fatimite caliph, and against whom even secret assassination seemed powerless. During his reign, also, the Syrian branch of the society, under their *dai*, Sinan, made themselves independent, and remained so ever afterwards. It was with this Syrian branch that the Crusaders made acquaintance; and it appears to have been their emissaries who slew Count Raymond of Tripoli and Conrad of Montserrat.

Mahomet III. died from the effects of poison, administered, it is believed, by his son, Jelaleddin Hassan III., who succeeded. He restored the old form of doctrine,—secret principles for the initiated, and Islamism for the people,—and his general piety and orthodoxy procured for him the name of the new Mussulman. During his reign of 12 years no assassinations occurred and he obtained a high reputation among the neighbouring princes. Like his father, he was removed by poison, and his son, Ala-eddin Mahomet III., a child of nine years of age, weak in mind and body, was placed on the throne. Under his rule the mild principles of his father were deserted, and a fresh course of assassination entered on. In 1255, after a reign of 30 years, Alaeddin was slain, with the connivance of his son, Rokneddin, the last ruler of the Assassins. In the following year Hulaku, brother of the Tatar, Mangu Khan, invaded the hill country of Persia, took Alamut and many other castles, and captured Rokneddin. He treated him kindly, and, at his own request, sent him under escort to Mangu. On the way, Rokneddin treacherously incited the inhabitants of Kirdkuh to resist the Tartars. This breach of good faith was severely punished by the khan, who ordered Rokneddin to be put to death, and sent a messenger to Hulaku commanding him to slay all his captives. About 12,000 of the Assassins were massacred, and their power in Persia was completely broken. The Syrian branch flourished for some years longer, till Bibars, the Mameluke sultan of Egypt, ravaged their country and nearly extirpated them. Small bodies of them lingered about the mountains of Syria, and are believed still to exist there. Doctrines somewhat similar to theirs are to be met with among the Druses, and particularly among the Ansarii or Nosarii, a small Syrian people, dwelling not far from Latakia. Some writers have thought that these Ansarii are the remnants of the Assassins, but this does not seem possible, for the two sects are at enmity, and in 1809 the stronghold of Massiat, then in possession of some Ismaelites, was attacked and pillaged by the Ansarii.

See Von Hammer, *Geschichte der Assassinen*, 1818; De Sacy, *Mémoires de l'Institut*, iv., 1818, who discusses the etymology fully; *Calcutta Review*, vols. iv. lvi.; A. Jourdain in Michaud's *Histoire des Croisades*, ii. pp. 465–484, and translation of the Persian historian Mirkhond in *Notices et Extraits des Manuscrits*, xiii. p. 143, *sq.* On the Ansarii, see Michaud et Poujoulat, *Correspondance d'Orient*, vi. p. 458, *sq.*; and F. Walpole, *The Ansayrii, or Assassins*, 3 vols., 1851.

ASSAULT, in English Law, is defined "as an attempt or offer with force or violence to do corporal hurt to another, as by striking at another with a stick or other weapon, or without a weapon, though the party misses his aim." Notwithstanding ancient opinions to the contrary, it is now settled that mere words, be they ever so provoking, will not constitute an assault. Coupled with the attempt or threat to inflict corporal injury, there must in all cases be the means of carrying the threat into effect. A *battery* is more than a threat or attempt to injure the person of another; the injury must have been inflicted, but it makes no difference however small it may be, as the law does not "draw the line between degrees of violence," but "totally prohibits the first and lowest stage of it." Every battery includes an assault. A common assault is a misdemeanour, and is punishable by one year's imprisonment with hard labour, but severer penalties are provided for the various kinds of aggravated assaults.

ASSAYE, a village of Haidarábád, in the Nizám's dominions, in Southern India, situated in 20° 18′ N. lat. and 75° 55′ E. long. The place is celebrated as the site of a battle fought on the 23d September 1803 between the combined Marhattá forces under Sindhiá and the Rájá of Berar and the British under Major-General Wellesley, afterwards the Duke of Wellington. The Marhattá force consisted of 50,000 men, supported by 100 pieces of cannon entrenched in a strong position. Against this the English had but a force of 4500 men, which, however, after a severe struggle, gained the most complete victory that ever crowned British valour in India. Assaye is 261 miles N.W. of Haidarábád.

ASSAYING. This term is used in metallurgy to denote a chemical operation in which the quantity of one ingredient of a mineral or alloy is determined; it is chiefly used in reference to the precious metals, gold and silver, and it is in this connection that the subject will here be treated of. In the wider acceptation of the term in which it is used amongst practical metallurgists, *assaying* means almost the same thing as the quantitative estimation of one constituent of a compound, when the process adopted is one which has to be frequently repeated in a laboratory, and the results are required for commercial purposes. In this sense we speak not only of the assay of gold and silver, but of other metals, such as lead and copper, of non-metallic elements, such as sulphur and iodine, and even of compounds such as nitre. The operations of assaying were, until recently, chiefly performed by what is called the dry method, but of late years the processes of volumetric analysis have been so largely introduced into the metallurgical laboratory, that the wet method is almost as much used as the dry method. In the processes of assaying the precious metals described in the following pages, the reader will have both these terms explained, for gold is assayed in the dry, while silver is assayed in the wet way.

The precious metals, gold and silver, being almost universally used as convenient representatives of value, and as such passing frequently between one country and another, it is of the utmost importance to ascertain, quickly and accurately, the marketable value of any sample of gold or silver bullion. Were these metals invariably used in their pure state, their commercial value would be in direct proportion to their weight, and all that would have to be known would be the actual value of a pound of gold or silver; but the metals exist in commerce in the form of alloys or mixtures containing an indefinite amount of base metal. Gold is generally alloyed with copper and silver, whilst silver is generally alloyed with copper. The problem is, therefore, to ascertain by some ready process, which admits of extreme accuracy as well as moderate rapidity, the exact proportion of pure gold present in an alloy, ore, or mixture containing this metal; and inasmuch as silver is also a precious metal, the assay of gold almost always involves the assay of the silver which accompanies it, for in many cases the amount of silver present may be sufficient to increase the commercial value of the substance under assay. It is very seldom, however, that the copper or other metal present is in sufficient quantity to be of value, unless, indeed, the substance under assay be a copper ore or pyrites containing only traces of gold. In the case of silver assay, when the base metal is copper, it is generally neglected. It is, however, frequently necessary to examine silver for gold, for, formerly, the methods of parting these two precious metals were by no means so exact as they are now, and on this account old silver frequently contains an amount of gold which it will pay well to extract by modern methods. The principle of assaying gold and silver is very simple theoretically, but in practice great experience is necessary to ensure accuracy, and there is no branch of business which more demands personal and undivided attention.

All substances containing gold may be divided into two classes. The first class comprises ores containing gold in a mineralised form. These include graphic tellurium and foliated tellurium, and are of no commercial importance. For the present purpose, we need simply mention the substances in the second class, which consist of *alloys* of gold, and include *native gold*, containing from 65 to 99 per cent. of gold; *palladium gold*, containing about 86 per cent. of gold; *rhodium gold*, containing from 59 to 66 per cent. of gold; *gold amalgam*, containing 38 per cent. of gold; and *artificial alloys*, as gold coin, jewellery, &c. Of the foregoing list, the only alloys which are of commercial importance are, *native gold* and *artificial alloys*. Native gold is commonly found in a quartzose gangue, and nearly always associated with iron and copper pyrites, mispickel or arsenical pyrites, blende, galena, many antimonial minerals, and nearly all the primitive rocks.

The only artificial alloys of gold which will be specially noticed here are the standard gold of this realm, and alloys of gold with silver or copper used for jewellery. The standard of alloys of gold is expressed in fractions of unity. It is assumed that there are 24 carats in unity, and $\frac{32}{32}$nds in the carat. Standard gold, in the 24 carats, contains 22 carats of pure or fine gold, as it is called, and two carats of alloying metal, either silver or copper, or a mixture of the two. Standard gold is, therefore, called 22-carat gold. In a similar way articles of jewellery are denominated 12-carat, 16-carat, 18-carat, &c., according to the proportion of fine gold alloyed with the inferior metal. An ordinary assay report of gold expresses the variation from the standard, and not the fine metal contained in it, and it is, therefore, marked as either better or worse than standard. The standard of gold being 22 carats fine and 2 alloy, an ingot of gold found to contain only 21 carats pure gold would be reported *worse* 1 carat. If it contained 23½ carats, it would then be reported *better* 1½ carat.

The processes by which gold is generally assayed are *cupellation*, when the alloy consists of copper, and *parting*, when the alloy consists of silver. Generally speaking, both operations are necessary. We will describe them as they would be performed in practice. When the standard of the alloy to be examined is not approximatively known, a preliminary assay must be made to ascertain the quantity of lead necessary to fuse with the gold alloy. But in most cases this is unnecessary, as, from the circumstances of the case, the standard of the alloy is generally known within sufficiently close limits.

The process of cupellation is briefly as follows:—The gold alloy is fused with a quantity of lead, and a little silver if silver is already present. The resulting alloy, which is called the *lead button*, is then submitted to fusion on a very porous support, made of bone-ash, and called a *cupel*. The fusion being effected in a current of air, the lead oxidises. The heat is sufficient to keep the resulting oxide of lead fused, and the porous cupel has the property of absorbing melted oxide of lead without taking up any of the metallic globule, exactly in the same way that blotting-paper will absorb water whilst it will not touch a globule of mercury. The heat being continued, and the current of air always passing over the surface of the melted lead button, and the oxide of lead or *litharge* being sucked up by the cupel as fast as it is formed, the metallic globule rapidly diminishes in size until at last all the lead has been got rid of. Now, if this were the only action, little good would have been gained, for we should simply have put lead into the gold alloy, and then taken it out again; but another action goes on whilst the lead is oxidising in the current of air. Other metals, except the silver and gold, also oxidise, and are carried by the melted litharge into the cupel. If the lead is therefore rightly proportioned to the standard of alloy, the resulting button will consist of only gold and silver, and these are separated by the operation of *parting*, which consists in boiling the alloy (after rolling it to a thin plate) in strong nitric acid, which dissolves the silver and leaves the gold as a coherent sponge. To effect this parting properly, the proportion of silver to gold should be as 3 to 1. The operation by which the alloy is brought to this standard is termed *quartation* or *inquartation*, and consists in fusing the alloys in a cupel with lead and the quantity of fine silver or fine gold necessary to bring it to the desired composition.

What is called the *Trial of the Pyx* is an ancient ceremony which takes place about once in every three years, at which the standard coin of the realm is carefully assayed. For a description of this see the article COINAGE.

It is unnecessary in the present work to describe the various delicate operations which we have briefly alluded to above, but we will describe the implements and furnaces which have been introduced and adopted in the Royal Mint by Mr H. W. Field, the late resident assay-master of that establishment.

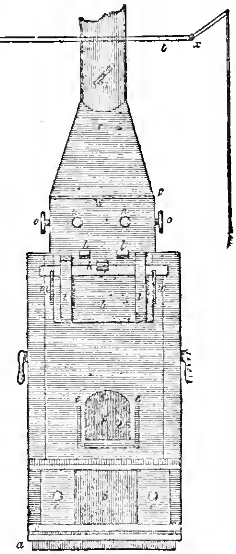


FIG. 1.—Front elevation of Furnace.

Fig. 1 is the front elevation of the furnace; *a*, a view of the front iron roller on which it rests, *b*, the ash-pit; *cc* are the dampers moving horizontally from side to side towards each other, meeting exactly in the centre; *d*, the muffle door by which the assays are introduced; *ee*, the door slides. So far, the furnace is similar to that formerly in use, except that the bars on which the muffle stands run from front to back, and are movable, rendering the removal of the brick-work unnecessary. By this means the muffle stand is easily introduced, and, having steady pins on the under side, it is raised about an inch above the bars. The furnace measures 2 feet 10 inches in height, 1 foot 7 inches in width, and 1 foot 11 inches in depth. Instead of the furnace, as formerly, being fed at the top, the fuel is charged by the door *h*, which also affords the means of regulating the draught, and of throwing a current of air through the muffle by the door *d*. This door has a bar *k*, traversing about two-thirds of it, running easily from the top towards the bottom within *ii*, with a ketch *m*, on each side to keep it close. These are made on an incline, and about 3½ inches long, so as to allow the traversing bar to slide freely when the door is not required to be closed. In this manner the door may be opened from a quarter of an inch to the extent of three inches. This feeding and regulating door is fixed by hinges *ll* to the front part of the *iron frame* covering the brick lining on the top of the furnace. On this frame rests the square dome *r*, the front of which, *w*, is removable by two handles *nn*; and by taking out the two thumb-screws *oo*, the door and part of the frame come away, leaving a large opening, so as to enable the furnace to be cleaned, the muffle repaired, &c. The furnace should be placed in a recess, under a chimney, with a movable iron ceiling *t*, about 1 foot above the dome, fitting close in every part, so that the draught of air may pass through the furnace. A door, or flap, *x*, is attached to the iron ceiling by a hinge opening on the side of the recess, with means to fix it at any point required, so that the current of air may be regulated by the operator; *s*, a swivel door affords another mode for damping the furnace.

Fig. 2 is a section of the furnace fig. 1; *aa*, the two rollers on which the furnace is placed; *bb*, the slides on which the ash-pit doors run; *c*, the door and ash-pit; *d*, the iron casing to the furnace; *e*, the brick lining; *f*, the ash-pit; *gg*, the two bars inserted in the brick lining,—one in front, one at the back supporting the furnace bars, which can easily be removed at pleasure; *h*, one of the bars on which the muffle plate rests; *i*, a movable tray on which the mouth coal is placed; *k*, a section of a muffle charged with its full complement of 50 cupels, showing also the rows of holes over each row of cupels, through which a current of air passes; similar holes are placed at the back in three rows; they are not pierced through horizontally, but slope towards the ceiling of the muffle at such an angle so as to exclude the ashes; *l* represents the extra covering of fire-clay; *m*, the anthracite coal, showing the level; *n*, the feeding and regulating door; *o*, the ketch or inclined plane on which the sliding-bar travels; *p*, the door, with running staples in which the bar slides; *q*, the mode in which the movable front is brought round and fixed by the thumb-screws *r*; *sv*, the hood; *t*, handle for removing the front; *wx*, the damper and handle.

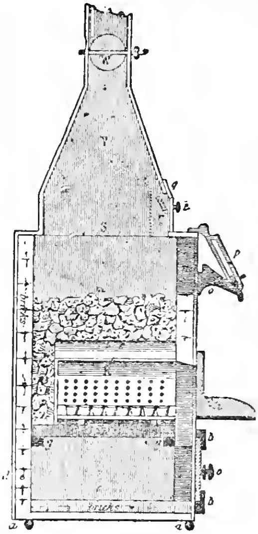


FIG. 2.—Section of Furnace.

Fig. 3 represents the upper interior view of the furnace bars with the muffle stand or plate, showing also the space intended for the fuel.

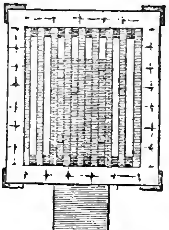


FIG. 3.—Section of Furnace.

Fig. 4 is the mouth of the muffle door, representing the mode of regulating the current of air by cylinders of charcoal.

Fig. 5 is the movable muffle door.

Fig. 6 is a representation of a muffle, $14\frac{1}{2}$ inches long, $7\frac{1}{2}$ inches wide, until it begins to taper at about $1\frac{1}{2}$ inches from the front (see fig. 7), when it does not exceed $5\frac{1}{2}$ inches. The height is $6\frac{1}{2}$ inches, in the clear $5\frac{5}{8}$ inches. Its sides are perforated with holes about a quarter of an inch in diameter.

Fig. 4.

Fig. 5.

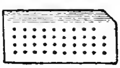


Fig. 6.

Fig. 7.

Fig. 8 is an annealing-iron for softening the assays after they are flattened and rolled. It resembles a square bar of iron about $\frac{1}{8}$th of an inch thick, having strengthening pieces rivetted at each end and two in the middle *bbb*, between which are receiving places for the assays *aaa*. The apertures are made diagonally, as shown by *ccc*, that the assays may not fall completely to the bottom of the box, so that they may be conveniently removed. The under part of the box has a kind of double keel *d* rivetted on it, so that in taking it from the furnace there be no danger of upsetting it on the *annealing trident*.

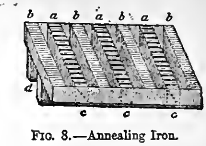


FIG. 8.—Annealing Iron.

Fig. 9 represents the trident for removing the annealing-iron from the furnace.

FIG. 9.—Trident.

Fig. 10 represents the cupel mould; fig. 11 being the section of the same, showing the four pieces of which it consists. The mould is circular, made of forged steel nicely turned. There are several substances of which cupels may be made, but the one in general use is the ash of burnt bones. This consists principally of phosphate of lime, with a little carbonate and some fluoride of calcium. The bones of sheep and horses are best for cupels. They should be burnt until they are quite white, care being taken not to heat the bone-earth too strongly. It must then be finely ground, sifted, and washed several times with boiling distilled water till all soluble salts are removed. The finest particles of the powdered bone-earth will remain longest suspended in the washing waters. This must be allowed to settle separately, and should be reserved for giving a final coating to the surface of the cupels. For the body of the cupels the bone-ash should be about as fine as wheat flour. The bone-ash being moistened with a quantity of water, just sufficient to make the particles adhere, is put into the mould *a*, fig. 11, and pressed down level with the surface. The mould is then put together, as in fig. 10, and the pestle struck with a hammer so as to compress the bone earth into a solid cake. The surface of the cupel may then have sifted over it a little of the very fine levigated bone-ash, and the pestle again hammered on it. The pestle is to be turned lightly round so as to smooth the inner surface of the cupel, and then withdrawn. The cupel is removed from the mould by gentle pressure on the narrowest end. It must be dried gently by a stove, and lastly ignited in a muffle to expel all moisture. It is then ready for use.

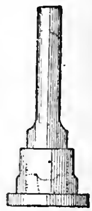


FIG. 10.—Cupel Mould.

FIG. 11.—Section of Cupel Mould.

Fig 12 shows the appearance of the finished cupel, which is generally 1 inch by $\frac{7}{8}$ths of an inch.

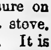


Fig. 12.

The lead used in cupellation should be of the greatest purity, because, as most lead contains a small portion of silver, this silver would necessarily combine with the assay and vitiate the accuracy of the result. Another important consideration is the *quantity* of lead to be used with each assay. This information is generally obtained by an experimental assay, unless, as most frequently happens, the circumstances of the case enable the assayer to judge the approximate standard of the alloy with sufficient accuracy. The sample of gold alloy is either cut from a corner, or drilled out of the centre of an ingot, care being taken to secure uniformity of composition with the whole mass. The amount of lead to be added to the alloy varies with the proportion of base metal present; as a rule, from 10 to 20 parts are required to 1 of alloy.

The amount of lead having been determined, the alloy is wrapped up in a known quantity (say one-half of that required for its purification), formed into a case somewhat resembling a thimble, great care being taken to make the joints firm and close so that no gold shall escape. The requisite quantity of silver is added at the same time. When a number of assays are made at the same time, they are arranged, enveloped in their lead cases, on a board divided into compartments corresponding in number and position with the cupels into which they are intended to be charged. As the assayer generally makes two or more trials of the same piece, so that great accuracy may be secured, it is his practice to give one assay a side place in the muffle, and the second a middle one, in order to check any irregularity in the result. When a sufficient number of assays are weighed and arranged upon the board in the manner referred to, and the furnace as well as the cupels raised to the necessary point of heat, the charging tongs are then taken, and the rest of the lead and silver apportioned to each assay placed individually upon the cupels, beginning at the back of the muffle. The lead added in this case is not flattened, but is a piece of known weight—various sizes of which, as well as cases, are kept in stock by the assayer. The lead so placed in the furnace rapidly melts, and becomes covered with a gray oxide, but soon after appears fluid and bright. At this point the assays are added by means of a pair of tongs (fig. 13), great care being taken that no part overhangs or touches the edge of the cupel. The assays are thus drawn into the mass of molten lead, and any particles of gold are in this manner prevented from adhering to the sides of the cupels in charging, sufficient despatch being used to obviate the fusion of the assay in its transition. The assays being charged in order on their respective cupels, and the furnace previously filled with fuel, the door of the muffle is partly closed, and the progress of the cupellation watched. Too much air must not enter, or the muffle will be chilled and the progress retarded, whilst if too little enters the operation will be too slow.


Fig. 13.

At first dense fumes will be observed to rise from the melted metal, indicating the oxidation and subsequent volatilisation of the lead. These after continuing some time are followed by the appearance of small luminous points on the surface, which increase in size and brilliancy as the operation progresses. Then a minute stream of red fused oxide of lead is seen to flow from the top of the metal globule and circulate round, when it is carried down and absorbed by the cupel. This is caused by the oxidation of the lead by the air, which at the same time oxidises the other metals, except silver, which accompany the gold. As the cupellation advances the fumes gradually lessen in density till they disappear altogether. The melted button at this stage is observed to become more convex and round, and as the last vestiges of the lead and alloy are being carried off, it assumes a cloudy appearance on the surface, changing to large bright points of the fused oxide, till at length it is nearly freed from all impurity. At this point the gold-silver alloy displays some singular and beautiful characteristics. Deprived of all the base alloy save the last minute portion that tarnished its lustre, it has become bright and pure, and finally it gives forth from its surface iridescent circulating bands of light, which indicate the successful completion of the operation. The globules after being cooled, are removed from the cupels with a pair of pincers and carefully cleaned. They are then placed in their compartments and weighed with the greatest nicety. Finally, they are submitted to the operation of *parting*. This is effected by boiling with strong nitric acid, which dissolves the silver and leaves the gold as a sponge. The gold-silver globule is first passed through a flattening mill, and reduced to long thin strips, which are annealed and then rolled up into a corkscrew spiral, so that the acid may penetrate between each fold. The spirals are now transferred in order to small platinum cups arranged on a frame, so that they can be simultaneously lowered into and removed from the nitric acid. They are kept in the hot acid for the requisite time, then washed, and the residual gold sponge, which possesses considerable coherence, and retains the shape of the original spiral, is carefully dried and finally weighed with the greatest possible accuracy.

We shall now proceed to describe briefly the process of silver assay. The cupellation process does not differ except in details from that of gold,—the outline already given will, therefore, be a sufficient description. Like gold, silver occurs in two classes of combinations,—*mineralised*, as in *red silver ore*, *chloride of silver*, *argentiferous galena*, &c., or as *metallic silver* and its alloys. In metallurgical establishments, where silver occurs in small proportion with metallic sulphides, such as those of lead or copper, the process of cupellation is generally adopted not only for quantitative estimation of the amount of silver present in the ore. but also for its extraction on the large scale. In the assay of silver bullion. however, the process of cupellation is now almost entirely superseded by a volumetric process, devised by the distinguished French chemist, Gay-Lussac, by whose influence it was introduced into the Paris Mint. The process consists in determining the fineness of silver bullion by the quantity of a standard solution of common salt necessary to precipitate fully and exactly the silver contained in a known weight of alloy. This process is based on the following principles :—

The alloy previously dissolved in nitric acid is mixed with a standard solution of common salt, which precipitates the silver as chloride, a compound perfectly insoluble in water and even in acids. The quantity of chloride of silver precipitated is determined not by its weight, which would be less exact, and occupy too much time, but by the weight or volume of the standard solution of common salt necessary to precipitate exactly the silver previously dissolved in nitric acid. The term of complete precipitation of the silver can be readily recognised by the cessation of all cloudiness when the salt solution is gradually poured into that of the nitrate of silver. One milligramme of that metal is readily detected in 150 grammes of liquid, and even a half or a quarter of a milligramme may be detected if the liquid be perfectly bright before the addition of the salt solution. By violent agitation during a minute or two, the liquid, rendered milky by the precipitation of chloride of silver, becomes sufficiently bright after a few moments' repose to allow of the effect of the addition of half a milligramme of silver to be perceptible. Filtration of the liquid is more efficacious than agitation ; but the latter, which is much more rapid, generally suffices. The presence of copper, lead, or any other metal, with the exception of mercury in the silver solution, has no sensible influence on the quantity of salt required for precipitation ; in other words, the same quantity of silver, pure or alloyed, requires for its precipitation a constant quantity of the standard salt solution. Supposing that 1 gramme of pure silver be the quantity operated on, the solution of salt required to precipitate exactly the whole of the silver ought to be of such strength that, if it be measured by weight, it shall weigh exactly 100 grammes, or if by volume, 100 cubic centimetres. This quantity of salt solution is divided into 1000 parts, called thousandths. The standard of an alloy of silver is generally the number of thousandths of solution of salt necessary to precipitate the silver contained in a gramme of the alloy.

The operations of assaying depend for their accuracy on the perfection of the balance used to ascertain the weights of the metals taken, and the resulting globules. In a good assay balance three essentials are indispensable:—(1.) It should be quick in its action; (2.) It should be constant and uniform; (3.) It should be extremely sensitive and delicate, indicating the minutest shades of difference. Assay balances, as now constructed, are capable of indicating a difference of the ten-thousandth of a grain. For a description of the modern chemical balance, see article BALANCE. (W. C.)

ASSELYN, HANS, a celebrated Dutch painter, was born at Antwerp in 1610, and died at Amsterdam in 1660. He received instruction from Esaias Vandervelde, and distinguished himself particularly in landscape and animal painting, though his historical works and battle-pieces are also admired. He travelled much in France and Italy, and modelled his style greatly after Bamboccio (Peter Laer). He was one of the first Dutch painters who introduced a fresh and clear manner of painting landscapes in the style of Claude Lorraine, and his example was speedily followed by other artists. Asselyn's pictures were in high estimation at Amsterdam, and several of them are in the museums of that city. Twenty-four pieces of landscapes and ruins, which he painted in Italy, have been engraved by Perelle.

ASSEMANI, the name of a Syrian Maronite family of famous Orientalists.

(1.) JOSEPH SIMON, a Maronite of Mount Lebanon, was born in 1687. When very young he was sent to the Maronite college in Rome, and was transferred thence to the Vatican Library. In 1717 he was sent to Egypt and Syria to search for valuable MSS., and returned with about 150 very choice ones. The success of this expedition induced the Pope to send him again to the East in 1735, and he returned with a still more valuable collection. On his return he was made titular archbishop of Tyre and librarian of the Vatican Library. He instantly began to carry into execution most extensive plans for editing and publishing the most valuable MS. treasures of the Vatican. His two great works are the *Bibliotheca Orientalis Clementino-Vaticana rec. manuscr. codd. Syr., Arab., Pers., Turc., Hebr., Samarit., Armen., Æthiop., Græc., Ægypt., Iber., et Malab., jussu et munif. Clem.* XI., Romæ, 1719–28, nine vols. folio, and *Ephraemi Syri opera omnia quæ extant, Gr., Syr., et. Lat.*, 6 vols. folio, Rome, 1737–46. Of the *Bibliotheca* the first three vols. only were completed. The work was to have been in four parts—(1.) Syrian and allied MSS., orthodox, Nestorian, and Jacobite; (2.) Arabian MSS., Christian and Mahometan; (3.) Coptic, Æthiopic, Persian, and Turkish MSS.; and (4.) Syrian and Arabian MSS. not distinctively theological; only the first part was completed, but extensive preparations were made for the others. There is a German abridgement by A. F. Peiffer.

(2.) JOSEPH ALOYSIUS, brother of Joseph Simon, and professor of Oriental languages at Rome. He died in 1782. Besides aiding his brother in his literary labours, he published, in 1749–60, *Codex Liturgicus Ecclesiæ Universæ in xv. libris* (this is incomplete), and *Comment. de Catholicis sive Patriarchis Chaldæorum et Nestorianorum*, Rome, 1775.

(3.) STEPHEN EVODIUS, nephew of Joseph Simon and Joseph Aloysius, was the chief assistant of his uncle Joseph Simon in his work in the Vatican Library. He was titular archbishop of Apamea in Syria, and held several rich prebends in Italy. His literary labours were very extensive. His two most important works were a description of certain valuable MSS. in his *Bibliothecæ Mediceo-Laurentianæ et Palatinæ codd. manuscr. Orientalium Catalogus*, Flor. 1742, fol., and his *Acta SS. Martyrum Orientalium.* He made several translations from the Syrian, and in conjunction with his uncle, he began the *Bibliothecæ Apostol. Vatic. codd. manusc. Catal., in tres partes distributus.* Only three vols. were published, and the fire in the Vatican Library in 1768 consumed the manuscript collections which had been prepared for the continuation of the work.

(4.) SIMON, grandnephew of Joseph Simon, was born at Tripoli in 1752, and was professor of Oriental languages in Padua. He died in 1820. He is best known by his masterly detection of the literary imposture of Vella, which claimed to be a history of the Saracens in Syria.

ASSEN, a town of the Netherlands, capital of the province of Drenthe, containing 6836 inhabitants. It lies 16 miles south of Groningen, is connected with the Zuyder-Zee by the Smilder canal, has a considerable trade in corn and peats. There are a number of highly interesting tumuli in the neighbourhood, in which various relics have been found, which are now deposited in the museum at Leyden.

ASSENS, a town of Denmark, on the west coast of Fühnen, the ordinary port for the traffic between that island and Schleswig. In 1535 it was stormed by John of Ranzau, and afterwards plundered and dismantled; but its fortifications, of which traces are still to be found, were restored in 1628. Population, 3581. Long. 9° 55′ E., lat. 55° 15′ N.

ASSER, JOHN, or ASSERIUS MENEVENSIS, was born in Pembrokeshire, and educated in the monastery of St David's by the Archbishop Asserius, who, according to Leland, was his kinsman. Here he became a monk, and by his assiduous application soon acquired universal fame as a person of great abilities and profound learning. King Alfred, always a munificent patron of genius, about the year 880 sent for him to court, and made him his preceptor and companion. As a reward for his services, the king appointed him abbot of two or three different monasteries, and at last promoted him to the episcopal see of Sherborne, where he died in the year 910. He was, says Pits, a man of happy genius, wonderful modesty, extensive learning, and great integrity of life. He wrote the life of Alfred (*De Vita et Rebus Gestis Alfredi*), in 893, apparently for the use of his Welsh countrymen. The authenticity of this work was denied by Mr Wright (in his *Biographia Britannica Literaria*), who thought it was the production of some monk of St Neots about the end of the 10th century. In this, however, he has had few followers, and the work is generally believed to be Asser's, though somewhat interpolated. It was first published by Archbishop Parker at the end of Walsingham's *Hist. Lond.*, 1574. The best editions are those of Wise (8vo, Oxon., 1722), and of Thorpe in his edition of *Florence of Worcester* for the English Historical Society. An English translation is to be found in Bohn's *Antiquarian Library.*

ASSESSOR, among the Romans, was a term generally applied to a trained lawyer who sat beside a governor of a province or other magistrate, to instruct him in the administration of the laws. The system is still exemplified in Scotland, where it is usual in the larger towns for municipal magistrates, in the administration of their civil jurisdiction, to have the aid of professional assessors. In municipal corporations in England, officers with the same name are appointed to assist at the election of councillors and ascertain the result. By the recent English Judicature Act, provision is made for trial of matters of fact by the judge with assessors instead of by jury, when parties so desire.

ASSETS, a technical English law word, derived through the old Norman phraseology from the same source as the French *assez*, enough, and signifying the property of a debtor available for the satisfaction of his creditors. Thus the property of a bankrupt is termed his *assets*, and is the fund out of which his liabilities must be paid. When a person dies, the goods which come to executors or administrators are called assets *personal;* the lands descending to the heir, are assets *real*. The former are the primary and natural fund out of which the debts of the testator or intestate of every description must be paid. The latter, by 3 and 4 Will. IV. c. 104, are also available, after the personal estate is exhausted, and preference is given to creditors by specialty over creditors by simple contract When one of two claimants may go to either fund, and the other is restricted to one fund only, if the first claimant has recourse to the fund open to both, equity will permit the other claimant to stand in the place of the first against the other fund. This is called *marshalling the assets.* If, for example, before the statute 3 and 4 Will. IV. c. 104, a special creditor, who might claim against either the real or the personal assets, satisfied his debt out of the latter, a creditor by simple contract, having the latter only to claim against, would be permitted to stand in place of the specialty creditor against the real estate.

ASSIDEANS, in Greek Ἀσιδαῖοι, is a transcription of the Hebrew *chasîdîm, pious ones*, a word frequent in the Psalms (xxxvii. 28, lxxix. 2, &c.,—E.V. generally *saints*). In the first book of Maccabees the name of Assideans appears as the designation of a society of men zealous for the law (1 Mac. ii. 42, according to the correct text as given by Fritzsche), and closely connected with the scribes (1 Mac. vii. 12, 13). It is plain from these passages that this society of "pious ones," who held fast to the law under the guidance of the scribes in opposition to the "godless" Hellenising party, was properly a religious, not a political organisation. For a time they joined the revolt against the Seleucids. But the direct identification of the Assideans with the Maccabee party in 2 Mac. xiv. 6 is one of the many false statements of that book, and directly contradictory to the trustworthy narrative of 1 Mac. vii., which shows that they were strictly a religious party, who scrupled to oppose the legitimate high priest even when he was on the Greek side, and who withdrew from the war of freedom as soon as the attempt to interfere with the exercise of the Jewish religion was given up. Under the Asmonean rule the Assideans developed into the better known party of the Pharisees, and assumed new relations to the ruling dynasty. It appears, however, from the *Psalter of Solomon* that the party continued to affect the title of "pious ones." Most recent inquirers hold that the Essenes as well as the Pharisees sprung from the Assideans (Ewald's *Geschichte*, vol. iv.; Wellhausen, *Die Pharisäer und die Sadducäer*, 1874).

ASSIGNMENT, Assignation, Assignee, are terms which, as derivatives of the verb assign, are of frequent technical use in the law of the different parts of the United Kingdom. To assign is to make over, and the term is generally used to express a transference by writing, in contradistinction to a transference by actual delivery. In England the usual expression is assignment, in Scotland it is assignation. The person making over is called the *assignor* or *cedent;* the recipient, the *assign* or *assignee.*

ASSISI (ancient *Asisium*), a city of Italy in the province of Perugia. It contains about 6000 inhabitants, depending chiefly for subsistence on the devotees, who, to the number of many thousands, make annual pilgrimages to the church which contains the tomb and bears the name of St Francis, the founder of the Franciscan order, who was born at Assisi in 1182. (See Francis, St.) This building is in the Pointed style, and was erected between the years 1228–30 It is attributed by Vasari to a German architect, and by its historian, Pietro Ridolfi, it is called Opus Teutonicum (Hope, *On Architecture*, vol. i.) The remains of an ancient temple of Minerva stand in the market-place, composed of six Corinthian pillars of fine proportions, and now forming the portico of Santa Maria de Minerva; and there are several churches of considerable artistic importance. The poet Metastasio was born here in 1698. Long. 12° 24′ 50″ E., lat. 43° 4′ 22″ N.

ASSIZE or Assise (from *assideo*, to sit together; Old French, *assire*, to set, *assis*, seated), literally signifies a "session," but is, in fact, as Littleton has styled it, a *nomen æquivocum*, meaning sometimes a jury, sometimes the sittings of a court, and sometimes the ordinances of a court or assembly.

1. It signified the form of trial by a jury of sixteen persons, which eventually superseded the barbarous judicial combat; this jury was named the Grand Assize. The Grand Assize was abolished by 3 and 4 Will. IV. c. 27; but the term assize is still applicable to the jury in criminal causes in Scotland.

2. In the only sense in which the word is not now almost obsolete, assize means the periodical session of the judges of the superior courts of Common Law, held in the various counties of England, chiefly for the purposes of gaol delivery and trying causes at *Nisi Prius.* Previous to Magna Charta (1215) writs of assize had all to be tried at Westminster, or to await trial in the locality in which they had originated at the septennial circuit of the justices in eyre; but, by way of remedy for the great consequent delay and inconvenience, it was provided by this celebrated Act that the assizes of *mort d'ancestor* and *novel disseisin* should be tried annually by the judges in every county. By successive enactments, the civil jurisdiction of the justices of assize was extended, and the number of their sittings increased, till at last the necessity of repairing to Westminster for judgment in civil actions was almost obviated to county litigants by an Act, passed in the reign of Edward I., which provided that the writ summoning the jury to Westminster should also appoint a time and place for hearing such causes within the county of their origin. The date of the alternative summons to Westminster was always subsequent to the former date, and so timed as to fall in the vacation preceding the Westminster term; and thus "*Unless before,*" or *Nisi Prius*, issues came to be dealt with by the judges of assize before the summons to Westminster could take effect. The *Nisi Prius* clause, however, was not then introduced for the first time. It occurs occasionally in writs of the reign of Henry III. The Royal Commissions to hold the assizes are—(1.) General, (2.) Special. The General Commission is issued twice a year to the superior courts of Common Law at Westminster, and two judges are generally sent on each circuit. It covers commissions—(1.) of *oyer* and *terminer;* (2.) of Nisi Prius; (3.) of gaol delivery; (4.) of the peace. Special commissions are granted for inquest in certain causes and crimes.

3. Assizes, in the sense of ordinances or enactments of a court or council of state, are of considerable interest in our earlier economic history. As early as the reign of John the observance of the *assisæ venalium* was enforced, and for a period of five hundred years thereafter it was considered no unimportant part of the duties of the legislature to regulate by fixed prices, for the protection of the lieges, the sale of bread, ale, fuel, &c. Sometimes in city charters the right to assize such articles is specially conceded. Regulations of this description, though hostile to free trade, were beneficial in the repression of fraud and adulteration.

4. Assizes are sometimes used in a wider legislative connection by early chroniclers and historians,—the "assisæ of the realme," *e.g.*, occasionally meaning the organic laws of the country. In a still more extended sense, the "Assizes of Jerusalem" is the name given to the code of laws framed for the kingdom of Jerusalem at the instance of Godfrey of Bouillon, the Crusader.

ASSOCIATION OF IDEAS, or MENTAL ASSOCIATION, is a general name used in psychology to express the conditions under which representations arise in consciousness, and also is the name of a principle of explanation put forward by an important school of thinkers to account generally for the facts of mental life. The more common expression, from the time of Locke, who seems to have first employed it, has been Association of Ideas; but it is allowed or urged on all hands that this phrase contains too narrow a reference; association, in either of the senses above noted, extending beyond ideas or thoughts proper to every class of mental states. In the long and erudite Note D**, appended by Sir W. Hamilton to his edition of *Reid's Works*, and offered as a contribution towards a history of the doctrine of mental suggestion or association, many anticipations of modern statements are cited from the works of ancient or mediæval thinkers, and for Aristotle, in particular, the glory is claimed of having at once originated the doctrine and practically brought it to perfection. Aristotle's enunciation of the doctrine is certainly very remarkable. As translated by Hamilton, but without his interpolations, the classical passage from the tract *De Memoria et Reminiscentia* runs as follows :—

"When, therefore, we accomplish an act of reminiscence, we pass through a certain series of precursive movements, until we arrive at a movement on which the one we are in quest of is habitually consequent. Hence, too, it is that we hunt through the mental train, excogitating from the present or some other, and from similar or contrary or coadjacent. Through this process reminiscence takes place. For the movements are, in these cases, sometimes at the same time, sometimes parts of the same whole, so that the subsequent movement is already more than half accomplished."

The passage is obscure (leaving open to Hamilton to suggest a peculiar interpretation of it, that may be noticed in connection with the elaborate doctrine of association put forward by himself, as if to evince the shortcomings rather than the perfection of Aristotle's), but it does in any case indicate the various principles commonly termed Contiguity, Similarity, and Contrast; and, though the statement of these cannot be said to be followed up by an effective exposition or application, it quite equals in scope the observations of many a modern inquirer. Zeno the Stoic also, and Epicurus, according to the report of Diogenes Laertius (vii. § 52, x. § 32, overlooked by Hamilton), enumerated similar principles of mental association. By St Augustin, at the end of his long rhapsody on the wonders of memory in book x. of his *Confessions*, it was noted (c. 19) that the mind, when it tries to remember something it knows it has forgotten, has, as it were, hold of part and thence makes quest after the other part. Meanwhile and later, Aristotle's doctrine received a more or less intelligent expansion and illustration from the ancient commentators and the schoolmen; and in the still later period of transition from the age of scholasticism to the time of modern philosophy, prolonged in the works of some writers far into the 17th century, Hamilton, from the stores of his learning, is able to adduce not a few philosophical authorities who gave prominence to the general fact of mental association—the Spaniard Ludovicus Vives (1492–1540) especially being most exhaustive in his account of the conditions of memory. This act of justice, however, once rendered to earlier inquirers, it is to modern views of association that attention may fairly be confined.

In Hobbes's psychology so much importance is assigned to what he called, variously, the succession, sequence, series, consequence, coherence, train, &c., of imaginations or thoughts in mental discourse, that he has not seldom been regarded, by those who did not look farther back, as the founder of the theory of mental association. He did, indeed, vividly conceive and illustrate the principle of Contiguity, but, as Hamilton conclusively shows, he reproduced in his exposition but a part of the Aristotelian doctrine, nor even this without wavering; representing the sequence of images, in such states as dreams, now (in his *Human Nature*) as casual or incoherent, now (in *Leviathan*), following Aristotle, as simply unguided. Not before Hume, among the moderns, is there express question as to a number of distinct principles of association. Locke had, meanwhile, introduced the phrase Association of Ideas as the title of a supplementary chapter incorporated with the fourth edition of his *Essay*, meaning it, however, only as the name of a principle accounting for the mental peculiarities of individuals, with little or no suggestion of its general psychological import. Of this last Hume had the strongest impression, and thinking himself, in forgetfulness or ignorance of Aristotle's doctrine of reminiscence, the first inquirer that had ever attempted to enumerate all the modes of normal association among mental states, he brought them to three—Resemblance, Contiguity in time and place, Cause and (or) Effect. Without professing to arrive at this result otherwise than by an inductive consideration of instances, he yet believed his enumeration to be exhaustive, and sought to prove it so by resolving Contrast—one of Aristotle's heads, commonly received—as a mixture of causation and resemblance. Viewed in relation to his general philosophical position, it must always remain a perplexing feature of Hume's list of principles, that he specified Causation as a principle distinct from Contiguity in time, while otherwise the list has no superiority to Aristotle's. Hume's fellow-countrymen, Gerard and Beattie, in opposition to him, recurred accordingly to the traditional enumeration; and, in like manner, Dugald Stewart put forward Resemblance, Contrariety, and Vicinity in time and place, though he added, as another obvious principle, accidental coincidence in the sounds of Words, and farther noted three other cases of relation, namely, Cause and Effect, Means and End, and Premisses and Conclusion, as holding among the trains of thought under circumstances of special attention. Reid, preceding Stewart, was rather disposed, for his own part, to make light of the subject of association, vaguely remarking that it seems to require no other original quality of mind but the power of habit to explain the spontaneous recurrence of trains of thinking, when become familiar by frequent repetition (*Intellectual Powers*, p. 387). The counter-observation of his editor, Hamilton, that we can as well explain habit by association as association by habit, might with reason have been pointed more sharply.

Hamilton's own theory of mental reproduction, suggestion, or association, given in outline in Note D***, following the historical note before mentioned, at the end of his edition of *Reid's Works*, calls for more special notice, as perhaps the most elaborate expression yet devised for the principles involved in the phenomena of mental representation. It is a development, greatly modified, of the doctrine expounded in his *Lectures on Metaphysics* (vol. ii. p. 223, *seq.*), which in agreement with some foreign authorities, reduced the principles of association first to two—Simultaneity and Affinity, and these farther to one supreme principle of Redintegration or Totality. In the ultimate scheme he posits no less than four general laws of mental succession concerned in reproduction: (1.) Associability or possible co-suggestion (all thoughts of the same mental subject are associable, or capable of suggesting each other); (2.) Repetition or direct remembrance (thoughts coidentical in modification, but differing in time, tend to suggest each other); (3.) Redintegration, direct remembrance or reminiscence (thoughts once coidentical in time, are, however, different as mental modes, again suggestive of each other, and that in the mutual order which they originally held); (4.) Preference (thoughts are suggested not merely by force of the general subjective relation subsisting between themselves, they are also suggested in proportion to the relation of interest, from whatever source, in which they stand to the individual mind) Upon these follow, as special laws:—A, Primary—modes of the laws of Repetition and Redintegration—(1), law of Similars (Analogy, Affinity); (2), law of Contrast; (3), law of Coadjacency (Cause and Effect, &c.); B, Secondary—modes of the law of Preference, under the law of Possibility—(1), laws of Immediacy and Homogeneity; (2), law of Facility. Such is the scheme; and now may be understood what interpretation Hamilton desires to put upon Aristotle's doctrine, when he finds or seeks in it a parallel relation to that established by himself between the general laws, more especially Redintegration, and his special ones. But, though the commentary of Themistius, which he cites, lends some kind of support to the position, it cannot be maintained without putting the greatest strain on Aristotle's language, and in one place it is as good as surrendered by Hamilton himself (footnote, p. 900, *b*). Nor is the ascription of such a meaning at all necessary to establish Aristotle's credit as regards the doctrine of mental association.

Thus far the principles of association have been considered only as involved in mental reproduction and representation. There has grown up, however, especially in England, the psychological school above mentioned, which aims at explaining all mental acquisitions, and the more complex mental processes generally, under laws not other than those determining simple reproduction. Hamilton also, though professing, in the title of his outline just noticed, to deal with reproduction only, formulates a number of still more general laws of mental succession—law of Succession, law of Variation, law of Dependence, law of Relativity or Integration (involving law of Conditioned), and, finally, law of Intrinsic or Objective Relativity—as the highest to which human consciousness is subject; but it is in a sense quite different that the psychologists of the so-called Associationist School intend their appropriation of the principle or principles commonly signalised. As far as can be judged from imperfect records, they were anticipated to some extent by the experientialists of ancient times, both Stoic and Epicurean (*cf.* Diogenes Laertius, as above). In the modern period, Hobbes is the first thinker of permanent note to whom the doctrine may be traced. Though he took, as has been seen, anything but an exhaustive view of the phenomena of mental succession, yet, after dealing with trains of imagination, or what he called mental discourse, he sought in the higher departments of intellect to explain reasoning as a discourse in words, dependent upon an arbitrary system of marks, each associated with, or standing for, a variety of imaginations; and, save for a general assertion that reasoning is a reckoning—otherwise, a compounding and resolving—he had no other account of knowledge to give. The whole emotional side of mind, or, in his language, the passions, he, in like manner, resolved into an expectation of consequences based on past experience of pleasures and pains of sense. Thus, though he made no serious attempt to justify his analysis in detail, he is undoubtedly to be classed with the associationists of the next century—Hartley and the others. They, however, were wont to trace the first beginnings of their psychological theory no farther back than to Locke's *Essay*. If this seems strange, when Locke did little more than supply them with the word Association, it must be remembered in what ill repute the name of Hobbes stood, and also that Locke's work, though not directly concerned with the question of psychological development, being rather of metaphysical or logical import, was eminently psychological in spirit, and might fairly be held to contain in an implicit form the principle or principles evolved later by the associationists. Berkeley, dealing, immediately after Locke and altogether in Locke's spirit, with the special psychological problem of visual perception, was driven to posit expressly a principle of suggestion or association in these terms:—"That one idea may suggest another to the mind, it will suffice that they have been observed to go together, without any demonstration of the necessity of their coexistence, or so much as knowing what it is that makes them so to coexist" (*New Theory of Vision*, § 25); and to support the obvious application of the principle to the case of the sensations of sight and touch before him, he constantly urged that association of sound and sense of language which the later school has always put in the foreground, whether as illustrating the principle in general or in explanation of the supreme importance of language for knowledge. It was natural, then, that Hume, coming after Berkeley, and assuming Berkeley's results, though he reverted to the larger inquiry of Locke, should be more explicit in his reference to association; and, not only explicit, he was original also, when he spoke of it as a "kind of attraction which in the mental world will be found to have as extraordinary effects as in the natural, and to show itself in as many and as various forms" (*Human Nature*, i. 1, § 4). Other inquirers were, in fact, appearing about the same time, who conceived of association with this breadth of view, and set themselves to track, as psychologists, its effects in detail.

Hartley's *Observations on Man*, published in 1749 (eleven years after the *Human Nature*, and one year after the better-known *Inquiry*, of Hume), opened the path for all the investigations of like nature that have since that time become so characteristic of the English name in psychology. According to his own statement, his attention was first turned to the subject about eighteen years before, through what he heard of an opinion of the "Rev. Mr Gay," that it was possible to deduce all our intellectual pleasures and pains from association. Gay is known only by a dissertation on the fundamental principles of virtue, prefixed, at first anonymously, in 1731, to Archdeacon (afterwards Bishop) Law's translation of King's *Origin of Evil*, wherein it was maintained, with considerable force, that by association the feelings belonging to ends may come to attach themselves to means, and give rise to action for the means as if they were ends, as seen (the instance has become a commonplace) in the passion for money-making. In this vein, but on a very different scale, Hartley proceeded to work. A physician by profession, and otherwise well versed in science, he sought to combine with an elaborate theory of mental association a minutely detailed hypothesis as to the corresponding action of the nervous system, based upon the suggestion of a vibratory motion within the nerves thrown out by Newton in the last paragraph of the *Principia*. So far, however, from promoting the acceptance of the psychological theory, this physical hypothesis proved to have rather the opposite effect, and it began to be dropped by Hartley's followers (as Priestley, in his abridged edition of the *Observations*, 1775) before it was seriously impugned from without. When it is studied in the original, and not taken upon the report of hostile critics, who would not, or could not—at all events, who did not—understand it, no little importance must still be accorded to, the first attempt, not seldom a curiously felicitous one, to carry through that parallelism of the physical and psychical, which since then has come to count for more and more in the science of mind. Nor should it be forgotten that Hartley himself, for all his paternal interest in the doctrine of vibrations, was careful to keep separate from its fortunes the cause of his other doctrine of mental association. Of this the point lay in no mere restatement, with new precision, of a principle of coherence among "ideas," but in its being taken as a clue by which to follow the progressive development of the mind's powers. Holding that mental states could be scientifically understood only as they were analysed, Hartley sought for a principle of synthesis to explain the complexity exhibited not only in trains of representative images, but alike in the most involved combinations of reasonings and (as Berkeley had seen) in the apparently simple phenomena of objective perception, as well as in the varied play of the emotions, or, again, in the manifold conscious adjustments of the motor system. One principle appeared to him sufficient for all, running, as enunciated for the simplest case, thus: "Any sensations A, B, C, &c., by being associated with one another a sufficient number of times, get such a power over the corresponding ideas (called by Hartley also vestiges, types, images) *a*, *b*, *c*, &c., that any one of the sensations A, when impressed alone, shall be able to excite in the mind *b*, *c*, &c., the ideas of the rest." To render the principle applicable in the cases where the associated elements are neither sensations nor simple ideas of sensations, Hartley's first care was to determine the conditions under which states other than these simplest ones have their rise in the mind, becoming the matter of ever higher and higher combinations. The principle itself supplied the key to the difficulty, when coupled with the notion, already implied in Berkeley's investigations, of a coalescence of simple ideas of sensation into one complex idea, which may cease to bear any obvious relation to its constituents. So far from being content, like Hobbes, to make a rough generalisation to all mind from the phenomena of developed memory, as if these might be straightway assumed, Hartley made a point of referring them, in a subordinate place of their own, to his universal principle of mental synthesis. He expressly put forward the law of association, endued with such scope, as supplying what was wanting to Locke's doctrine in its more strictly psychological aspect, and thus marks by his work a distinct advance on the line of development of the experiential philosophy.

The new doctrine received warm support from some, as Law and Priestley, who both, like Hume and Hartley himself, took the principle of association as having the like import for the science of mind that gravitation had acquired for the science of matter. The principle began also, if not always with direct reference to Hartley, yet, doubtless, owing to his impressive advocacy of it, to be applied systematically in special directions, as by Tucker (1768) to morals, and by Alison (1790) to æsthetics. Thomas Brown (d. 1820) subjected anew to discussion the question of theory. Hardly less unjust to Hartley than Reid or Stewart had been, and forward to proclaim all that was different in his own position, Brown must yet be ranked with the associationists before and after him for the prominence he assigned to the associative principle in sense-perception (what he called external affections of mind), and for his reference of all other mental states (internal affections) to the two generic capacities or susceptibilities of Simple and Relative Suggestion. He preferred the word Suggestion to Association, which seemed to him to imply some prior connecting process, whereof there was no evidence in many of the most important cases of suggestion, nor even, strictly speaking, in the case of contiguity in time where the term seemed least inapplicable. According to him, all that could be assumed was a general constitutional tendency of the mind to exist successively in states that have certain relations to each other, of itself only, and without any external cause or any influence previous to that operating at the moment of the suggestion. Brown's chief contribution to the general doctrine of mental association, besides what he did for the theory of perception, was, perhaps, his analysis of voluntary reminiscence and constructive imagination—faculties that appear at first sight to lie altogether beyond the explanatory range of the principle. In James Mill's *Analysis of the Phenomena of the Human Mind* (1829), the principle, much as Hartley had conceived it, was carried out, with characteristic consequence, over the psychological field. With a much enlarged and more varied conception of association, Professor Bain has re-executed the general psychological task in the present generation, while Mr Herbert Spencer has revised the doctrine from the new point of view of the evolution-hypothesis. John Stuart Mill made only occasional excursions into the region of psychology proper, but sought, in his *System of Logic* (1843), to determine the conditions of objective truth from the point of view of the associationist theory, and, thus or otherwise being drawn into general philosophical discussion, spread wider than any one before him its repute.

It is remarkable that the Associationist School has been composed chiefly of British thinkers, but in France also it has had distinguished representatives. Of these it will suffice to mention Condillac, the author of the sensationalist movement in the 18th century, who professed to explain all knowledge from the single principle of association (*liaison*) of ideas, operating through a previous association with signs, verbal or other. At the present day the later English school counts important adherents among the younger French thinkers. In Germany, before the time of Kant, mental association was generally treated in the traditional manner, as by Wolff. Kant's inquiry into the foundations of knowledge, agreeing in its general purport with Locke's, however it differed in its critical procedure, brought him face to face with the newer doctrine that had been grafted on Locke's philosophy; and to account for the fact of synthesis in cognition, in express opposition to associationism, as represented by Hume, was, in truth, his prime object, starting, as he did, from the assumption that there was that in knowledge which no mere association of experiences could explain. To the extent, therefore, that his influence prevailed, all such inquiries as the English associationists went on to prosecute were discounted in Germany. Notwithstanding, under the very shadow of his authority a corresponding, if not related, movement was initiated by Herbart. Peculiar, and widely different from anything conceived by the associationists, as Herbart's metaphysical opinions were, he was at one with them, and at variance with Kant, in assigning fundamental importance to the psychological investigation of the development of consciousness, nor was his conception of the laws determining the interaction and flow of mental presentations and representations, when taken in its bare psychological import, essentially different from theirs. In Beneke's psychology also, and in more recent inquiries conducted mainly by physiologists, mental association has been understood in its wider scope, as a general principle of explanation.

Associationists differ not a little among themselves in the statement of their principle, or, when they adduce several principles, in their conception of the relative importance of these. Hartley took account only of Contiguity, or the repetition of impressions synchronous or immediately successive; and the like is true of James Mill, though, incidentally, he made an express attempt to resolve the received principle of Similarity, and through this the other principle of Contrast, into his fundamental law—law of Frequency, as he sometimes called it, because upon frequency, in conjunction with vividness of impressions, the strength of association, in his view, depended. In a sense of his own, Brown also, while accepting the common Aristotelian enumeration of principles, inclined to the opinion that "all suggestion may be found to depend on prior coexistence, or at least on such proximity as is itself very probably a modification of coexistence," provided account be taken of "the influence of emotions and other feelings that are very different from ideas, as when an analogous object suggests an analogous object by the influence of an emotion which each separately may have produced before, and which is, therefore, common to both." (Upon which view it obviously occurs to remark, that, except in the particular case, plainly not intended, where the objects are experienced in actual succession with the emotion common to both, a suggestion through *similar* emotions must still be presumed.) To the contrary effect, Mr Spencer maintains that the fundamental law of all mental association is that presentations aggregate or cohere with their like in past experience, and that, besides this law, there is in strictness no other, all further phenomena of association being incidental. Thus in particular, he would explain association by Contiguity as due to the circumstance of imperfect assimilation of the present to the past in consciousness; a presentation in as far as it is distinctly cognised is in fact recognised through cohering with its like in past experience, but there is always, in consequence of the imperfection of our perceptions, a certain range within which the classing of the present experience with past is doubtful—a certain cluster of relations nearly like the one perceived, which become nascent in consciousness in the act of assimilation; now contiguity is likeness of relation in time or in space, or in both, and, when the classing, which, as long as it is general, goes easily and infallibly forward, becomes specific, a presentation may well arouse the merely contiguous, instead of the identical, from former experience. Midway between these opposed views should be noted, finally, the position of Professor Bain, who regards Contiguity and Similarity, logically, as perfectly distinct principles, though in actual psychological occurrence they blend intimately with each other; contiguous trains being started by a first (it may be, implicit) representation through Similarity, while the express assimilation of present to past in consciousness is always, or tends to be, followed by the revival of what was presented in contiguity with that past.

That Similarity is an ultimate ground of mental association cannot seriously be questioned, and to neglect or discount it, in the manner of the older representatives of the school, is to render the associationist theory quite inadequate for purposes of general psychological explanation. It is simply impossible to over-rate the importance of the principle, and, when Mr Spencer, by way of supporting his position, maintains farther, that the psychological fact of conscious assimilation corresponds with the fundamentally simple physiological fact of re-excitation of the same nervous structures, the force as well as pertinence of the observation is at once evident. Nevertheless, it is one question whether a representation, upon a particular occasion, shall be evoked by Similarity, and another question what shall be raised into consciousness along with it; nor for this is there any help but in positing a distinct principle of Contiguity. The phenomena of presentative cognition or objective perception on which Mr Spencer bases his argument, are precisely those in which the function of Contiguity is least explicitly manifested, but only because of the certainty and fixity it has assumed through the great uniformity and frequency of such experience. Let the series of presentative elements, as in formal education, be less constant in composition, and less frequently recurrent, than are those aggregates of sensible impressions that, in the natural course of experience, become to us objects in space with a character comparatively fixed, and then the function of Contiguity starts out with sufficient prominence, being found as often as not to fail in determining a revival of the corresponding representative series. All the phenomena, too, of coalescence, in which a variety of elements become fused to a result in consciousness as heterogeneous as any chemical compound in relation to its constituents—phenomena that have remained the very property of the Associationist School since they first were distinctly noted by Hartley—how are these to be explained by the principle of Similarity? Involved as it incontestably is in every repeated apprehension, whether of the elements, or of the product, or of the relation between them, Similarity of itself is powerless to determine a relation the essence of which lies not more in the heterogeneous character of the result than in the diversity of the elements brought together. Nor, in order to support the claim of the principle of Contiguity to an equally fundamental position with that of Similarity, is it more difficult to find an expression in terms of physiology corresponding with the subjective process. The fact that different nerve-centres are excited together, synchronously or successively, along definite lines of connection, will leave them, being so connected, in a state of relative instability, which, other things equal, will vary in proportion to the frequency and strength of the excitation; and thus, when one of them is, in whatever way, again aroused, the rest will tend to be re-affected also by reason of the instability that has remained. The process of psychological representation, running parallel with the nervous events here supposed, involves assimilation at every stage from and including the first; it is also constantly happening, in contiguous trains, that a break occurs at a particular stage through an express suggestion, by Similarity, of something foreign to the train. But in the one case, as in the other—alike coincident with the implicit action of Similarity, and in the pauses of express assimilation—the principle of Contiguity has a part to play, not to be denied or confounded with any other.

A minor question, also disputed, is whether by the side of Contiguity and Similarity, Contrast should be held, as by Aristotle, an independent principle of association. That things contrasted may and do often suggest each other in consciousness is on all hands allowed, but ever since Hume attempted, however infelicitously, to resolve the principle into others, its independence has not ceased to lie under suspicion. When the question is approached without prejudice, it cannot but appear strange that mental states which suggest each other because of likeness, should suggest each other because of unlikeness also. In that case anything might suggest everything else, since like and unlike conscious states are all that are possible; nay, unlike states alone are all, as there must always be some difference between any two. Now it is true, in one sense, that anything may suggest anything be it ever so unlike, namely, if the things have been once or repeatedly experienced in conjunction; but then the bond of association is the contiguity, and not the unlikeness, which obviously cannot be a ground for suggesting this one other thing more than any other thing. By contrast, however, is not generally meant bare unlikeness. Genuine contrasts, as black-white, giant-dwarf, up-down, are peculiar in having under the difference a foundation of similarity, the two members lying within the sphere of a common higher notion, and only being distinguished the more impressively by reason of the accompanying unlikeness. Clearly, in the case of mutual suggestion, if it be not the similarity itself that is here the ground of association, it may again be Contiguity, the sharpest experience of each member of the contrast having been when there was experience also of the other; or both grounds may conspire towards the result, the association being then what Professor Bain has marked as Compound. On the whole, it must be concluded that only in a secondary sense can Contrast be admitted as a principle of mental association.

The highest philosophical interest, as distinguished from that which is more strictly psychological, attaches to the mode of mental association called Inseparable. The coalescence of mental states noted by Hartley, as it had been assumed by Berkeley, was farther formulated by James Mill in these terms:—

"Some ideas are by frequency and strength of association so closely combined that they cannot be separated; if one exists, the other exists along with it in spite of whatever effort we make to disjoin them."—(*Analysis of the Human Mind*, 2d ed. vol. i. p. 93.)

J. S. Mill's statement is more guarded and particular:—

"When two phenomena have been very often experienced in conjunction, and have not, in any single instance, occurred separately either in experience or in thought, there is produced between them what has been called inseparable, or, less correctly, indissoluble, association; by which is not meant that the association must inevitably last to the end of life—that no subsequent experience or process of thought can possibly avail to dissolve it; but only that as long as no such experience or process of thought has taken place, the association is irresistible; it is impossible for us to think the one thing disjoined from the other."—(*Examination of Hamilton's Philosophy*, 2d ed. p. 191.)

Even this statement, however, is somewhat lacking in precision, since there never is any impossibility of thinking the things apart, in the sense of considering them as logically distinct; the very fact of association implies at least such distinctness, while there may be evident, besides, a positive difference of psychological origin, as when, in the case of visual extension, the colour of the field is referred to the passive sensibility of the eye, and the expanse to its mobility. The impossibility is of representation apart, not of logical consideration or thought. It is chiefly by J. S. Mill that the philosophical application of the principle has been made. The first and most obvious application is to so-called necessary truths—such, namely, as are not merely analytic judgments but involve a synthesis of distinct notions. Again, the same thinker has sought, in the work just cited, to prove Inseparable Association the ground of belief in an external objective world. The former application, especially, is facilitated, when the experience through which the association is supposed to be constituted is understood as cumulative in the race, and transmissible as original endowment to individuals—endowment that may be expressed either, subjectively, as latent intelligence, or, objectively, as fixed nervous connections. Mr Spencer, as before suggested, is the author of this extended view of mental association.

For a detailed exposition of the psychological theory of the Associationist School, the reader is referred to the works of its latest representatives named above. The question is still under discussion, how far the theory avails to account for the facts of intelligence, not to say the complex phases of mental life in general in all their variety; nor, were the theory carried out farther than it has yet been by any one, and formulated in terms commanding more general assent than any expression of it has yet obtained even from professed adherents, is it likely to be raised above dispute. Yet it must be allowed to stand forward with a special claim to the scientific character; as already in his time Laplace (who, though an outsider, could well judge) bore witness, when, speaking of the principle of association (Contiguity) as applied to the explanation of knowledge, he declared it *la partie réelle de la métaphysique* (*Essai phil. sur les Probabilités, Œuvres,* vol. vii. p. cxxxvii.) If in the physical sciences the object of the inquirer is confined to establishing laws expressive of the relations subsisting amongst phenomena, then, however different be the internal world of mind—however short such treatment may seem to come of expressing the depth and fulness even of its phenomenal nature—a corresponding object is as much as the scientific psychologist can well set to himself. The laws of association express undoubted relations holding among particular mental states, that are the real or actual facts with which the psychologist has to deal, and it becomes a strictly scientific task to inquire how far the whole complexity of the internal life may receive an explanation therefrom. Understood in this sense, Hume's likening of the laws of mental association to the principle of gravitation in external nature is perfectly justifiable. It is to the credit of the associationists to have grasped early, and steadily maintained, such a conception of psychological inquiry, and, whatever their defects of execution may have been or remain, their work retains a permanent value as a serious attempt to get beyond barren description of abstract mental faculties to real and effective explanation. The psychologists that, in the related point of view, have earned the title of the Analytical School, from holding before their eyes the exemplar of the method of the positive sciences, are precisely those that have fastened upon the principles of association as the ground of mental synthesis; and, till it is shown that the whole method of procedure is inapplicable to such a subject as mind, their conception is entitled to rank as a truly scientific one. (G. C. R.)

ASSUAY, formerly the most southern department of Ecuador, in South America. It is now broken up into the two provinces of Cuença and Loxa. Cuença, Loxa, Jaca, and Borga, were its principal towns. Its chief productions were cinchona bark and silver.

ASSUMPTION, a festival of the Christian church, observed on the 15th August, in honour of the miraculous ascent of the Virgin Mary into heaven. It rests upon a purely traditional account of the ascent, first recorded by Gregory of Tours. Its present place in the calendar was fixed early in the 8th century. The Roman and Greek Churches both celebrate this festival.

ASSYRIA. The two great empires which grew up on the banks of the Tigris and Euphrates can be separated as little historically as geographically. It is proposed, therefore, to treat both under the heading BABYLONIA. From the beginning their history is closely intertwined; and the power of the one is a measure of the weakness of the other. This interdependence of Assyrian and Babylonian history was recognised by ancient writers, and has been confirmed by modern discovery. But whereas Assyria takes the first place in the classical accounts to the exclusion of Babylonia, the decipherment of the inscriptions has proved that the converse was really the case, and that, with the exception of some six or seven centuries, Assyria might be described as a province or dependency of Babylon. Not only was Babylonia the mother country, as the tenth chapter of Genesis explicitly states, but the religion and culture, the literature and the characters in which it was contained, the arts and the sciences of the Assyrians were derived from their southern neighbours. Both had the same population and spoke the same language. In accordance, therefore, with the evidence of the native monuments, Assyria will be treated in connection with Babylonia. With all the similarity, however, there were, of course, certain differences in the character and development of the two countries. These differences will be carefully noted, and subjects which peculiarly belong to either the one or the other empire will be fully and separately dealt with. (See BABYLONIA.)

AST, George Anthony Frederick, a German philosopher and philologist of considerable distinction, was born at Gotha in 1778. He was educated at the gymnasium of that town, and afterwards at the university of Jena. He distinguished himself as a student, and in 1802 he became a privat-docent in his alma mater. Three years later he was appointed professor of classical literature in the university of Landshut, where he remained until 1826, when that institution was transferred to Munich. In this latter city he spent the rest of his life. In recognition of his services as a teacher and author he was made an aulic councillor, and a member of the Bavarian Academy of Sciences. He died on the 30th of December 1841. Ast was an independent although not an original thinker. He was more of a scholar and critic than a philosopher. He belonged to the school of Schelling, but was ready to welcome truths from the most diverse quarters. His writings on æsthetics,—*System der Kunstlehre* (1805) and *Grundriss der Æsthetik* (1807),—although containing no distinctively new thoughts, had the merit not only of combining and elaborating the principles of Schelling on beauty and art, but of supplementing them to some extent by the views of Winckelmann, Lessing, Kant, Herder, Schiller, Jean Paul, and others, on these subjects. His *Grundlinien der Philosophie*, published in 1807, was republished in 1809, but soon after sank into oblivion. His *Grundriss einer Geschichte der Philosophie*, also published in 1807, was longer lived, and deservedly. It was the best book of the kind which the Schelling school could show, at least until the publication of Rixner's *Manual*, fifteen years later. It is among the earliest of the works pervaded by the thought, so familiar now but so fresh then, that the history of philosophy is not a history of opinions, but the history of reason, the several philosophies being only stages in the development of the one true philosophy, the gradually self-revealing absolute reason. It is also among the earliest attempts to "construe" the history of philosophy and to formulate its law of movement. The author published a second edition of it in 1825, and *Hauptmomente der Geschichte der Philosophie* in 1829. In two works, both published in 1808, he sought to determine and expound the principles of the chief divisions of the study in which he was strongest. They are his *Grundlinien der Philologie* and *Grundlinien der Grammatik, Hermeneutik, und Kritik*. Both have been commended by competent judges. His reputation as a philologist, however, rests mainly on the vast and toilsome labours on Plato, which occupied the last twenty-five years of his life. His *Platon's Leben und Schriften*, published in 1816, is the earliest of those elaborate critical inquiries regarding the life of Plato, the authenticity of the works which have come down to us under his name, the order of their composition, their purpose, plan, &c., which may be regarded as having had their proximate cause in the celebrated *Introductions* of Schleiermacher, and their primary cause in the historical scepticism of Niebuhr and Wolf. He allows scarcely any weight to the ancient biographies and traditions; but, taking a few of the finest dialogues as standards, he draws from them the criteria in virtue of which he accepts or rejects the others. He pronounces spurious not only those compositions which are generally admitted to be so,—the *Epinomis*, *Minos, Theages, Erastæ, Clitopho, Hipparchus, Eryxias*, the *Letters and Definitions*, but also the *Meno, Euthydemus, Charmides, Lysis, Laches*, the *First and Second Alcibiades, Hippias Major and Minor*, the *Ion, Euthyphron, Apology, Crito*, and even, in defiance of the explicit testimony of Aristotle, the *Laws*. He arranges the dialogues, which he admits to be genuine, into three series; the group which he regards as the earliest in date of composition, and which he describes as characterised by the predominance of the poetical and dramatical element, consists of the *Protagoras, Phædrus, Gorgias*, and *Phædo*, the second, distinguished by the marked prominence of dialectic keenness and subtility, comprises the *Theætetus, Sophist, Statesman, Parmenides*, and *Cratylus*; while the third, displaying the dialectical and poetical qualities of Plato's mind in interpenetration and harmony, includes the *Philebus, Banquet, Republic, Timæus*, and *Critias*. This book was followed by a complete edition of Plato's works (1819–32) in 11 vols., with a Latin translation, and a learned commentary, which occupies the last two volumes. Professor Ast crowned these labours by his *Lexicon Platonicum* (1834–9), in 3 vols., one of the most comprehensive and valuable of special dictionaries. He wrote various other works of less importance than those which have been mentioned. (R. F.)

ASTARTE [Ashtaroth] was the chief goddess of the Phœnicians in Zidon, where was a temple in her honour. In Tyre also she had a temple, and from thence her worship was transplanted to Carthage. At what time it may have been introduced among the Jews is not known, but its power of attracting them may be seen by reference to 2 Kings xxiii. 13; 1 Kings xi. 5; Judges ii. 13. Among classical writers the usual epithet of Astarte was *Cœlestis* or *Urania*, but while that distinguishes her only as a goddess of the heavens, it would seem that her name itself signifies "star." Her symbol in her temple at Tyre was a star. Lucian (*De Dea Syria*, 4) expressly identifies her with Selene, the goddess of the moon; others, again, with the planet Venus. With the goddess Venus (*Aphrodite*), as worshipped at Paphos in Cyprus, Astarte had in common the character of a deity of the sky (*Urania*), and perhaps, also the patronage of immorality ("Ashtaroth, the abomination of the Zidonians," 2 Kings xxiii. 13). The Romans, in calling her Juno Cœlestis, appear to have been guided by her connection with Baal, and her position as queen of heaven. At the time of the 19th Egyptian dynasty Ashtaroth was introduced, with other Asiatic deities, into the religious system of the Egyptians, and had a temple at Memphis. But no representation of her occurs on the Egyptian monuments. The Assyrian goddess Ishtar seems to have been the same as Astarte (Movers, *Die Phönizier*, p. 601).

ASTELL, Mary, an English authoress, born at Newcastle-upon-Tyne in 1668. She was instructed by her uncle, a clergyman, in Latin and French, logic, mathematics, and natural philosophy. In her twentieth year she went to London, where she continued her studies. Her efforts were especially directed to the mental improvement of her sex, and she published, in 1697, a work entitled *A Serious Proposal to the Ladies, wherein a Method is offered for the Improvement of their Minds*. With the same end in view she elaborated a scheme for a ladies' college, which was favourably entertained by Queen Anne, and would have been carried out had not Bishop Burnet interfered. The most important of her other works was *The Christian Religion, as professed by a Daughter of the Church of England*, published in 1705. She died in 1731.

ASTER, a genus of composite plants (*Compositæ*), found largely in North America, and scattered sparingly over Asia, Europe, and South America. They are usually perennial, and their flowers are arranged in numerous heads (*capitula*). Asters receive the name of Michaelmas and Christmas daisies, because they have heads like daisies, and, when the weather is mild, they flower up to these periods of the year. They are, consequently, valuable plants in a garden. The only British species is *Aster Tripolium*, found abundantly in saline marshes near the sea. One of the species (*Aster alpinus*) grows at a considerable height on the mountains of Europe. Some of them, such as *Aster spectabilis* of North America, are very showy. The plant called the Cape Aster is *Agathœa amelloides*, while the China aster is *Callistephus chinensis*. Both these plants belong also to the Natural Order *Compositæ*. A variety of the Chinese aster, having beautifully coloured florets of rose, violet, and white, is called Reine Marguerite by gardeners.

ASTERIUS, of Cappadocia, was a heathen sophist and teacher of rhetoric in Galatia. About the year 300 he was converted to Christianity, and became the disciple of Lucian, the founder of the school of Antioch. During the persecution in 304 he relapsed into Paganism, but was received again into the church by Lucian. He is best known as an able defender of the Arian doctrine, and was styled by Athanasius the "advocate" of the Arians. His chief work was the *Syntagma*, but he wrote many others, chiefly commentaries. *Cf.* Mountfaucon, *Collectio Nova PP. et Script. Græc.*

ASTERIUS, Bishop of Amasia, in Pontus, in the end of the 4th and in the beginning of the 5th century. His fame rests chiefly on his *Homilies*, which were greatly esteemed in the Eastern Church. Most of these have been lost, but five were published in a 4to vol. by Ph. Rubenius of Antwerp in 1615, under the title *Asterii Amas. Homil. Quinque, Gr. et Lat.* Combefis published six more, so that we have eleven complete; and Dupin gives fragments of at least twenty-two.

ASTEROIDS, the name given to a large number of small planets, which revolve round the sun in orbits lying between those of Mars and Jupiter. They are all extremely small, their brightness seldom exceeding that of stars of the eighth magnitude; their paths, which cross and recross each other, extend over a belt about 250,000,000 miles in breadth; and the eccentricities of the orbits of many of them, and the inclinations of their planes to the plane of the ecliptic, are much greater than those of the larger planets. All the asteroids have been discovered during the present century. The first seen, Ceres, was discovered by Piazzi at Palermo on the first day of the century (Jan. 1, 1801), Pallas was seen in 1802, Juno in 1804, and Vesta in 1807. The next, Astræa, was not discovered till 1845; three more were seen in 1847, and since that time the number has been increased every year, amounting at the end of 1874 to 140. (See ASTRONOMY, p. 806.)

ASTHMA (ἆσθμα, a gasping, ἀσθμαίνω, to gasp for breath), a disorder of respiration characterised by severe paroxysms of difficult breathing, usually followed by a period of complete relief, with recurrence of the attacks at more or less frequent intervals. The term is often incorrectly employed in reference to states of embarrassed respiration, which are plainly due to permanent organic disease within the chest, and which have none of the distinctive characters of true asthma. The onset of an attack of asthma is usually sudden, although there may exist certain premonitory symptoms which warn the sufferer of its approach, such as a feeling of discomfort, drowsiness, irritability, and depression of spirits. The period when the asthmatic paroxysm comes on is generally during the night, or rather in the early hours of morning. The patient then awakes in a state of great anxiety and alarm, with a sense of weight and tightness across the chest, which he feels himself unable to expand with freedom. Respiration is performed with great difficulty, and is accompanied with wheezing noises. His distress rapidly increases, and he can no longer retain the recumbent position, but gets up, and sits or stands with his shoulders raised, his head thrown back, and his whole body heaving with his desperate efforts to breathe. His countenance is pale or livid, and wet with perspiration, while his extremities are cold; his pulse is rapid and weak, and frequently irregular or intermitting. All his clothing must be loose about him; he cannot bear to be touched, and the very presence of others around him seems to aggravate his distress. His one desire is to breathe fresh air; and he will place himself by an open window and sit for hours in the middle of the night, unmindful of the exposure. His appearance is alarming in the extreme, and it often seems as if each breath would be his last. The paroxysm, after continuing for a variable length of time, often extending over many hours, begins to abate, the breathing becomes easier, and the subsidence of the attack is frequently marked by the occurrence of coughing with expectoration. When the expectoration is abundant the asthma is called *humid*, but where there is a little or none it is termed *dry*. After the cessation of the attack the patient appears to be and feels comparatively well. In cases, however, of long standing the subject of asthma comes to bear permanent evidence of its effects. He is easily put out of breath on exertion and he requires to lie with his head elevated, circumstances to be ascribed to organic changes in the chest, which oft-recurring attacks of asthma are liable to induce. The asthmatic paroxysms, although occasionally periodic, do not generally observe any regularity in their return. They may recur each successive night for several days, or there may be no return for many weeks or months, this being to a large extent dependent on a renewal of the exciting cause. Asthma is much more common in men than in women. In may be developed at any age, but is most frequently observed in early and middle life. A large number of cases take their origin in diseases affecting the respiratory system during infancy, such as hooping-cough, measles, and bronchitis. Asthma is often hereditary, and in all cases one attack appears to predispose to others.

With respect to the pathology of asthma, it is now generally held that the essential nature of the disease consists in a spasmodic contraction of the bronchial tubes. This is due to some deranged condition of the nervous system, affecting, either directly or by reflex action, the nerves supplying the contractile fibres lining the bronchi and regulating their calibre. The bronchial tubes being thus spasmodically narrowed, and losing for the time their expansile power, air can only, with the utmost difficulty, be got into or out of the chest. In these circumstances the muscles of the trunk concerned in respiration are called on to act with great violence to expand the chest, but with little avail, and hence the distress and threatened suffocation. But while asthma is thus to be regarded as essentially a nervous ailment, its occurrence, apart from some organic disease in the chest or elsewhere, is admitted to be comparatively rare. Some cases, however, appear to be of purely nervous origin. To these the term *Nervous* or *Spasmodic Asthma* is applied, and it is more particularly to this form that the symptoms above narrated refer. In such cases no actual disease can be discovered with which the asthma could be directly connected. Attacks of this nature appear capable of being excited in those subject to them in very various ways. Thus violent emotions are not unfrequently the cause of asthmatic paroxysms. The effect of the inhalation of certain effluvia in exciting attacks of asthma is undoubted, as in the familiar instances of the odour of hay and of ipecacuan. In no particular is the eccentric character of this disease more remarkable than in that of locality. Changes of air, otherwise inappreciable, may give occasion to the most severe attacks of asthma, as, on the other hand, they may be the means of accomplishing a cure of the disease where it exists. Circumstances, apparently the most trifling, have been known to give rise to severe paroxysms of asthma, as the extinguishing of a light in a sleeping apartment or the shutting of a door. But asthma is very frequently associated with some form of chest complaint, more particularly bronchitis, and hence the term *Bronchitic Asthma.* The relation between the two ailments in such cases is rendered sufficiently obvious by the fact that the one does not occur without the other; and it is evident that the irritation of the bronchial mucous membrane gives rise by reflex nervous action to narrowing of the tubes. When the bronchitis is cured the asthma disappears. Asthmatic-like paroxysms are also of occasional occurrence in some forms of heart disease, and the term *Cardiac Asthma* is used to describe such cases. They can, however, scarcely be regarded as cases of asthma, but rather as attacks of difficult breathing referable to some impediment to the pulmonary circulation, the result of the heart disease.

The treatment of asthma consists in the employment of remedies to allay the paroxysms, and in the adoption of measures likely to prevent their recurrence. During the attack the patient should be placed in as favourable circumstances for breathing as practicable. He usually selects the position easiest for himself. Abundance of air should be admitted to the apartment, and he should be interfered with as little as possible. The remedial agents employed with the view of relieving the paroxysms are very numerous, and only a few of the more important of them can be alluded to. Opiates administered internally or hypodermically are of known efficacy, as is also the inhalation of anæsthetic vapours. Much value is attached by many to the smoking of stramonium, and even tobacco smoking appears in some instances to give relief. The fumes of nitre-paper (blotting-paper prepared by being dipped in a saturated solution of nitre and dried) burnt in the apartment often succeed in mitigating the paroxysm. The use of the tincture of *Lobelia inflata* is recommended by many high authorities, as are also the employment of emetics, the latter more especially where the attack can be traced to errors in diet. None of these remedies, however, ought to be tried without medical advice. Coffee is a popular and useful remedy, but to do good the infusion must be very strong, and taken upon an empty stomach. To prevent the recurrence of the paroxysms special care must be taken by the sufferer to avoid those influences, whether connected with locality or mode of life, which his experience may have proved to have been the occasion of former attacks. Where the paroxysms are of periodic occurrence the use of quinine or arsenic has been tried with good results. (J. O. A.)

ASTI, a large and well-built town of Italy, in the province of Alessandria (Piedmont), situated on the left bank of the Tanaro. It is the see of a bishop, the chief town of a *circondario,* and a station on the Turin and Alessandria railway. Its Gothic cathedral dates from 1348, besides which there are a large number of churches, a college, an old castle, and a theatre. In the Middle Ages Asti was a great commercial city, and one of the most powerful republics of Northern Italy. It was long famous for its hundred towers, of which a number are still standing. As a free city it opposed Frederick I., but it was taken by him and burnt in 1155. In 1348 it fell into the possession of the Visconti, and thus passed first to France, and then, after the peace of Cambray in 1529, to Charles V., who bestowed it on his aunt, Beatrice of Savoy. In the war of the Spanish Succession it frequently changed hands, and in 1745 was taken by storm by the French. It was the birth-place of Alfieri, whose statue, by Vini, adorns the *piazza.* The inhabitants carry on a considerable trade in corn, wine, and silk, and are also engaged in the manufacture of woollen goods, leather, paper, and hats. Population, about 31,000.

ASTOR, John Jacob, an enterprising American merchant, founder of the Astor Library at New York, was born at the village of Walldorf near Heidelberg, on the 17th July 1763. His father was a peasant, and his early years were spent in the common labours of the farm. At sixteen he joined an elder brother, a musical instrument maker, in London, and at twenty sailed for the United States. On the voyage he became acquainted with a fur-trader, by whose advice he devoted himself to the same business. By his energy, industry, and sound judgment he gradually enlarged his schemes, did business in all the fur markets of the world, and amassed an enormous fortune,—the largest up to that time made by any American. He devoted many years to carrying out a project for organising the fur trade from the Lakes to the Pacific Ocean, and thence by way of the Sandwich Islands to China and India. In 1811 he founded at the mouth of the Columbia River a settlement, named after him Astoria, which was intended to serve as the central depôt; but in the following year the settlement was taken and occupied by the English. The incidents of this undertaking are the theme of Washington Irving's *Astoria.* A series of disasters frustrated the gigantic scheme. Astor made vast additions to his wealth by investments in land in New York city. He made many charitable bequests by his will, and among them a gift of $50,000 to the poor of his native village in Germany. But the deed by which he will be chiefly remembered was the foundation and endowment by his will of the Astor Library at New York, for which he bequeathed the sum of $400,000. The building, erected in Lafayette Place (1850–53), is in the Byzantine style of architecture. Washington Irving was appointed first president, and the formation and arrangement of the library was entrusted to Mr J. G. Cogswell. The building has since been enlarged at the cost of the eldest son of the founder. Mr Astor spent the last twenty five years of his life in retirement, and died at New York, March 29, 1848.

ASTORGA (the ancient *Asturica Augusta*), a city of Spain, in the province of Leon, in a plain near the Tuento. It confers the title of marquis on the Osorio family, the ruins of whose palace, destroyed in 1810 by the French, are still an object of interest. It is surrounded with ancient Roman fortifications, which now afford a pleasant promenade; and there is in the vicinity a ruined castle. It was formerly called the "city of priests," from the great numbers of that profession resident within its walls; and it is still the see of a bishop under the church of Compostella, and has a Gothic cathedral of the 15th century.

ASTORGA, Emmanuele d', a distinguished musical composer, was born at Palermo about 1680. His father, a baron of Sicily, took an active part in the attempt to throw off the Spanish yoke, but was betrayed by his own soldiers and publicly executed. His wife and son were compelled to be spectators of his fate; and such was the effect upon them, that Emmanuele fell into a state of gloomy despondency, which threatened to deprive him of reason, while his mother died on the spot. By the kindness of the Princess Ursini, the unfortunate young man was placed in a convent at Astorga, in Leon, from which town he afterwards took his name. Here he recovered his health, and his admirable musical talents were cultivated under the best masters. In 1703 he entered the service of the duke of Parma, and while at his court produced many compositions. The duke, suspecting that an attachment existed between his daughter and Astorga, dismissed the musician, but gave him a letter of recommendation to Leopold of Austria. The emperor received him kindly, and at his court Astorga produced his pastoral opera of *Daphne.* In 1705, on the death of his patron, he visited Florence, and then London, where he remained for two years, and wrote his *Stabat Mater,* considered the best of all his works. He seems to have resided for some years in Spain, and to have died in Bohemia, at r near Prague. The date of his death is quite uncertain.

ASTRABAD, or ASTERABAD, a small province of Persia, bounded on the N. by the Caspian Sea and the desert, on the S. by the Elburz Mountains, W. by Mazanderan, and E. by the river Gourgan. The country, although mountainous, and interspersed with dense forests, in which it is scarcely possible to travel, possesses beautiful and fertile valleys, producing rice, wheat, and other grains in abundance, or spread out in a boundless expanse of verdure, the pasturage of numerous flocks and herds. Fraser, who travelled through Persia in 1822, extols in the most lavish terms the appearance of the country. The soil, with little culture, is exceedingly productive, owing to the abundance of water which irrigates and fertilises it. But while the province in many parts presents a landscape of luxuriant beauty, it is a prey to the ravages of disease, and the frequent incursions of the surrounding tribes. The heavy torrents which fall in the rainy season stagnate in the forests, forming morasses, which, in the heats of summer and autumn, exhale a pestilential vapour, from the decomposition of the vegetable matter they contain. From these seats of noxious effluvia the wandering tribes of shepherds fly beyond the Gourgan or the Atrek, and live on the verge of the burning sand, although they have to carry water for each day's consumption from the distant river. The better classes retire from the intense heats of summer into the mountains; but the settled inhabitants of the villages, who cannot so easily remove, and who generally remain, suffer severely from sickness. The inhabitants, notwithstanding the unhealthiness of their climate, are a stout and athletic race. The province is famous for furnishing a supply of matchlocks for the king's body-guard. It is the ancient Hyrcania, and the native country of the Kajers, a Turkish tribe, of whom the king is the head, and on whom he considers he can rely in times of danger.

ASTRABAD, or ASTERABAD, the capital of the above province, is situated near the mouth of the River Gourgan, which flows into the Caspian, and at the head of a sheltered bay, convenient for shipping. It is a straggling town, about 3½ miles in circuit, and picturesque in appearance, from the buildings being intermingled with trees and gardens. At one time of greater size, it was reduced by Nadir Shah within its present limits. It is surrounded by a dilapidated mud wall, once lofty and formidable, and defended by numerous towers, and also by a wide and deep ditch, now almost filled with rubbish. Astrabad owes its origin to Yezzen-ibn-Messlub, who commanded the armies of Soliman, the seventh caliph of the Ommiades, early in the 7th century. It was destroyed by Tamerlane in 1384. In 1744 Hanway the English traveller visited the place, and attempted to open a direct trade with Europe. At present its bazaars, though extensive, are but poorly filled, but commercial activity is said to be on the increase, in spite of the insecurity caused by the Turcomans, who attack the caravans at the very gate of the town. The number of houses within the walls is estimated at from 2000 to 3000. Owing to the noxious exhalations of the surrounding forests, the town is so extremely unhealthy during the hot weather as to have acquired the title of the City of the Plague. Distance N.E. of Ispahan, 400 miles. Long. 54° 25′ E., lat. 36° 50′ N.

ASTRAKHAN, a government of European Russia, bounded on the S.E. by the Caspian Sea, N.E. by Orenburg, N. by Saratov, W. by the country of the Don Cossacks, and S.W. by the government of the Caucasus. It lies between lat. 44° 50′ and 49° 50′ N. and between long. 43° 30′ and 51° 0′ E. It has an area of about 84,948 square miles, divided into two nearly equal parts by the Volga, and consists chiefly of sandy deserts, interspersed with saline lakes; but in the delta, and on the banks of the rivers, grapes and other fruits of southern climates are raised. The population in 1867 was estimated at 573,954, comprising Russians, Tatars, Georgians, Armenians, Persians, Hindus, &c., who engage in the rearing of horses, cattle and sheep, and also in fishing for sturgeon, which forms the principal source of the wealth of the government. The vicissitudes of climate are great; with a mean annual temperature of 48° Fahr., the summer averages 70°, and the winter 13° Fahr. The government is divided into four districts:—Astrakhan, Krasnoi-Yar, Zenotaïesk, and Chemyi-Yar. Its capital, Astrakhan, is the only place of much importance.

ASTRAKHAN, the capital of the above government, is situated on a small island in the Volga, about 30 miles above the influx of that river into the Caspian. It is a large, rambling, wood-built city, "dusty in summer, windy in autumn, frozen-up in winter, and knee-deep in mud in spring." It consists of three parts,—(1.) The *Kremlin*, or citadel, dating from 1550, which stands on a hill, and contains the cathedral of the Assumption (1582), a spacious brick edifice of peculiar architecture, with the archbishop's palace, and the convent of the Trinity. (2.) The *Belogorod*, or white town, containing the government buildings, bazaars, &c. (3.) The *Llobodeo*, or suburbs, where the bulk of the population reside. Astrakhan is the seat of a Greek and of an Armenian archbishop; and, besides a number of Greek and Armenian churches and convents, it contains a Catholic and a Lutheran church, a Hindu temple, and several mosques. Mention may also be made of a botanic garden, bazaars, a theatre, a gymnasium, an ecclesiastical seminary, and several inferior schools. From its favourable position the town enjoys a very considerable trade both with the interior of Russia, and with India, Persia, &c. Besides its importance as a fishing station, it has considerable manufactures of cotton, silk, leather, &c. Living is very cheap,—£20 per annum being a fair income for the maintenance of an ordinary family. This city was anciently the capital of a kingdom belonging to the Tatars, who were expelled about 1554 by the Russian prince, Ivan Vassilivich. In 1569 it was besieged by the Turks under Selim, but they were defeated with great slaughter by the Russians. In 1670 it was seized by the rebel Stenko Razin; but in 1671 he was dispossessed of it by his uncle, Jacolof, who remained faithful to the Czar. In 1722, when Peter the Great extended his conquests on the Caspian, Astrakhan was his headquarters. In 1702, 1718, and 1767, it suffered severely from conflagrations, it was plundered by the Persians in 1719, and, in 1830, the cholera swept away a great portion of its inhabitants. Lat. 46° 21′ N., long. 47° 55′ E. Population estimated at 50,000 or 60,000.

ASTROLOGY, the so-called science by which various nations, in various ways, have attempted to assign to the material heavens a moral influence over the earth and its inhabitants. For long ages astronomy and astrology were identified. Isidore of Seville is the first to distinguish between the two; nor did astronomy wholly rid itself of astrology, till, with the system of Copernicus, the conviction that the earth itself is one of the heavenly bodies was finally established. Even at the present day a few may be found who, from a superstitious reverence for the past, or the spirit of contradiction, pride themselves on their adherence to the belief in stellar influences. It is no longer necessary to protest against an error which is dead and buried, but let us pause a moment and ask what we mean by an error With Spinoza we would say that erroneous ideas consist in the fancies and opinions which the senses suggest to the mind in a confused, imperfect, and ill-ordered manner. To this sort of knowledge Spinoza gives the name of vague experience. This vague experience is further complicated by the employment of signs, which flatter the fancy, and of which we form ideas like those which the objects themselves presented at first to our imagination. If to these two elements—vague experience and the misleading use of signs—we add the instinctive impulse which led primitive man to imagine a universe created according to the analogy of his mind, we have before us the three causes which led the Indians, Greeks, Egyptians, Chaldeans, and their Alexandrian disciples, the Arabs and their followers, during the Middle Ages and the Renaissance, to lend themselves to the illusions of astrology, and by a preposterous philosophy to deduce the laws of nature from a theory of morals.

Astrology is generally divided into natural astrology, the science which predicts the motions of heavenly bodies and eclipses of sun and moon, and judicial astrology, which studies the influence of constellations on the destiny of men and empires. But it is obvious that both of these branches presuppose an advanced stage of astronomical knowledge, and a state of society not necessarily better but more complex than that in which the first worshippers of the heavens were placed. It follows, then, that both natural astrology and judicial astrology must have been preceded by a science less learned in heavenly motions and at the same time (as we shall attempt to show) more moral in the best sense of the word. Astronomers have taken very little pains to trace their favourite science to its source by help of the copious astrological commentaries in which the earliest observers embodied their theories of the heavens. Philosophers, with the single exception of Schopenhauer, have shown the same indifference. Of modern writers who have treated of astrology, some, like M. Alfred Maury, have sought to place its errors in a ridiculous light; others, like Eusèbe Salverte, have exposed the quackeries which rendered it a possible profession; and lastly, a few, like Eliphas Lévi and M. P. Christian, simply attempt to build up again with words a belief which has ceased to rest either on facts or ideas. Neither class of writers is likely to advance the history of human reason. The time has come for a calm and dispassionate survey of an illusion which for a while seemed probable, and may even be said to have done good service in its day. How did the error arise? Whence its persistency? These are questions which demand an answer, if only in order to preserve modern science from illusions which, though differing in form, are in their essence similar.

M. Alfred Maury begins his treatise by examining what are the beliefs of savages on the subject of magic and astrology. So too M. F. Höfer, in his *History of Astronomy*, well remarks: "If we wish to seek for the origin of the science, let us place a child or a savage in presence of the earth and the heavens, and ask what thoughts these suggest to him. We shall then obtain a clue to guide us on our path." We shall do well to follow the example of MM. Maury and Höfer, provided we do not confuse the savage of a superior and the savage of an inferior race, or the ancient savage and the modern child. But how can we question the ancient savage? Only by help of his cosmogonies.

It was long before man learned to distinguish the planets from the fixed stars; even then, as the word πλάνητες proves, he assigned to them an erratic instead of a regular motion. Further, we must bear in mind that the first star-gazers had no knowledge of optics, physics, or meteorology, to teach them that the blue of the firmament is a subjective phenomenon caused by the light traversing our atmosphere before it strikes the optic nerve; that its regular spherical form is an effect of perspective; that winds, clouds, and northern lights are terrestrial phenomena related to astronomy, but distinct from the science of the true heavens. The ancestors of the sublime and childlike bards of the Rig-Veda deified the morning glow *Arustra*, and the diurnal and nocturnal heavens as the twin brethren who had been nursed on the bosom of *Aditi*. Aditi with them is the space beyond the horizon. Aditi is the sky, heaven. Aditi is mother, father, son. The gods were *Adityas, i.e.*, children of Aditi. Aditi, in a word, was boundless space, but space endowed with life, form, and power,—the power, namely, of delivering men from the heaviest of their chains, that is, sin. Aditi, too, is the mother of storms (*Rudras*). With the original Aryans storms represented the fecundating principle. Thus they pictured the storm among the clouds under the lively image of a bull among cows. Hence the celestial animals. The horse had been already placed in heaven to represent the sun (*Asva*). The fire of the hearth, too, which they produced by rubbing two sticks together, was as much a god as *Varuna* and *Mitra*, and worshipped as *Agni*, one of the Adityas. Such was the innocent childhood of the Hindus, which originated a poetical mythology so closely allied to science, so rich in moral lessons,—could such innocence last?

Let us pass on to astrology as we find it among the Etruscans. We shall see the moral astrology of the primitive Aryans changed into political astrology. The word *templum*, the diminutive of *tempus*, as Varro tells us (*de Ling. Lat.* lib. vi.), signified—1, a division of the sky; 2, a spot on earth marked out by auspices; 3, by analogy, a spot below the earth. The augur with a staff (*lituus*) traced a line from north to south called *cardo*, and another from east to west called *decumanus*. Thus a *temple* consisted in marking out a spot; the entry was from the south, the sanctuary was at the north, propitious signs came from the east, unpropitious from the west. The same precautions which, according to Columella, agriculturists took in transplanting a tree to preserve the same aspect for roots and branches, the Romans, as disciples of the Etruscans, observed in fixing the site of their camps, their towns, &c., and not only this, but their observation of the flight of birds, their curious commentaries on the various forms of thunder and lightning, may all be reckoned as parts of astrology, inasmuch as to the Etruscan bards air and thunder appeared celestial phenomena. Just as Chinese astrologists professed the power of producing or averting eclipses, the Etruscan priests asserted that they could draw down or divert lightning. In fact, such claims are a common characteristic of what we have ventured to call political astrologies: everywhere political astrologists have laid claim to the production of phenomena which calculation, empiricism, or good fortune has enabled them to predict. If perchance their prediction failed, they saved their credit by saying that by their art they had averted the impending disaster. The Etruscans called their deities *consentes*, sharers of the destinies of their race, and believed that they were fated to perish after a reign of 6000 years. This doctrine of the renovation of heaven, earth, and gods, is found to prevail wherever politics, the growth of conquest, have supplanted the simple and childlike faith which springs up of itself among an innocent and unconquered race. When a nation left its home,—that land and sky which both witnessed the birth of its religion, and was part and parcel of that religion,—its priests gradually lost faith in their religion, and began to mix up politics with religion; its astrologers, whose business it was to interpret the signs of the heavens, felt that their power was doomed, and predicted a universal ruin, in which the nation, its religion, its gods, and heaven itself, were involved. But hope, which springs eternal in the human breast, made them add to their prophecy, that after the exhaustion of evil and the death of perverted races, a new order of things should be born. This is the creed of Hesiod's sublime cosmogony;

this is the burden of the 4th ec.ogue, in which Virgil has clothed the solemn strains of Etruria with a tenderness that is all his own. India, Egypt, Arabia, have all held the same belief, though the period between each palingenesis is different with each. Later on we shall meet with the same doctrine in the subtle doctor Cardan, though strangely disguised. With the Romans, before they were initiated into the learning of Greece, astrology was only another name for sorcery. Most readers will remember the picture in Tibullus of the witch who can draw down the moon by her charms, or succour the labouring moon. They can understand the idea of Heraclitus (for Greece, too, passed through this stage of meteorological psychology), who thought that truth is mixed up with the atmosphere, and that the sage breathes it. The same idea is thus rendered by Ovid, *Fasti* i. 473,—

> "Quæ, simul æthereos animo conceperat ignes,
> Ore dabat vero carmina plena dei."

This is the genuine *ἐνθουσιασμός*. Nearly every one is familiar with the famous passage in the fourth *Georgic*, beginning "*Esse apibus partem divinæ mentis et haustus*," and the noble commentary of the poet which follows.

It was the sober belief of primitive Greece that the sun was a torch, and the stars candles periodically lit and extinguished. Xenophanes was the first philosopher who developed this astrological idea, and expounded the connection of the stars with the earth. Xenophanes thought that the stars were meteors, that is, terrestrial effluvia. This enables us to explain the malignant influence on plants and animals which both Greeks and Romans attributed to the stars, and expressed respectively by the words *ἀστροβολεῖσθαι* and *siderari*. The latest development of this belief is to be found in an English philosopher, who has written a book which proves that epidemics are due to the shocks of comets (Forster, *Illustrations of the Astronomical Origin of Epidemic Diseases*, Chelmsford, 1829). An American, in a work which shows some lucid intervals, borrows directly the thesis of Xenophanes, and demonstrates that wicked men contaminate the heavens and stars by their breath. Modern hallucinations are often the best commentary on ancient errors.

But the true source of astrology must be sought for in a remoter age than any we have yet reached. So far we have seen men grouped together as nations, possessing laws, reckoning more or less perfectly the course of time, making capital out of the defects of their calendar, like the Romans, or, it may be, complaining of those defects, and hailing the advent of a Meton like the Athenians in Aristophanes's *Clouds*. But there must have been long preceding ages during which the passage of time was unmarked and unrecorded. Does not this idea of time mark the first stage of civilisation? Some savages cannot reckon at all; others, like children, cannot go farther back than yesterday, or the day before yesterday; others, again, can only mark the year by the changes of the seasons, and their only landmarks for the past are great calamities which have befallen the tribe. But it would be a great mistake to conclude that Chaldeans, Persians, Egyptians, &c., set to work methodically to invent a system of notation, and to map out time into years and months. Assuredly, if men had had no other end in view than the possibility of some day or other keeping double entry, figures would be still to seek. Similarly, if men had thought that the chief result of the various researches and discoveries which a calendar presupposes, would be to enable them to make an appointment a month beforehand, the inducement would have proved insufficient. Fortunately, there were other and higher motives to urge on our ancestors of various races in the path of discovery—those of religion and of astrology. The earth, as Hesiod tells us, was once a common abode of gods and men. These are two remarkable lines of Homer (*Od.* xviii. 136), which Aristotle quotes, and Cicero has translated :—

> 'τοῖος γὰρ νόος ἐστὶν ἐπιχθονίων ἀνθρώπων
> οἷον ἐπ' ἦμαρ ἄγῃσι πατὴρ ἀνδρῶν τε θεῶν τε.'

Such was Homer's astrology. But as, in course of time, each superior race in turn degenerated through the effects of conquest, either by mixing with inferior races, or by oppressing their equals (thus, for instance, the Lacedæmonians mixed with the Messenians or Helots, and thus the primitive Aryans oppressed the Dravidian tribes), as each race passed from the age of gold, the age of innocence, to the age of bronze or iron, of Krali or evil, so, to compensate in some way for the loss of morality, we find them making discoveries in science and art. Thus swords were forged of iron, notwithstanding that iron (according to the Finnish legend) had sworn never to slay men. Thus, too, they began to distinguish the several constellations through which the sun appeared to pass. Let us turn to the strange *Theogony* of Hesiod (l. 119 *seq.*), we shall find that Chaos is the parent of Night and Erebus; but the Earth,—seemingly because it had been the peaceful abode of the Immortals who dwell on the snowy peaks of Parnassus, partly, too, because the fairest of the Immortals is Love,—the Earth is the parent of the Heavens :—

> "Tellus vero primum quidem genuit parem sibi
> Cœlum stellis ornatum ut ipsam totam obtegat,
> Utque beatis sedes Divis tuta semper," &c.

That the gods inhabited the mountains or groves before they migrated to heaven is a universal belief. But in what can this heaven of the gods be said to resemble earth? A tradition, which Manilius has preserved, informs us that when Justice was banished from the earth she took up her abode, not in the heart of a king of France (there was then no France or king in the modern sense of the word), but in heaven as one of the constellations of the zodiac.

The zodiac was the heaven which exactly corresponded to the earth (the first astronomers, we need not remark, knew nothing of declinations); it was the zodiac which protected the earth, taught the earth its duties, pointed out not only days and seasons, but the proper work for each day and season. The zodiac was the first book that lay open for all to read, written in runes, as the Scandinavians thought,—in *mim* and *elif* as the Arabs interpreted it,—and in the hieroglyphics of animals and symbols, according to Assyrians and Egyptians. But, alas! this grand conception, which seemed so true to the first astronomers, was obscured by the continual displacement of the zodiac. Thus, in judicial astrology the sign under which a child is born is always the ram, as in our almanacs it is the first sign of the year. Thus, too, the sign of Jupiter ♃ in a slightly altered shape, still heads our prescriptions. Nor is this the only remaining trace of zodiacal belief. For not only was agricultural and political life regulated at first directly by the zodiac, and then through the calendar, but the zodiac applied no less to civil life. Hence the Roman ides and kalends, hence the Greek decade, hence the week of the Jews and other nations. This is not the place to discuss the difficult question of the relation of the zodiac to the week; for our purpose it is enough to observe, that it was by the days of the week, each placed under the protection of some stellar deity, that the priests regulated the whole civil life of a nation, its law courts, its markets, and marriages. The primitive week began with the day of Saturn, the ancient Bel of the Assyrians, so called in distinction from the younger Bel, *i.e.*, Jupiter, and it ended with the day of Venus, the Assyrian Mylitta. This day, which was afterwards held accursed by the Christian Fathers, was probably consecrated to marriages. Saturn's day, or the day of Soetere, was identified with the Sabbath, and Sunday with the Lord's day; the day of Venus with that of Friga, the goddess of love (Friday); Jove's with that of the Norse Thor (Thursday); Mercury's with that of Woden, the god who grants wishes (Wednesday); and Mars's with that of Tiw, the god of war (Tuesday). The Latin division of days into *dies fasti* and *nefasti* has perpetuated the same distinction of lucky and unlucky days which inspired Hesiod's *Works and Days.* Many a tradesman at Rome must have made the same complaint as La Fontaine's cobbler, "*On nous ruine en fêtes.*" With the Arabs Tuesday and Wednesday were the days for blood-letting, Mars being the lord of iron and blood, and Mercury of the humours. Even at the present day, travellers tell us, when an auspicious day has been proclaimed by the astrologers, the streets of Baghdad may be seen running with blood from the barbers' shops. We see how soon the invention of the week became the engine of politicians and astrologers.

Our investigations have now brought us to judicial astrology, which is nothing else than the corruption of the purer astrology, the various phases of which we have attempted to trace. In a book published at Geneva in 1643, the year of Condé's great victory, and of the succession of Louis XIV., entitled *Janua Aurea reserata quatuor linguarum*, 12mo, by J. A. Comenius, we find the following definition:—"*Astronomus siderum meatus seu motus considerat: Astrologus eorumdem efficaciam, influxum, et effectum.*" Kepler was more cautious in his opinion; he spoke of astronomy as the wise mother, and astrology as the foolish daughter, but he added that the existence of the daughter was necessary to the life of the mother. Tycho Brahe and Gassendi both began with astrology, and it was only after pursuing the false science, and finding it wanting, that Gassendi devoted himself to astronomy. In their numerous allusions to the subtle mercury, which the one makes when treating of a means of measuring time by the efflux of the metal, and the other in a treatise on the transit of the planet, we see traces of the school in which they served their first apprenticeship. Huyghens, moreover, in his great posthumous work, *Cosmotheoros, seu de terris cœlestibus*, shows himself a more exact observer of astrological symbols than Kircher himself in his *Iter exstaticum.* In that remarkable discussion on the plurality of worlds, which was at once translated into French, and afterwards reproduced in a popular form by Fontenelle, Huyghens contends that between the inhabitants of different planets there need not be any greater difference than exists between men of different types on the earth. "There are on the earth," continues this rational interpreter of the astrologers and chiromancers, "men of cold temperament who would thrive in Saturn, which is the furthest planet from the sun, and there are other spirits warm and ardent enough to live in Venus." Astrology among the Egyptians, the Chaldeans, and at Alexandria, had established a complete parallelism between men of different types and the planets, on the basis of their relative distance from the sun. These different types of character had been fixed by the Greeks in their conception of the planetary gods, Apollo, Mars, Mercury, Jupiter, and Venus. To these the cabalists added the moon, as the planet corresponding to the pl legmatic temperament of the northern races. Apollo represented the nervous physique which Carus has rightly pronounced the most intellectual. But whence did the notion of this parallelism originate? The solution of this problem will elucidate the practical side of astrology.

Let us once more revert to the first infancy of science. From the general tendency of primitive man to bring all knowledge under a single head, we may safely conclude that the first study of the heavens embraced and dominated over every other attempt at science. The cosmogonists pretended to explain the earth by the heavens, but as they were bound to proceed from the known to the unknown, they did, in fact, explain the heaven by the earth and, in particular, by men. Hence, in many mythologies, the universe is an egg, and in that of Finland a duck's egg, the spots on the shell representing the constellations. Later on we find the eternal revolution and renovation of the universe symbolised by a serpent biting its tail. Lastly, the universe as a perfect and harmonious order, a κόσμος, is conceived as the highest organism to be found on earth, a huge animal. This cosmical animal in turn, owing to the interlacing of religious ideas, images, and symbols, was supposed to influence the different parts of the body. This gives us the clue to the first steps of medical science, which, like the other sciences, began by being astrological. In short, the first encyclopædia was astrology. There is a well-known story of the case of two brothers who fell ill at the same instant. Posidonius the astrologer, on being consulted, pronounced that they were born under the same constellation. Hippocrates the physician concluded from the coincidence that they must be twins; yet even Hippocrates could not rid himself of the terrestrial theory of the heavens. (See chap. 11, *de auris, de aquis, de locis.*) The Egyptians peopled the constellations of the zodiac with genii; the ram (*Arnum*) was lord of the head; the bull (*Apis*), of the neck and shoulders; the twins (Hercules and Apollo), of the arms and hands; and lastly, to the fishes were assigned the feet. The Persians, again, ascribed to the empyrean generally the influence over the citadel of the body—the head. Dionysius the Areopagite, indulging his religious proclivities, established hierarchies of genii in the constellations. The Assyrians were led by their form of government to place thirty-six conciliar-gods in the twelve signs of the zodiac, and to the interpreter-gods, whose province it was to inspect and survey the various divisions of the heavens, they allotted the wandering planets. Whenever a new discovery was made in medicine or science, the province of the god-stars was immediately enlarged; thus the Egyptians, observing the symmetry of the human body, and connecting this with the dualism of human faculties, at once made the sun (*Ra*) the lord of the forehead, the moon mistress of the brain, and Mercury of the tongue; but to Saturn they assigned only the left eye; to Jupiter was given the right; Mars had the right nostril, Venus the left. Meanwhile, in another quarter of the globe a religion was growing up,—a religion of mild anthropomorphism, wholly removed from Oriental transcendentalism. It is in Greece, whose deities had been gradually moulded and drilled so as to serve as types of men and manners, that we must look for the key of astrology. Jupiter, the embodiment of authority, and Cronos, or Saturn, the impersonation of malignant opposition to authority, are the two most prominent figures of ancient mythology. Venus was placed below Mars; that is, the sensual passion was subjected to martial ardour. The astrologers of the Renaissance deviated from the Egyptians in assigning the right nostril to Venus, and the left to Mars: the reason was, that, with Cardan and Vanini, Venus represented rather the German Friga than the Eastern Mylitta,—chaste love rather than luxury. Those of our readers who wish to learn further the opinion of Cardan and Vanini, we would refer to the *Amphitheatrum æternæ Providentiæ* and *De admirandis naturæ reginæ deæque mortalium arcanis libri quatuor*, in which the mocking astrologer breaks a lance with the too subtle philosopher. The quarrel between two learned doctors of the art naturally resulted in the death of the patient. Astrology, already at its last gasp, could not bear such rude treatment. Vanini, the Lucian among astrologers, the hero who exclaimed, as he was being led to the stake, "Courage—let them see how a philosopher can die," has in his works crushed Aristotle by the help of Averroes, and Averroes and Cardan by the help of good sense. And yet the good-humoured satirist, who suffered for his free speech by having his tongue cut out, and being then burnt at the stake, was, notwithstanding, the disciple of Averroes, and the admirer of Cardan. So true is it that reason in its early stages of civilisation is the good genius of the privileged few, who, unlike many moderns, have more sense than they give themselves credit for,—a privilege which they dearly purchased by persecution, or, worse still, by neglect.

Under Albumazar (776–885), astrology, returning to Persian and Græco-Egyptian ideas, appears as the legislator of action and religion. The Caliph Al-Mamun embraced the theory of his favourite astrologer, which fixed the duration of the Mahometan religion at 544, and that of Christianity at 1460 years. Is not this fact in itself sufficient to explode the generally received notion of Mussulman intolerance? Cardan developed this thesis. In one plan he makes Christianity born under Jupiter and Mercury (authority and cunning); and, according to this horoscope, it was destined to be short-lived. For once Vanini is found quoting Cardan with ill-concealed satisfaction. But afterwards, to curry favour with the Papacy, he recants, and says that Christianity was born under the most favourable conjunction of the planets Jupiter and the sun (authority and justice). Thereupon Vanini attacks Cardan under the assumed mask of a Dutch atheist. This example will suffice to show us how astrological symbols were employed by the sceptics, and what interpretation we must put upon their astrological phraseology.

We may now describe the ordinary proceedings of an astrologer. The zodiac was first arranged in much the same fashion as the cards in the game of Tarots. The four ages of man had each three houses in the zodiac. Each of this triple series was composed of a cardinal, a succeeding, and a declining or cadent house. Disastrous signs predominated over auspicious. For kings and nobles these signs were modified, but they took care to preserve a copy of the horoscope to be modified as circumstances required. Pascal remarks,—"They say that eclipses portend misfortunes, because misfortunes are common, so that, as some ill chance often happens, they are often right, whereas if they said that they portended good fortune, they would be generally wrong. They only assign good fortune to rare conjunctions of the stars, and this is how their predictions rarely fail." Those ages during which astrologers were dominant by the terror they inspired, and sometimes by the martyrdom they endured when their predictions were either too true or too false, were in truth the saddest in the world's history. Faith, to borrow their own language, was banished to Virgo, and rarely shed her influence on men. Cardan, for instance, hated Luther, and so changed his birthday in order to give him an unfavourable horoscope. In Cardan's times, as in those of Augustus, it was a common practice for men to conceal the day and hour of their birth, till, like Augustus, they found a complaisant astrologer. But, as a general rule, astrologers did not give themselves the trouble of reading the stars, they contented themselves with telling fortunes by faces. They practised chiromancy, and relied on afterwards drawing a horoscope to suit. As physiognomists their talent was undoubted, and we may again call Vanini as a witness that there is no need to mount to the housetop to cast a nativity. "Yes," he says, "I can read his face; by his hair and his forehead it is easy to guess that the sun at his birth was in the sign of Libra and near Venus. Nay, his complexion shows that Venus touches Libra. By the rules of astrology he could not lie." No doubt, by the rules of chiromancy, a calm forehead, clustering locks, a clear and sanguine complexion, are signs of sincerity. If we combine Apollo and Venus, *i.e.*, manliness and tenderness, the product is sincerity. If we wish to see this type of character to perfection, we have only to look at a good portrait of Spinoza.

In conclusion, we shall give a few salient facts concerning the astrologers and their predictions, remarkable either for their fulfilment, or for the ruin and confusion they brought upon their authors. We may begin with one taken from Bacon's *Essay of Prophecies*:—"When I was in France, I heard from one Dr Pena, that the queen mother, who was given to curious arts, caused the king her husband's nativitie to be calculated, under a false name; and the astrologer gave a judgment, that he should be killed in a duell; at which the queene laughed, thinking her husband to be above challenges and duels; but he was slaine, upon a course at tilt, the splinters of the staffe of Mongomery going in at his bever." A favourite topic of the astrologers of all countries has been the immediate end of the world. As early as 1186 the earth had escaped one threatened cataclysm of the astrologers. This did not prevent Stoffler from predicting a universal deluge for the year 1524—a year, as it turned out, distinguished for drought. His aspect of the heavens told him that in that year three planets would meet in the aqueous sign of Pisces. 'The prediction was believed far and wide, and president Aurial, at Toulouse, built himself a Noah's ark—a curious realisation, in fact, of Chaucer's merry invention in the *Miller's Tale*. In China any false prediction of the astrologers was punished with death. But, as Juvenal remarks in his *Sixth Satire*, the astrologers' chief power depends on their persecution. M. Höfer cannot persuade himself that the Chinese possessed any extensive astronomical knowledge which they afterwards forgot. Still, the position of the astrologists, that is, the astronomers, in China sufficiently explains this relapse in astronomy. They preferred to trust to chance, and live in honour with credulous emperors, at the risk of being hanged by those they failed to please. Inordinate rewards and inordinate punishments made them indifferent to all pure love of science, and life with Orientals has always been reckoned a small stake in the game. Not only was Tycho Brahe from his fifteenth year devoted to astrology, but adjoining his observatory at Uranienburg, the astronomer royal of Denmark had a laboratory built in order to study alchemy, and it was only a few years before his death that he finally abandoned astrology. We may here notice one very remarkable prediction of the master of Kepler. That he had carefully studied the comet of 1577 as an astronomer, we may gather from his adducing the very small parallax of this comet as disproving the assertion of the Aristotelians that a solid sphere enveloped the heavens. But besides this, we find him in his character of astrologer drawing a singular prediction from the appearance of this comet. It announced, he tells us, that in the north, in Finland, there should be born a prince who should lay waste Germany and vanish in 1632. Gustavus Adolphus, it is well known, was born in Finland, overran Germany, and died in 1632. The fulfilment of the details of this prophecy was, of course, nothing but a lucky hit, but we may convince ourselves that Tycho Brahe had some basis of reason for his prediction. He was no dupe of vulgar astrology, but gifted rather with a happy inspiration like that of Paracelsus, who saw in himself the forerunner and prototype of the scientific ascendency of Germany. Born in Denmark of a noble Swedish family, a politician, as were all his contemporaries of distinction, Tycho, though no conjuror, could foresee the advent of some great northern hero. Moreover, he was doubtless well acquainted with a very ancient tradition, that heroes generally came from the northern frontiers of their native land, where they are hardened and tempered by the threefold struggle they wage with soil, climate, and barbarian neighbours.

Kepler explained the double movement of the earth by the rotation of the sun. At one time the sun presented its friendly side, which attracted one planet, sometimes its adverse side, which repelled it. He also peopled the planets with souls and genii. He was led to his three great laws by musical analogies, just as later on an organist of Hanover, William Herschel, passed from music to astronomy. Kepler, who in his youth made almanacs, and once prophesied a hard winter, which came to pass, could not help putting an astrological interpretation on the disappearance of the brilliant star of 1572, which Tycho had observed. Theodore Beza thought that this star, which in December 1573 equalled Jupiter in brilliancy, predicted the second coming of Christ. Astronomers were only then beginning to study variable and periodic stars, and disturbances in that part of the heavens, which had till then, on the authority of Aristotle, been regarded as incorruptible, combined with the troubles of the times, must have given a new stimulus to belief in the signs in heaven. Montaigne (*Essais*, lib. i. chap. 10) relates a singular episode in the history of astrology Charles V. and Francis I., who both bid for the friendship of the infamous Aretin, surnamed the divine, both likewise engaged astrologers to fight their battles. In Italy those who prophesied the ruin of France were sure to be listened to. These prophecies affected the public funds much as telegrams do nowadays. "At Rome," Montaigne tells us, "a large sum of money was lost on the Change by this prognostication of our ruin." The marquis of Saluces, notwithstanding his gratitude to Francis I. for the many favours he had received, including his marquisate, of which the brother was despoiled for his benefit, was led in 1536 to betray his country, being scared by the glorious prophecies of the ultimate success of Charles V. which were then rife. The influence of the Medici made astrologers popular in France. Richelieu, on whose council was Gaffarel, the last of the cabalists, did not despise astrology as an engine of government. At the birth of Louis XIV. a certain Morin de Villefranche was placed behind a curtain to cast the nativity of the future autocrat. A generation back the astrologer would not have been hidden behind a curtain, but have taken precedence of the doctor. La Bruyère dares not pronounce against such beliefs, "for there are perplexing facts affirmed by grave men who were eye-witnesses." In England William Lilly and Robert Fludd were both dressed in a little brief authority. The latter gives us elaborate rules for the detection of a thief, and tells us that he has had personal experience of their efficacy. "If the lord of the sixth house is found in the second house, or in company with the lord of the second house, the thief is one of the family. If Mercury is in the sign of the Scorpion he will be bald, &c." Francis Bacon abuses the astrologers of his day no less than the alchemists, but he does so because he has visions of a reformed astrology and a reformed alchemy. Sir Thomas Browne, too, while he denies the capacity of the astrologers of his day, does not venture to dispute the reality of the science. The idea of the souls of men passing at death to the stars, the blessedness of their particular sphere being assigned them according to their deserts (the metempsychosis of J. Reynaud), may be regarded as a survival of religious astrology, which, even as late as Descartes's day, assigned to the angels the rôle of moving the planets and the stars. Joseph de Maistre, the last and ablest champion of old-fashioned orthodoxy, believed in comets as messengers of divine justice, and in animated planets, and declared that divination by astrology is not an absolutely chimerical science. Lastly, we may mention a few distinguished men who ran counter to their age in denying stellar influences. Aristarchus of Samos, Martianus Capella (the precursor of Copernicus), Cicero, Favorinus, Sextus Empiricus, Juvenal, and in a later age La Fontaine, a contemporary of the neutral La Bruyère, were all pronounced opponents of astrology.

In England Swift may fairly claim the credit of having given the death-blow to astrology by his famous squib, entitled *Prediction for the Year 1708, by Isaac Bickerstaff, Esq.* He begins by professing profound belief in the art, and next points out the vagueness and the absurdities of the philomaths. He then, in the happiest vein of parody, proceeds to show them a more excellent way:—"My first prediction is but a trifle, yet I mention it to show how ignorant these sottish pretenders to astrology are in their own concerns: it refers to Partridge the almanac-maker. I have consulted the star of his nativity by my own rules, and find he will infallibly die upon the 29th of March next about eleven at night of a raging fever. Therefore I advise him to consider of it and settle his affairs in time." Then followed a letter to a person of quality giving a full and particular account of the death of Partridge on the very day and nearly at the hour mentioned. In vain the wretched astrologer protested that he was alive, got a literary friend to write a pamphlet to prove it, and published his almanac for 1709. Swift, in his reply, abused him for his want of manners in giving a gentleman the lie, answered his arguments *seriatim*, and declared that the evidence of the publication of another almanac was wholly irrelevant, "for Gadbury, Poor Robin, Dove, and Way do yearly publish their almanacs, though several of them have been dead since before the Revolution."

Seeing that astrology once permeated all sciences, all religion, and all politics, it is not strange if traces of it crop up when we should least expect them. To astrological politics we owe the theory of heaven-sent rulers, instruments in the hands of Providence, and saviours of society. Napoleon as well as Wallenstein believed in his star. Even now that the science is dead it lives on in our language. Many passages in our older poets are unintelligible without some knowledge of astrology. Chaucer wrote a treatise on the astrolabe; Milton constantly refers to planetary influences; in Shakspeare's *King Lear*, Gloucester and Edmund represent respectively the old and the new faith. We still *contemplate* and *consider*; we still speak of men as *jovial*, *saturnine*, or *mercurial*; we still talk of the *ascendency* of genius, or a *disastrous* defeat.

ETYMOLOGIES.—Belief in the influence of the heavens, the air, and the flight of birds upon human affairs has left traces in all languages. The Greek ἀστροβολεῖσθαι, and the Latin *siderari*, *sideratio*, *templum*, have been already referred to. In French, *heur*, *malheur*, *heureux*, *malheureux*, are all derived from the Latin *augurium*; the expression *né sous une mauvaise étoile*, born under an evil star, corresponds (with the change of *étoile* into *astre*) to the word *malôtru*, in Provençal *malastruc*; and *son étoile pâlit*, his star grows pale, belongs to the same class of illusions. The Latin *ex augurio* appears in the Italian *sciagura*, *sciagurato*, softened into *sciaura*, *sciaurato*, wretchedness, wretched. The influence of a particular planet has also left traces in various languages; but these must rather be explained by chiromancy than by astrology. The French and English *jovial* and the English *saturnine* correspond rather to the gods who served as types in chiromancy than to the planets which bear the same names. But this is not the case with the expressions *bien* or *mal luné*, well or ill-mooned, *avoir un quartier de lune dans la tête*, to have the quarter of the moon in one's head, nor with the German *mondsüchtig* and the English *moonstruck*; the fundamental idea of such expressions lies in the extraordinary opinions formerly held about the moon. The belief in good or evil influence by the mere medium of a look has also left its mark on language; as in the Italian *il buon*, *il cattiv' occhio*, the good, or evil, eye; *la jettatura*, bewitching by a look, &c. (J. A.)

ASTRONOMY

ASTRONOMY (from ἄστρον, a star, and νέμω, to classify or arrange) is the science which deals with the distribution, motions, and characteristics of the heavenly bodies. It is here treated of under two heads: first, the History of Astronomy; and, secondly, Theoretical Astronomy, in which the different theories of the motions of the celestial bodies are explained, and such facts described as observation has made known respecting their nature and constitution.

Part I.—History of Astronomy.

Origin of the science.

Astronomy may probably be regarded as the most ancient of the sciences. Even the least civilised races must have recognised the regular vicissitudes of day and night (and, therefore, the diurnal course of the sun), while before long the variety and succession of the seasons would be noted, and their cause—the oblique annual motion of the same luminary—would be recognised. The moon in the sun's absence is so conspicuous and so useful that her motions, her various phases, and her regular disappearance and return after equal intervals of time, must have been watched in the earliest times with attention and interest. The occurrence of eclipses and other unusual phenomena would stimulate closer scrutiny. The spectacle of the starry heavens, seemingly unchangeable, save for the motions of a few wandering orbs along a certain zone of the star-sphere, early suggested an association between the fates of men and nations and these emblems of unchanging destiny on the one hand and of the changeful lot of mankind on the other. Thus *astrology* had its origin,—a superstition which bore the same relation to astronomy that alchemy bore to chemistry. Like alchemy, astrology was of service—superstition though it was—in encouraging observation and in leading to discoveries of interest.

But though mankind were probably first impelled by motives of mere curiosity to observe the courses of the stars, no great length of time could have elapsed ere they perceived that the regular and uniform revolutions of the heavens might be rendered subservient to their own wants and conveniencies. By the help of the stars the shepherd, during the night, could count the hours, the traveller track his course through the uniform wastes of the desert, and the mariner guide his bark over the ocean: the husbandman, also, learned to regulate his labours by the appearance of certain constellations, which gave him warning of the approaching seasons. The indications derived from the simple observation of such phenomena were doubtless extremely vague; but as civilisation advanced, the necessity of determining accurately the length of the solar year and of the lunar month, in order to regulate the calendar and the religious festivals, led to the accumulation and comparison of different observations, whereby errors were gradually diminished, and the foundations laid of a more perfect science.

Astronomy thus presenting so many objects of curiosity and interest, and having so many practical uses, could not fail to be one of the sciences first cultivated by mankind. Its origin is, consequently, hid amidst the obscurity of remote ages, and is, in fact, coeval with the earliest development of the human intellect. The records or traditions of almost every ancient nation furnish some traces of attention to the state of the heavens, and of some rude attempts to discover the laws, the order, and the period of the most remarkable phenomena, such as eclipses of the sun and moon, the motions of the planets, and the heliacal risings of the principal stars and constellations. The Chaldeans and Egyptians, Chinese and Indians, Gauls and Peruvians, equally regard themselves as the founders of astronomy,—an honour, however, of which Josephus deprives them all, in order to ascribe it to the antediluvian patriarchs. The fables relating to the two columns of brick and marble which these sages are said to have erected, and on which they engraved the elements of their astronomy, to preserve them from the universal destruction by fire and water to which they are said to have learned from Adam the earth was doomed, are not worth the trouble of repetition; nor is there any better proof than the assertion of that credulous historian, of their acquaintance with the *annus magnus*, the astronomical cycle of 600 years, which brings back the sun and moon to the same points of the heavens so nearly, that its discovery implies a pretty correct knowledge of the solar and lunar motions. Passing over those details of traditional observations or unimportant facts, we proceed to give a brief account of the state of astronomy among some early nations who have undoubtedly contributed to the improvement of the science, or who, at least, have transmitted to future ages some records of their astronomical labours.

Astronomy of the Chaldeans, Egyptians, Phœnicians, Chinese, and Indians.

According to the unanimous testimony of the Greek historians, the earliest traces of astronomical science are to be met with among the Chaldeans and Egyptians. The spacious level and unclouded horizon of Chaldea afforded the utmost facilities for observing the celestial phenomena; and its inhabitants, enjoying the leisure afforded by a pastoral life, and stimulated by the vain desire of obtaining a knowledge of the future from the aspects of the stars, assiduously cultivated astronomy and astrology. By a long series of observations of eclipses, extending, according to the testimony of some authors, over nineteen centuries, or even a longer period, they had discovered the cycle of 223 lunations, or eighteen solar years, which, by bringing back the moon to nearly the same position with respect to her nodes, her perigee, and the sun, brings back the eclipses in the same order. This is supposed to be the period which they distinguished by the name of *Saros*. They had others, to which they gave the names of *Sossos* and *Neros*; but nothing positive is known with regard to their nature or extent. It is certain, however, that these Chaldaic periods, whatever they were, were purely empirical. Detected by the comparison of recorded observations, they imply neither theory nor science, unless, indeed, a simple arithmetical operation is to be considered as such; nor is there any reason to suppose that the Chaldeans employed any process of computation whatever in their predictions of eclipses. Having once established their cycle they were in possession of a simple means of predicting all those which occurred in the course of it, with as great a degree of accuracy as they considered requisite. Chaldeans.

The Egyptians were in ancient times the rivals of the Chaldeans in the cultivation of astronomy; and although they have left behind them still fewer monuments of their labours, they have obtained, through the exaggerated statements of the Greeks, even a greater reputation. The Greeks acknowledge themselves indebted to the Egyptians for their science and civilisation; but regarding themselves likewise as descendants of that ancient people, they indulged their vain-glory in magnifying the accounts of the antiquity and knowledge of their supposed ancestors. It is not improbable that some traditional observations of the Egyptians.

heavens, along with some arts indispensable to society even in its earliest stages, were carried into Europe by tribes migrating from the banks of the Nile; and it is certain that the early philosophers of Greece travelled into Egypt for the purpose of acquiring a more perfect knowledge of astronomy than could be obtained in their own country. But the facts from which it can be inferred that the Egyptians had much to communicate, are few and ill-attested. They are also blended with so much absurdity and fable, that no accurate notions can be formed, from the accounts that have been transmitted to us, of the real advances which that people had made in astronomical science. The priests were the depositaries of the national knowledge; and they carefully concealed it from the common people by shrouding it in allegories, traces of which, it has been remarked, may be detected in the institutions even of the present day.

Phœnicians.

The Phœnicians are also generally enumerated among the nations who cultivated astronomy at a very early period, though it does not appear, from any facts mentioned by ancient authors, that they devoted themselves specially to the observation of the heavens, or made any discoveries relative to the motions of the planets. That they excelled in the art of navigation is certain, from the commercial intercourse which they carried on with many places on the coasts of Africa and Spain, and with the principal islands of the Mediterranean; and it may readily be allowed that in their long voyages they would direct their course during the night by the circumpolar stars. If they had any speculative notions of astronomy, these were probably derived from the Chaldeans or Egyptians.

In China, astronomy has been cultivated from the remotest ages, and has always been considered a science indispensably necessary to the civil government of the state. The Chinese boast of a series of eclipses, recorded in the annals of the nation, extending over a period of 3858 years, all of which, they affirm, were not only carefully observed, but were calculated and figured previous to their occurrence. The same motives which led the Chaldeans and Egyptians to attend to the celestial phenomena, namely, the regulation and division of time, had equal influence among the Chinese, and we accordingly find the care of the calendar occupying the attention of their earliest princes. The emperor Fou-Hi, whose reign commenced about 2857 years before our era, is said to have assiduously studied the motions of the celestial bodies, and laboured to instruct his ignorant subjects in the mysteries of astronomy. But as they were not yet enlightened enough to comprehend his theories, he was obliged to content himself with giving them a rule for the computation of time by means of the numbers 10 and 12, the combination of which produces the cycle of 60 years, which is the standard or unit from which they deduce their hours, days, and months. Tradition is silent with respect to the sources from which Fou-Hi derived his own knowledge. In the year 2608 B.C., Hoang-Ti caused an observatory to be built, for the purpose of correcting the calendar, which had already fallen into great confusion, and appointed one set of astronomers to observe the course of the sun, another that of the moon, and a third that of the stars. It was then discovered that the twelve lunar months do not exactly correspond with a solar year; and that, in order to restore the coincidence, it was necessary to intercalate seven lunations in the space of nineteen years. If this fact rested on undoubted evidence, it would follow that the Chinese had anticipated the Greeks by 2000 years in the discovery of the Metonic cycle. The reign of Hoang-Ti is also rendered memorable by the institution of the Mathematical Tribunal, for promoting the science of astronomy, and regularly predicting eclipses, to which an extraordinary importance has always been attached in China. The members of this celebrated tribunal were made responsible with their lives for the accuracy of their predictions, by a law of the empire, which ordained that, "whether the instant of the occurrence of any celestial phenomenon was erroneously assigned, or the phenomenon itself not foreseen and predicted, either negligence should be punished with death." In the reign of Tchong-Kang, the two mathematicians of the empire, Ho and Hi, were the victims of this sanguinary law—an eclipse having taken place which their skill had not enabled them to foresee. The emperor Yao, who mounted the throne, according to the Chinese annals, about the year 2317 B.C., gave a new impulse to the study of astronomy, which had begun already to decline. He ordered his astronomers to observe with the utmost care the motions of the sun and moon, of the planets and the stars, and to determine the exact length of each of the four seasons. To this emperor are attributed the Chinese division of the zodiac into 28 constellations, called the houses of the moon, and the severe laws already noticed in regard to the erroneous prediction of the celestial phenomena. From the time of Yao the Chinese year consisted of $365\frac{1}{4}$ days. They also divided the circle into $365\frac{1}{4}$ degrees, so that the sun daily described in his orbit an arc of one Chinese degree. Their common lunar year consisted of $364\frac{348}{940}$ days; and by combining this number with $365\frac{1}{4}$, they formed the period of 4617 years, after which the sun and moon again occupy the same relative positions.

The earliest Chinese observations we are acquainted with, sufficiently precise to afford any result useful to astronomy, were made by Tcheou-Kong, whose reign commenced about the year 1100 before our era. Two of these observations are meridional altitudes of the sun, observed with great care at the village of Loyang, at the time of the summer and winter solstices. The obliquity of the ecliptic thus determined at that remote epoch is 23° 54′ 3″·15—a result which perfectly agrees with the theory of universal gravitation. Another observation made about the same time relates to the position of the winter solstice in the heavens; and it also corresponds to within a minute of a degree with the calculations of Laplace. Laplace considers this extraordinary conformity as an indubitable proof of the authenticity of those ancient observations. The golden age of Chinese astronomy extended from the reign of Fou-Hi to the year 480 B.C.,—that is, over a space of 2500 years. It is only, however, towards the latter part of this long period that the history of China becomes in any degree authentic; and the true date which must be assigned for the commencement of observations on which any reliance can be placed, is the year 722 B.C., that is, 25 years posterior to the era of Nabonassar. From that period to the year 400 B.C., Confucius reckons a series of 36 eclipses, and of these 31 have been verified by modern astronomers. After this the science fell into great neglect, notwithstanding the inveterate tenacity with which the Chinese in general adhere to their ancient customs. The decline of their astronomy is ascribed, whether justly or not, to the barbarous policy of the emperor Tsin-Chi-Hong-Ti, who, in the year 221 B.C., ordered all the books to be destroyed, excepting those only which related to agriculture, medicine, and astrology, the only sciences which he considered as being of any use to mankind. In this manner, it is said, the precious mass of astronomical observations and precepts which had been accumulating for ages was irretrievably lost.

On considering attentively the accounts which have been given of the Chinese astronomy, we find that it consisted only in the practice of observations which led to nothing more than the knowledge of a few isolated facts. The missionaries who were sent out by the Jesuits about the end of the 17th century, to whom we are indebted for what is known of the early history of China, either seduced by some appearances of truth, or thinking it prudent to conciliate the people whom they were attempting to convert, adopted their marvellous relations regarding the antiquity of their science, and spread them over Europe. As the history of the nation begins to become more authentic, their astronomy shrinks into its real, insignificant dimensions. Superstitiously attached to their ancient usages, and blindly adopting the habits of their ancestors, the Chinese continued to observe the heavens from century to century without making the slightest advances in theoretical knowledge. In later times they have adopted many improvements, for which they are entirely indebted to foreigners. During the time of the caliphs many Mahometans passed into China, carrying with them the astronomical methods and knowledge of the Arabians. The missionaries introduced the science of Europe; and the most that can be said in praise of the Chinese is, that their Government sometimes relaxed so far its spirit of jealousy and exclusion, as to afford protection to these strangers, adopt their arts, and place them at the head of the Mathematical Tribunal.

Indians. The astronomy of the Indians forms one of the most curious problems which the history of science presents, and one which, notwithstanding much discussion, still continues involved in great uncertainty. Of the science of the ancient nations of which we have already spoken, the accounts which have come down to our times are founded on conjecture and tradition; for few monuments remain to confirm or confute the glowing descriptions which authors have given of its high antiquity and great perfection. But the claims of the Indians rest on a more solid foundation. We are in possession of the tables from which they compute the eclipses and places of the planets, and of the methods by which they effect the computation; we have, in short, an Indian astronomy committed to writing, which represents the celestial phenomena with considerable exactness, and which, therefore, could only be produced by a people far advanced in science. But the difficulty the problem presents is the determination of the sources whence this science originated and the epoch of its existence—the question whether it was created by the people who now blindly follow its precepts without understanding its principles, or was communicated to them by another race of a more original genius through channels with which we are unacquainted. Some authors regard India as the cradle of all the sciences, particularly of astronomy, which they suppose to have been cultivated there from the remotest ages; others date the origin of the Indian astronomy from the period when Pythagoras travelled into that country, and carried thither the arts and sciences of the Greeks; a third opinion is, that astronomy was conveyed to India by the Arabians in the 9th century of our era, and that the Brahmins are only entitled to the humble merit of adapting the rules and practices of that people to their own peculiar methods of calculation.

Astronomy of the Greeks.

The origin of astronomy in Greece, as in other early nations, ascends beyond the period of authentic history.
Thales. The true foundations of Grecian science were laid by Thales, who was born at Miletus 640 years before our era. He formed a sect which has been distinguished by the title of the "Ionian School." His doctrines regarding astronomy contain a few truths which do honour to his sagacity and observation, though they are mixed with much error and absurdity. He taught that the stars are formed of fire; that the moon receives her light from the sun, and is invisible at her conjunctions, because she is hid in the sun's rays. He also taught the sphericity of the earth, which he placed at the centre of the universe. He divided the sphere into five zones, by the arctic and antarctic circles, and the two tropics; and held that the equator is cut obliquely by the ecliptic, and perpendicularly by the meridian. He is also said to have observed eclipses; and Herodotus relates that he predicted the famous one which put a stop to the war between the Medes and the Lydians. It does not appear, however, that he ventured to assign either the day or the month of the eclipse, so that his prediction must have been confined to the year. According to Callimachus, he determined the positions of the stars which form the Lesser Bear, by which the Phœnicians guided themselves in their voyages. It is difficult, however, to conceive how Thales, unacquainted with instruments, could determine the positions of stars with so much accuracy as to render any essential assistance to the navigator. It is probable that he only pointed out the configuration and some of the more brilliant stars of that constellation, among which he might remark that which is nearest the pole of the heavens. Thales was succeeded by Anaximander, to whom also is attributed a knowledge of the Anaximander sphere and of the zodiac. According to Diogenes Laertius, he, like his master Thales, supposed the earth to be spherical, and placed at the centre of the universe; but Plutarch ascribes to him the less philosophical opinion of its resemblance to a column. He supposed the sun to be of equal magnitude with the earth. He invented the gnomon, and placed one at Lacedæmon to observe the solstices and equinoxes. The circumstance which best entitles Anaximander to the gratitude of posterity is the invention of geographical charts. Anaximenes succeeded Anaximenes. Anaximander in the Ionian school, and maintained nearly the same doctrines. Pliny says he was the first who taught the art of constructing dials, an invention which, as we have just seen, has also been ascribed to Anaximander. These two philosophers probably revived the knowledge of an instrument, the use of which had been forgotten amidst the general rudeness and ignorance of their countrymen. Before their time the Greeks only marked the divisions of the day by the different lengths of the sun's shadow. Anaxagoras Anaxagoras. was the disciple and successor of Anaximenes. If this philosopher really entertained the ridiculous opinions ascribed to him by Plutarch, the Ionian school must rather have retrograded than advanced in sound philosophy from the time of Thales. He is said to have believed that the sun is a mass of red-hot iron, or of heated stone, somewhat bigger than the Peloponnesus, that the heaven is a vault of stones, which is prevented from tumbling only by the rapidity of its circular motion, and that the sun is prevented from advancing beyond the tropics by a thick and dense atmosphere, which forces him to retrace his course. These alleged opinions are probably greatly exaggerated; but it does not appear that Anaxagoras contributed much to extend the knowledge of the heavens. His disregard for the superstitious notions of his age brought its usual penal consequences. Having shown the reason of the eclipses of the moon, he was accused of ascribing to natural causes the attributes and power of the gods; and having taught the existence of only one God, he was accused of impiety and treason towards his country. Sentence of death was pronounced on the philosopher and all his family; and it required the powerful interest of his friend and disciple Pericles to obtain a commutation of the sentence into one of perpetual banishment.

While the Ionian sect was so successfully employed in cultivating and propagating a knowledge of nature in Greece, another, still more celebrated, was founded in Italy by Pythagoras. Pythagoras is said to have acquired in Pythagoras. Egypt the knowledge of the obliquity of the ecliptic, and of the identity of the morning and evening stars.

What he chiefly deserves to be commemorated for in the history of astronomy, is his philosophical doctrine regarding the motion of the earth. He taught publicly that the earth is placed at the centre of the universe; but among his chosen disciples he propagated the doctrine that the sun occupies the centre of the planetary world, and that the earth is a planet revolving round the sun. This system, which still retains his name, being called the old or Pythagorean system of the universe, is that which was revived by Copernicus. It is, however, only just to the latter to observe, that there is a vast difference between the bare statement of the possibility of a fact, and the demonstration of its existence by irrefragable arguments. Pythagoras having remarked the relation which subsists between the tone of a musical chord and the rapidity of its vibration, was led by analogy to extend the same relation to the planets, and to suppose that they emit sounds proportional to their respective distances, and form a celestial concert too melodious to affect the gross organs of mankind. Another fancy into which he was led by his passion for analogies, was the application of the five geometrical solids to the elements of the world. The cube symbolically represented the earth; the pyramid, fire; the octahedron, air; the icosahedron, or twenty-sided figure, water; and the dodecahedron, or figure with twelve faces, the exterior sphere of the universe. Pythagoras left no writings; and it is doubtful whether he really entertained many of the opinions and reveries which have usually been ascribed to him.

Philolaus. Philolaus of Crotona, a disciple of Pythagoras, embraced the doctrine of his master with regard to the revolution of the earth about the sun. He supposed the sun to be a disk of glass which reflects the light of the universe. He made the lunar month consist of $29\frac{1}{2}$ days, the lunar year

Nicetas. of 354 days, and the solar year of $365\frac{1}{2}$ days. Nicetas of Syracuse seems to have been the first who openly taught the Pythagorean system of the universe. Cicero, on the authority of Theophrastus, the ancient historian of astronomy, gives him the credit of maintaining that the apparent motion of the stars arises from the diurnal motion of the earth about its axis;[1] but this rational doctrine seems to have been first broached by Heraclides of Pontus, and Ecphantus, a disciple of Pythagoras.

Metonic cycle. The introduction of the Metonic cycle forms an era in the history of the early astronomy of Greece. The Chaldeans, as we have already stated, established several lunisolar periods; and the difficulty of reconciling the motions of the sun and moon, or of assigning a period at the end of which these two luminaries again occupy the same positions relatively to the stars, had long embarrassed those who had the care of regulating the festivals. Meton and Euctemon had the merit of first obviating this difficulty, at least for a time, for the motions of the sun and moon being incommensurable, no period can be assigned which will bring them back to precisely the same situations. These two astronomers formed a cycle of nineteen lunar years, twelve of which contained each 12 lunations, and the seven others each 13, which they intercalated among the former. It had long been known that the synodic month consisted of $29\frac{1}{2}$ days nearly, and in order to avoid the fraction, it had been usual to make the twelve synodic months, which compose the solar year, to consist of 29 and 30 days alternately, the former being called *deficient* and the latter *full* months. Meton made his period consist of 125 full and 110 deficient months, which gives 6940 days for the 235 lunations, and is nearly equal to 19 solar years. This cycle commenced on the 16th of July in the year 433 B.C. It was received with acclamation by the people assembled at the Olympic games, and adopted in all the cities and colonies of Greece. It was also engraved in golden letters on tables of brass, whence it received the appellation of the *golden number*, and has been the basis of the calendars of all the nations of modern Europe. It is still in ecclesiastical use, with such modifications as time has rendered necessary.

Eudoxus of Cnidus, about the year 370 B.C., obtained Eudoxus. great reputation as an astronomer. According to Pliny, he introduced the year of $365\frac{1}{4}$ days into Greece. Archimedes says that he supposed the diameter of the sun to be nine times greater than that of the moon, which shows that he had in some degree overcome the illusions of sense. The titles of three of his works have been preserved,—the *Period or Circumference of the Earth*, the *Phenomena*, and the *Mirror*. His observatory was still standing at Cnidus in the time of Strabo. He is noteworthy for his contempt of the Chaldean predictions, and for having contributed to separate true astronomy from the reveries of judicial astrology. Eudoxus seems to have been the first who attempted to give a mechanical explanation of the apparent motions of the planets. He supposed that each planet occupies a particular part of the heavens, and that the path which it describes is determined by the combined motion of several spheres performed in different directions. The sun and moon had each three spheres: one revolving round an axis which passes through the poles of the earth, and which occasions the diurnal motion; a second revolving round the poles of the ecliptic, in a contrary direction, and causing the annual and monthly revolutions; the third revolving in a direction perpendicular to the first, and causing the changes of declination. Each of the planets had a fourth sphere to explain the stations and retrogradations. As new inequalities and motions were discovered, new spheres were added, till the machinery became so complicated as to be altogether unintelligible.

Although Plato can hardly be cited as an astronomer, Plato. yet the progress of the science was accelerated by means of the lights struck out by his penetrating genius. He seems to have had just notions of the causes of eclipses; and he imagined that the celestial bodies originally moved in straight lines, but that gravity altered their directions, and compelled them to move in curves. He proposed to astronomers the problem of representing the courses of the stars and planets by circular and regular motions. Geometry was assiduously cultivated in the school of Plato; and on this account he claims a distinguished place among the promoters of true astronomy.

Astronomy is also under some obligations to Aristotle. Aristotle. In a treatise which he composed on this science, he recorded a number of observations which he had made; and, among others, mentions an occultation of Mars by the moon, and another of a star in the constellation Gemini by the planet Jupiter. As such phenomena are of rare occurrence, their observation proves that he had paid considerable attention to the planetary motions.

A great number of astronomers flourished about this time whose labours and observations prepared the way for the reformation of the science which was shortly after effected by Hipparchus. Helicon of Cyzicus is renowned Helicon. for the prediction of an eclipse, which took place, as Plutarch affirms, at the time announced. History records the names of only three individuals in ancient Greece who predicted eclipses,—Thales, Helicon, and Eudemus. Eudemus composed a history of astronomy, a fragment Eudemus. of which, consisting of only a few lines, is preserved by

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[1] "Nicetas Syracusius, ut ait Theophrastus, cœlum, solem, lunam, stellas, supera denique omnia, stare censet; neque, præter terram, rem ullam in mundo moveri; quæ cum circum axem se summa celeritate convertat et torqueat, eadem effici omnia, quasi, stante terra, cœlum moveretur."—(Cicero, *Acad. Quæst.*, lib. iv. cap. 39.) Copernicus himself could not have stated the doctrine with greater precision.

Fabricius in the *Bibliotheca Græca.* In this it is mentioned that the axes of the ecliptic and equator are separated from each other by the side of a pentedecagon, which is equivalent to saying that they contain an angle of 24°. This is the first value which we find assigned by the Greeks to the obliquity of the ecliptic. It is given in round numbers, and may easily be supposed to contain an error of a quarter of a degree.

Calippus.

Calippus is celebrated for the period which he formed of four Metonic cycles. Having observed, by means of an eclipse of the moon which took place about six years before the death of Alexander, that the Metonic cycle contained an error of a fourth of a day, he introduced the period of 940 lunations, containing four Metonic cycles, diminished by one day. He likewise formed a collection of observations on the heliacal risings of the planets.

Theophrastus.

Theophrastus wrote a history of astronomy, and supposed the Milky Way to be produced by the imperfect junction of the two hemispheres, which allowed the light to penetrate from the firmament beyond.

Autolycus.

Autolycus of Pitane wrote two books,—one on the movable sphere, the other on the risings and settings of the stars. These are the most ancient of the astronomical works of the Greeks which have come down to our times.

Pytheas.

Pytheas of Marseilles, about the time of Alexander the Great, determined the length of the solstitial shadows in various countries by means of the gnomon. He found the shadows equal at Marseilles and Byzantium—a circumstance which does not give a favourable idea of the accuracy of his observations, inasmuch as the difference of the latitudes of the two places amounts to $2\frac{1}{4}$ degrees. The observation is, however, interesting, as it is the most ancient of the kind which has been preserved after that of Tcheou-Kong, and as it confirms the successive diminution of the obliquity of the ecliptic. Pytheas undertook several voyages for the purpose of obtaining geographical and astronomical information, and advanced northwards as far as Iceland. His accounts have been treated as fabulous by Strabo and Polybius, but the accuracy of the greater number of them has been confirmed by modern observation and experience. He was the first who distinguished the climates by the different lengths of the days and nights.

Astronomy in the School of Alexandria.

Aristillus and Timocharis.

The first astronomers of the Alexandrian school were Aristillus and Timocharis, who flourished under the first Ptolemy, about 300 years before Christ. The chief object of their labours was the determination of the relative positions of the principal stars of the zodiac instead of merely announcing their risings and settings, as had been the practice of the Orientals and the ancient Greeks. The observations of these two astronomers conducted Hipparchus to the important discovery of the precession of the equinoxes, and served as the basis of the theory which Ptolemy, some centuries afterwards, gave of that phenomenon.

Aristarchus.

Aristarchus of Samos, the next in order of the Alexandrian astronomers, composed a treatise *On the Magnitudes and Distances of the Sun and Moon*, which has been preserved to our times. In this treatise he describes an ingenious method which he employed to obtain the relative distances of the two luminaries. At the instant when the moon is dichotomised, that is, when the exact half of her disk appears to a spectator on the earth to be illuminated by the sun's light, the visual ray passing from the centre of the moon to the eye of the observer is perpendicular to the line which joins the centre of the moon and sun. At that instant, therefore, he measured the angular distance of the two bodies, and finding it to be 87°, he concluded, by the resolution of a right-angled triangle, that the distance of the sun is between eighteen and nineteen times greater than that of the moon. This method is perfectly correct in theory, but it is difficult to be assured of the exact instant of the moon's dichotomy, and in an angle of such magnitude a very small error greatly affects the result. The error of Aristarchus is very considerable, the true angle being about 87° 50′. The estimated distance of the sun is by consequence far too small; yet the determination, faulty as it was, contributed to expand greatly the existing notions relative to the boundaries of the universe, for the Pythagoreans had taught that the sun is only three, or at most three and a half times more distant than the moon. Another delicate observation made by Aristarchus was that of the magnitude of the sun's diameter, which, as we learn from Archimedes, he determined to be the 720th part of the circumference of the circle which the sun describes in his diurnal revolution. This estimate is not very far from the truth, and the observation is by no means an easy one. He embraced the doctrine of Pythagoras respecting the earth's motion, and appears to have entertained juster notions than any of the astronomers who preceded him, regarding the magnitude and extent of the universe. The treatise *On the Magnitudes and Distances* is published in the third volume of the works of Dr Wallis, with a Latin translation by Commandine, and some notes.

Eratosthenes.

Eratosthenes, the successor of Aristarchus, a native of Cyrene, was invited to Alexandria by Ptolemy Euergetes, who appointed him keeper of the royal library. He is supposed to have been the inventor of armillary spheres, a species of instrument extensively used by the ancient astronomers. By means of an instrument of this kind he observed the distance between the tropics to be to the whole circumference of a great circle as 11 to 83,—a ratio equivalent to 47° 42′ 39″, half of which gives 23° 51′ 19″·5 for the obliquity of the ecliptic. This is a very important observation, and confirms the gradual diminution of the obliquity as indicated by theory. Eratostheues is celebrated as the first who attempted, on correct principles, to determine the magnitude of the earth. Having remarked, by some means with which we are unacquainted, that Syene, the most southern of the cities of ancient Egypt, is situated nearly on the same meridian as Alexandria, he conceived the idea of determining the amplitude of the celestial arc intercepted between the zeniths of the two places, and of measuring at the same time their distance on the ground,—operations which would afford data for the determination of the whole length of the terrestrial meridian. Syene was known to be situated exactly under the tropic; for at the summer solstice the gnomon had no shadow, and the sun's rays illumined the bottom of a deep well in that city. On the day of the solstice he found the meridional distance of the sun from the zenith of Alexandria to be 7° 12′, or a fiftieth part of the circumference. It had also been ascertained by the *bematists* or surveyors of Alexander and the Ptolemies, that the itinerary distance between Alexandria and Syene was 5000 stadia; therefore $5000 \times 50 = 250{,}000$ stadia form the circumference of a great circle of the earth, or the length of the terrestrial meridian. Unfortunately, on account of the uncertainty respecting the length of the stadium here employed, we possess no means of estimating the degree of approximation afforded by this rude though ingenious attempt.

About this time the science of astronomy was enriched by the discoveries of some of the distinguished geometricians whose labours have so greatly extended the glory of the Alexandrian school.

Euclid.

Euclid, the celebrated author of the *Elements*, lived in the reign of the first Ptolemy. He composed a book on the sphere, which probably served as a model for future works of the same kind, and was the first who treated in a geometrical manner the phenomena of the different inclinations of the sphere.

Conon.

Conon of

Samos, the friend of Archimedes, collected the records of eclipses, which had been observed by the ancient Egyptians; and Callimachus ascribes to him the constellation of Berenice's hair. Archimedes Archimedes also claims a high rank among the cultivators of astronomy. His celebrated planetarium, which represented the motions of the sun, moon, planets, and starry sphere, has been a frequent theme of the praises of the poets:—

> Jura poli, rerumque fidem, legesque deorum,
> Ecce Syracosius transtulit arte senex."
> ·Claudian, *Epigr.* 18.

Apollonius. Apollonius of Perga solved the important problem of the stations and retrogradations of the planets by means of epicycles and deferents; and he is entitled to the glory of having formed the alliance between geometry and astronomy, which has been productive of the greatest advantages to both.

Hipparchus. Astronomy, which had as yet only consisted of a knowledge of isolated facts, acquired a systematic form, and almost a new existence, from the genius of Hipparchus, perhaps the greatest of all ancient philosophers in the sciences which are not purely speculative. This illustrious founder of astronomical science was born at Nicæa in Bithynia, and observed at Rhodes. Flamsteed and Cassini, probably misled by some ambiguous expressions of Ptolemy, have related that his observations were made at Alexandria; and this opinion seems generally to have been adopted by historians. The question has been examined carefully, and at considerable length, by Delambre (*Astronomie Ancienne*), who comes to the conclusion that there is no reason whatever to infer that Hipparchus ever saw Alexandria. Ptolemy, in reporting the observations of Hipparchus, supposed Rhodes and Alexandria to be situated on the same meridian, and consequently does not find it necessary to mention the place at which the observations were made. Hipparchus commenced his brilliant career by verifying the determination of the obliquity of the ecliptic made by Eratosthenes. He next directed his attention to the length of the tropical year. By comparing one of his own observations of the summer solstice with a similar one made by Aristarchus 140 years before, he found that the anciently received value of $365\frac{1}{4}$ days was too great by seven minutes. This leaves the tropical year a value still too great; but it is probable that the error arose from the inaccuracy of the observation of Aristarchus; for the observations of Hipparchus, compared with those of the moderns, make the length of the tropical year amount to 365 days, 5 hours, and 49 minutes, which is only 12 seconds greater than the truth. By a careful observation of the solstices and equinoxes, he discovered that the year is not divided by these points into four equal parts, the sun occupying $94\frac{1}{2}$ days in passing from the vernal equinox to the summer solstice, and only $92\frac{1}{2}$ from the same solstice to the equinox of autumn. The sun, consequently, remained 187 days in that part of the ecliptic which lies between the equator and the north pole, and therefore only about 178 in the other part. This observation led Hipparchus to the great discovery of the eccentricity of the solar orbit. He accounted for the apparent inequality of the sun's motion by supposing that the earth is not placed exactly at the centre of the circular orbit of the sun, and that, consequently, his distance from the earth is subject to variation. When the sun is at his greatest distance, he appears to move more slowly; and when he approaches nearer, his motion becomes more rapid. The distance of the earth from the centre of the orbit is called the eccentricity; it produces an equation between the real and apparent motions which is called the "equation of the centre." He determined the magnitude of this equation in terms of the radius of the ecliptic, and fixed the position of the line of the apsides, or that which joins the two opposite points of the orbit which are at the greatest and least distance from the earth. With these data he formed the first tables of the sun which are mentioned in the history of astronomy. The discovery of the eccentricity also led Hipparchus to that of the inequality of the lengths of the solar days at different seasons of the year. In the interval which elapses between the sun's passage over the meridian and his return to it the following day, the sun advances by his own proper motion towards the east nearly a degree. But the rate of this motion is unequal, varying between 57 and 61 minutes of a degree; and the accumulation of the inequalities forms what is called the equation of time, that is, the difference between the true time, as shown by the sun, and the mean time, shown by a well-regulated clock, the motions of which are equal and uniform.

The attention of Hipparchus was next directed to the motions of the moon; and on this subject his researches were attended with equal success. From the comparison of a great number of the most circumstantial and accurate observations of eclipses recorded by the Chaldeans, he was enabled to determine the period of the moon's revolution relatively to the stars, to the sun, to her nodes, and to her apogee. These determinations are among the most valuable results of ancient astronomy, inasmuch as they corroborate one of the finest theoretical deductions—the acceleration of the mean lunar motion—and thus furnish one of the most delicate tests of the truth of Newton's law of gravitation. It was indeed, by a comparison of the observations of Hipparchus with those of the Arabian and modern astronomers that Dr Halley was led to the discovery of that important phenomenon. Hipparchus also determined the eccentricity of the lunar orbit, and its inclination to the plane of the ecliptic; and the values which he assigned to these elements, making allowance for the evection and the inequalities of the moon's motion in latitude, are within a few minutes the same as those which are now observed. He had also an idea of the second inequality of the moon's motion, namely, the evection, and made all the necessary preparations for a discovery which was reserved for Ptolemy. He likewise approximated to the parallax of the moon, which he attempted to deduce from that of the sun, by determining the length of the frustum cut off from the cone of the terrestrial shadow by the moon, when she traverses it in her eclipses. From the parallax he concluded that the greatest and least distances of the moon are respectively equal to 78 and 67 semi-diameters of the earth, and that the distance of the sun is equal to 1300 of the same semi-diameters. The first of these determinations exceeds the truth, the second falls greatly short of it, the distance of the sun being nearly equal to 24,000 terrestrial semi-diameters. It may, however, be remarked that Ptolemy, who undertook to correct Hipparchus with regard to the parallax, deviated still farther from the truth.

The apparition of a new star in the time of Hipparchus induced him to undertake the formation of a catalogue of all the stars visible above his horizon, to fix their relative positions, and mark their configurations, in order that posterity might have the means of observing any changes which might in future take place in the state of the heavens. This arduous undertaking was rewarded by the important discovery of the precession of the equinoxes, one of the fundamental elements of astronomy. By comparing his own observations with those of Aristillus and Timocharis, he found that the first point of Aries, which, in the time of these astronomers, or 150 years before, corresponded with the vernal equinox, had advanced two degrees, according to the order of the signs, or at the rate of 48 seconds a year. This determination is not very far from the truth; for, according to modern observations, the rate of the precession is about 50·1 seconds annually. His catalogue contained 1080 stars,—not, as has sometimes been erroneously stated, 1022, the number in that of Ptolemy, in which the nebulous and some obscure stars are omitted. He also commenced a series of observations to furnish his successors with the means of forming a theory of the planets. Hipparchus likewise invented the planisphere, or method of representing the starry firmament on a plane surface, which afforded the means of solving the problems of spherical trigonometry in a manner often more exact and more convenient than the globe itself. He was the first who demonstrated the methods of calculating triangles, whether rectilineal or spherical; and he constructed a table of chords, from which he drew nearly the same advantages as we derive at present from the tables of sines. Geography is also indebted to him for the happy idea of fixing the position of places on the earth by means of their latitudes and longitudes; and he was the first who determined the longitude by the eclipses of the moon.

After the death of Hipparchus nearly three centuries elapsed before any successor arose worthy of the name. During this long period astronomy made no essential advancement. Some rough observations, scarcely superior to those of the Chaldeans, and a few meagre treatises, are the only monuments which exist to testify that science had not fallen into utter oblivion in an age so fertile of poets and orators. Geminus and Cleomedes wrote treatises, which have been preserved to our times; Agrippa and Menelaus are said to have observed; the Roman calendar was reformed by Julius Cæsar and the Egyptian astronomer Sosigenes; and Posidonius measured a degree, and remarked that the laws of the tides depend on the motions of the sun and moon.

Ptolemy.

Ptolemy was born at Ptolemais in Egypt, and flourished at Alexandria about the 130th year of our era, under the reigns of Hadrian and Antoninus. This illustrious ornament of the Alexandrian school is entitled by his own discoveries to the high rank among astronomers which has universally been assigned to him; but the most signal service which he conferred on science was the collection and arrangement of the ancient observations. Out of these materials he formed the Μεγάλη Σύνταξις, or *Great Composition*, a collection which exhibits a complete view of the state of astronomy in the time of Ptolemy, and which contains the germ of most of the methods in use at the present day. The hypothesis which Ptolemy adopted for the purpose of explaining the apparent motions, was that which had been followed by Hipparchus. To account for the uniform circular motion, Apollonius imagined the ingenious apparatus of epicycles and deferents; and Hipparchus advanced a step farther, by placing the centre of the sun's circle at a small distance from the earth. Ptolemy adopted both hypotheses, and supposed the planet to describe an epicycle by a uniform revolution in a circle, the centre of which was carried forward uniformly in an eccentric round the earth. By means of these suppositions, and by assigning proper relations between the radii of the epicycle and deferent circle, and also between the velocity of the planet and the centre of its epicycle, he was enabled to represent with tolerable accuracy the apparent motions of the planets, and particularly the phenomena of the stations and retrogradations, which formed the principal object of the researches of the ancient astronomers. The notions of Apollonius and Hipparchus were thus reduced to a systematic form, and the proportions of the eccentrics and epicycles of all the planets assigned, by Ptolemy; on which account the system has been generally ascribed to him, and has obtained the name of the *Ptolemaic System* of the universe.

The most important discovery which astronomy owes to Ptolemy is that of the evection of the moon. Hipparchus had discovered the first lunar inequality, or the equation of the centre, which serves to correct the mean motion at the syzygies, and had also remarked the necessity of another correction for the quadratures. He even undertook a set of observations, with a view to ascertain its amount and its law; but death put a stop to his labours before he had brought them to a successful issue. Ptolemy completed the investigation, and discovered that the eccentricity of the lunar orbit is itself subject to an annual variation, depending on the motion of the line of the apsides. The variation of the position of the apsides produces an inequality of the moon's motion in her quarters, which has been technically denominated the evection. The equation given by Ptolemy, though of course empirical, is remarkably exact.

Ptolemy employed a very simple process for determining the moon's parallax, which was probably suggested to him by the situation of Alexandria, where he observed. He determined the latitude of a place a little to the south of that city, over the zenith of which the moon was observed to pass when her northern declination was the greatest possible. But when the moon is in the zenith, or in the same straight line with the observer and the centre of the earth, she has no parallax; consequently the obliquity of the ecliptic and the latitude of the station being known, the moon's greatest northern latitude was also determined. The next step was to observe the moon's meridian altitude fifteen days after the first observation, when her southern latitude was necessarily the greatest possible. This observation gave the *apparent* altitude of the moon, but her greatest northern and southern declinations being supposed equal, her *true* altitude, as seen from the centre of the earth, was easily computed from the previous observation, and the difference between the true and apparent altitudes gave the amount of the parallax.

The observations of Hipparchus relative to the motion of the stars in longitude, or the regression of the equinoctial points, were confirmed by Ptolemy, although he mistook his amount, and diminished a quantity which Hipparchus had already estimated too low. According to Hipparchus the regression is at the rate of two degrees in 150 years. Ptolemy reduced it to one degree in 90 years. This disagreement would seem to indicate an error of more than a degree in the observations, which can with difficulty be admitted, considering the accordance which subsists among the different observations cited by Ptolemy in support of his own determination. For this and some other reasons Ptolemy has been accused of altering the observations of Hipparchus, and accommodating them to his own theory; and there would appear to be but too just grounds for the imputation. The error with regard to the regression may, however, have arisen from the circumstance, that Hipparchus had assigned too great a value to the length of the year, whence the motion of the sun with regard to the equinoxes would be made too slow, and the longitudes employed by Ptolemy consequently diminished.

Ptolemy has been called The Prince of Astronomers,—a title which may perhaps be justified by the universal and long-continued prevalence of his system, but to which he has no claim from the number or value of his own observations. After a laborious and minute examination of the *Almagest*, Delambre doubts whether anything is contained in that great work, beyond the author's own statement, from which it can be decisively inferred that Ptolemy ever observed at all. He, indeed, frequently makes mention of observations made by himself; but his solar tables, rate of the precession, eclipses, determination of the moon's motion and parallax, and above all, his catalogue of stars, render it impossible to doubt that the greater part of the results which he has given as observations are merely computed from the tables of Hipparchus. He never in any instance cites a single observation more than is just necessary for the object he has immediately in view, and consequently, by precluding all comparison of one observation with another, has deprived us of the means even of guessing at the probable amount of the errors of his solar, lunar, and planetary tables. If an astronomer, as Delambre justly remarks, were to adopt the same course at the present day, he would be certain of forfeiting all claim to confidence; but Ptolemy stood alone; he had neither judges nor rivals; and now no one condescends to calculate the few observations he has left us. His catalogue contains only 1022 stars, and is therefore less extensive than that of Hipparchus, but it is exceedingly valuable on account of its details.

Astronomy of the Arabians.

The most celebrated of the Arabian astronomers was Albategni, or Muhammed Ben Geber Al-Batani, so called from Batan, a city of Mesopotamia, where he was born about 850. He was a prince of Syria, and resided at Rakka in Mesopotamia; but many of his observations were made at Antioch. Having studied the *Syntaxis* of Ptolemy, and made himself acquainted with the methods practised by the Greek astronomers, he began to observe, and soon found that the places assigned to many of the stars in Ptolemy's tables were considerably different from their actual situations, in consequence of the error which the latter had committed with regard to the precession of the equinoxes. Albategni measured the rate of the precession with greater accuracy than had been done by Ptolemy; and he had still better success in his attempt to determine the eccentricity of the solar orbit, his value of which differs extremely little from that which results from modern observations. In assigning the length of the year, however, he fell into an error of more than two minutes; but this proceeded, as has been shown by Dr Halley, from too great confidence in the observations of Ptolemy. Albategni also remarked that the place of the sun's apogee is not immovable, as former astronomers had supposed, but that it advances at a slow rate, according to the order of the signs,—a discovery which has been confirmed by the theory of gravitation. A new set of astronomical tables, more accurate than those of Ptolemy, likewise resulted from the indefatigable labours of Albategni; and his observations, important in themselves, are doubly interesting on account of the fact that they form a link of connection between those of the astronomers of Alexandria and of modern Europe. The works of Albategni were published in 1537 under the title of *De Scientia Stellarum.*

Ibn-Junis, who flourished at the beginning of the 11th century, constructed a set of tables, and composed a sort of celestial history, in which he has recorded numerous observations of his own and of other astronomers belonging to the same country. This work, imperfectly known through some extracts, long excited the curiosity of astronomers, as it was supposed to contain observations tending to establish the acceleration of the mean motion of the moon. A manuscript copy of it, belonging to the University of Leyden, was, in 1804, transmitted to the French Institute, and translated by Professor Caussin. It contains 28 observations of eclipses from the year 829 to 1004; seven observations of the equinoxes; one of the summer solstice; one of the obliquity of the ecliptic made at Damascus, by which the value of that element is found to be 23° 35′; and likewise a portion of tables of the sun and moon, with some other matter illustrative of the state of astronomy among the Arabians. The observations which regard the acceleration of the mean lunar motion are two eclipses of the sun and one of the moon, observed by Ibn-Junis, near Cairo, in the years 977, 978, and 979, and they agree with theory in confirming the existence of that phenomenon.

Ulugh Begh. Ulugh Begh, a Tartar prince, and grandson of the great Tamerlane, not only encouraged the study of astronomy, but was himself a diligent and successful observer. At Samarcand, the capital of his dominions, he established an academy of astronomers, and caused the most magnificent instruments to be constructed for their use. By means of a gnomon 180 feet in height, he determined the obliquity of the ecliptic to be 23° 30′ 20″, the precession of the equinoxes at 1° in 70 years, and obtained elements for the construction of tables which have been found to be scarcely inferior in accuracy to those of Tycho Brahe. The ancient astronomy had produced only one catalogue of the fixed stars, that of Hipparchus. Ulugh Begh has the honour of having formed a second, after an interval of sixteen centuries.

Revival of Astronomy in Europe.

After the death of Ulugh Begh, astronomy received no farther accessions in the East. But the seeds of knowledge had now begun to take root in a more propitious soil, and Europe, destined to carry the development of the human energies to its fullest extent, began to awake from the lethargy in which it had continued during so many ages.

Purbach. The 14th century produced no astronomer from whose labours the science gained any accessions. George Purbach, or Beurbach, so named from a small town in Austria, where he was born in 1423, obtained great celebrity as a professor. He studied at Vienna, and after giving proofs of exceptional talent, he travelled into Italy, where he was favourably received by Cardinal de Cusa, who himself cultivated astronomy. On his return to Vienna he undertook a translation of the *Almagest;* and although ignorant both of Greek and Arabic, his perfect acquaintance with the subject enabled him to correct many errors which had been introduced through the carelesness or ignorance of former translators. Purbach had the good fortune to form a disciple who executed many of the plans which had been interrupted by his premature death. This was the celebrated John Müller of Königsberg, better known by the name of Regiomontanus. Attracted to Vienna in his youth by the great reputation of Purbach, he continued to study there during ten years, and on the death of his master repaired to Rome for the purpose of acquiring the Greek language, and of making himself, through it, acquainted with the *Almagest.* At Rome he continued his observations, and translated into Latin the works of Ptolemy, the *Conics* of Apollonius, and some other treatises of ancient science. In 1471 he retired to Nuremberg, where, with the aid of Bernard Walther, a wealthy burgess, he founded an observatory and furnished it with excellent instruments principally of his own invention, by means of which he was enabled to detect many errors in the ancient tables. After the death of Regiomontanus, Walther continued to observe at Nuremberg during thirty years. His observations were collected by order of the senate of Nuremberg, and published by Schöner in 1544, a second time by Snellius, and, lastly, along with those of Tycho Brahe. In 1484 Walther began to make use of clocks, then a recent invention, to measure time in celestial observations. He was also the first who employed the planet Venus in determining the longitudes of the stars.

Regiomontanus

Nuremberg had the honour of producing another astronomer of some celebrity. John Werner was the first who explained the method, which was afterwards brought into general use by Maskelyne, of finding the longitude at sea, by observing the distance between a fixed star and the moon. He published some mathematical and geographical treatises, and made a number of observations to determine the obliquity of the ecliptic and the precession of the equinoxes.

We come now to the period of the overthrow of the Ptolemaic system and the total renovation of the science of astronomy, which was due to the labours of Copernicus. Copernicus. The system which is associated with the name of Copernicus is now so familiar to every one, that it is almost unnecessary to describe it. The heaven, composed of stars perfectly at rest, occupies the remotest bounds of space, then the orbit of Saturn, next Jupiter, Mars, the Earth (accompanied by its moon), Venus, Mercury, and, lastly, the Sun immovable at the centre. By this arrangement the stations and retrogradations of the planets became simple mathematical corollaries, following from the differences of the radii of their orbits and their unequal motions. The diurnal rotation of the earth explained more simply and rationally the apparent daily revolution of the heavens; and the precession of the equinoxes was referred to a small variation in the inclination of the earth's axis to the plane of the ecliptic. But the simplicity of the system, and its consequent probability, were the only arguments which Copernicus was able to bring forward in proof of its reality. The motion of the earth can, indeed, never be made an object of ocular demonstration; but after Richer's discovery of the diminution of gravity towards the equator, it was impossible to doubt longer of the existence of its rotatory motion; and when Roemer had measured the velocity of light, and Bradley observed the phenomena of aberration, the evidences of its annual revolution were rendered equally convincing. Great, however, as were the merits of Copernicus, it must be acknowledged that he left his system in a very imperfect state. After the example of the ancients, he assumed as an axiom the uniform circular motion of the planets; and as the only motions which are observed are in a state of incessant variation, he was obliged, in order to explain the inequalities, to suppose a different centre to each of his orbits. The sun was placed *within* the orbit of each of the planets, but not in the centre of any of them, consequently he had no other office to perform than to distribute light and heat; being excluded from any influence on the system, he became as it were a stranger to all the motions. Yet notwithstanding these and other imperfections, the establishment of the doctrine of the earth's motion, with an evidence which dissipated the illusions of sense, was a great step towards the true knowledge of the planetary system; and when we consider the ignorance and prejudices of the age, we cannot hesitate to admit his claim to a high rank among philosophers. But whether the actual services which he rendered to astronomy are commensurate with the great fame he has obtained, may admit of doubt. He revived an ancient opinion opposed to the prejudices and religious dogmas of his times, and fortified it with new and strong, though not absolutely convincing, proofs. It seldom happens, however, with regard to those sciences which ultimately appeal to experience, that general reasoning, even of the soundest kind, tends much to their real advancement; and there is little reason for thinking that astronomy would have been less perfect, or that any discoveries since made in it would have been retarded a single day, even if Copernicus had never lived. His great merit, like that of Lord Bacon, consists in the sound views which he took of nature, and in advancing so far before the general attainments of his age. For the events of his life see COPERNICUS.

Tycho Brahe. Tycho Brahe stands next in chronological order on the roll of those who have contributed to the progress of astronomy. As an indefatigable and skilful observer, he is justly considered as far superior to any astronomer who had preceded him since the revival of the science in Europe. His ample fortune gave him the means of procuring the best instruments which the age could produce; and by his ingenuity and persevering application, he was admirably qualified to employ them to the best advantage. He computed the first table of refractions, and if it extended only to 45°, the reason was, that the effects of refraction, at a higher altitude, were altogether insensible to his instruments. His solar tables were brought to so great a degree of exactness, that he affirms he could never detect an error in them exceeding a quarter of a minute; but there is reason to suspect some exaggeration in this statement, particularly as Cassini, a century after, with much better means, could scarcely answer for errors of a whole minute. He contributed greatly to the improvement of the lunar tables, and detected a considerable inequality in the moon's motion in longitude, to which he gave the name of the *Variation*, by which it has ever since been distinguished. He also discovered an equation in latitude similar to the evection which had been observed by Hipparchus, and fixed its amount with great accuracy. He remarked the fourth inequality of the moon in longitude, although he failed in his attempt to ascertain its amount, or assign its law. He represented the inequalities of the motions of the nodes, and in the inclination of the lunar orbit, by the motion of the pole of that orbit in a small circle round the pole of the ecliptic. He demonstrated that the region of the comets is far beyond the orbit of the moon, and determined the relative and absolute positions of 777 fixed stars with scrupulous exactness, which gave his catalogue an immense superiority over those of Hipparchus and Ulugh Begh; and he left to his successors a regular series of observations of the planets, amassed for the purpose of establishing the truth of his own system, but of which Kepler made a better use by employing them to establish the system of Copernicus. For an account of his life, see BRAHE, TYCHO.

Kepler. The great mass of accurate observations accumulated by Tycho furnished the materials out of which his disciple Kepler may be said to have constructed the edifice of the universe. The observations of the Danish astronomer had furnished the latter with the means of establishing with certainty the truth or inaccuracy of the various hypotheses which he successively imagined; and the diligence with which he laboured in comparing and calculating these observations during 20 years, was finally rewarded by some of the most important discoveries which had yet been made in astronomy. Deceived by an opinion which had been adopted by Copernicus, and had never been called in question by the ancients, that all the celestial motions are performed in circles, he long fruitlessly endeavoured to represent by that hypothesis the irregular motions of Mars; and after having computed with incredible labour the observations of seven oppositions of that planet, he at length discovered that the motions could only be accurately represented by supposing the planet to move in an ellipse, having the sun in one of its foci. Having arrived at this important result, he next proceeded to consider the angular motion of the planet, and finding that it was not uniform in respect of any point situated within the orbit, he concluded that uniform motion, till then universally received as an axiom, had no existence in nature. He perceived, however, that the areas described in equal times by the radius vector of the planet, at its greatest and least distances, were equal; and subsequent observations enabled him to demonstrate that this equality extended to every point of the orbit. It was therefore discovered that Mars moves in an elliptic orbit, of which the sun occupies a focus, and in such a manner, that the area described by a line drawn from the centre of the planet to that of the sun is always proportional to the time of description. The same conclusions he found to be true in respect of the orbit of the earth; and therefore he could no longer hesitate to extend them by analogy to the other plants. These are two of the three general principles which are known by the name of the 'Laws of Kepler."

It was some years later before Kepler arrived at the knowledge of the analogy which subsists between the distances of the several planets from the sun, and the periods in which they complete their revolutions. To the discovery of this analogy he attached the greatest importance, and regarded all his other labours as incomplete without it. After having imagined numberless hypotheses, it at last occurred to him to compare the different powers of the numbers which express the distances and times of revolutions; and he found, that the squares of the periodic times of the planets are always in the same proportion as the cubes of their mean distances from the sun. This is the third law of Kepler. He demonstrated it to be true of all the planets then known. It has been found to be equally true in regard to those which have been since discovered, and likewise to prevail in the systems of the satellites of Jupiter and Saturn. It is, indeed, as can be shown mathematically, a necessary consequence of the law of gravitation—directly as the masses, and inversely as the squares of the distances.

By these brilliant discoveries, the solar system was reduced to that degree of beautiful simplicity which had been conceived by Copernicus, but from which that great astronomer had found himself constrained to depart. The sun could not occupy the common centre of the circular orbits, but his place is in the common focus of the elliptic orbits of all the planets; and it is to this focus that every motion is to be referred, and from this that every distance is to be measured. The discovery of the elliptic motion, of the proportionality of the areas to the times, and the method of dividing an ellipse, by straight lines drawn from the focus to the periphery, into segments having a given ratio, formed the solution of a problem which had been the constant object of the labours of all astronomera from Ptolemy to Tycho, namely, to assign the place of a planet at any instant of time whatever. The tables which he computed for the elliptic motions form the model of those in present use. Some additions have been made in consequence of perturbations which the geometry of Kepler was inadequate to estimate, and which were only partially detected by the genius of Newton. It has been considered matter of surprise that Kepler did not think of extending the laws of the elliptic motion to the comets. Prepossessed with the idea that they never return after their passage to the sun, he imagined that it would only be a waste of time to attempt the calculation of the orbits of bodies which had so transitory an existence. He supposed the tail to be produced by the action of the solar rays, which, in traversing the body of the comet, continually carry off the most subtile particles, so that the whole mass must be ultimately annihilated by the successive detachment of the particles. He therefore neglected to study their motions, and left to others a share of the glory resulting from the discovery of the true paths of the celestial bodies.

The observations of eclipses had formed the principal object of the earliest astronomers, but it was Kepler who first showed the practical advantages which may be derived from them, by giving an example of the method of calculating a difference of meridians from an eclipse of the sun. The method extends to occultations of the stars, and is deservedly considered as the best we possess for determining geographical longitudes and correcting the tables. He composed a work on optics, replete with new and interesting views, and gave the first idea of the telescope with two convex glasses, which has since been advantageously substituted for that of Galileo. Prompt to seize every happy idea of his contemporaries, he perceived with delight the advantages which practical astronomy would derive from the new invention of the logarithms, and he immediately constructed a table, from which the logarithms of the natural numbers, sines, and tangents could be taken at once.

Kepler was not merely an observer and calculator, he inquired with great diligence into the physical causes of every phenomenon, and made a near approach to the discovery of that great principle which maintains and regulates the planetary motions. He possessed some very sound and accurate notions of the nature of gravity, but unfortunately conceived it to diminish simply in proportion to the distance, although he had demonstrated that the intensity of light is reciprocally proportional to the surface over which it is spread, or inversely as the square of the distance from the luminous body. In his famous work *De Stella Martis*, which contains the discovery of the laws of the planetary motions, he distinctly states that gravity is a corporeal affection, reciprocal between two bodies of the same kind, which tends, like the action of the magnet, to bring them together, so that when the earth attracts a stone, the stone at the same time attracts the earth, but by a force feebler in proportion as it contains a smaller quantity of matter. Further, if the moon and the earth were not retained in their respective orbits by an animal or other equipollent force, the earth would mount towards the moon one fifty-fourth part of the interval which separates them, and the moon would descend the fifty-three remaining parts, supposing each to have the same density. He likewise very clearly explains the cause of the tides in the following passage:—"If the earth ceased to attract its waters, the whole sea would mount up and unite itself with the moon. The sphere of the attracting force of the moon extends even to the earth, and draws the waters towards the torrid zone, so that they rise to the point which has the moon in the zenith." It is not difficult to imagine how much these views must have contributed to the immortal discovery of Newton. (See KEPLER.)

Contemporary with Kepler was the illustrious Galileo, Galileo.
whose discoveries, being of a more popular nature, and far more striking and intelligible to the generality of mankind, had a much greater immediate effect on the opinions of the age, and in hastening the revolution which was soon about to change the whole face of physics and astronomy. While residing at Venice, he heard it reported that Metius, a Dutch optician, had discovered a certain combination of lenses, by means of which distant objects were approximated to the sight. This vague and scanty intelligence sufficed to excite the curiosity of Galileo, who immediately set about inquiring into the means whereby such an effect could be produced. His researches were attended with prompt success, and on the following day he had a telescope which magnified about three times. It was formed by the combination of two lenses, a plano-convex and plano-concave, fitted in a leaden tube. In a second trial he obtained one which magnified seven or eight times; and subsequent essays enabled him to increase the magnifying power to 32 times. On directing his telescope to the moon, he perceived numerous inequalities on her surface, the diversified appearances of which led him to conclude almost with certainty that the moon is an opaque body similar to the earth, and reflecting the light of the sun unequally, in consequence of her superficial asperities. The planet Venus exhibited phases perfectly similar to those of the moon. These phases had been formerly announced by Copernicus as a necessary consequence of

his system; and the actual discovery of their existence made it impossible to doubt the revolution of Venus round the sun. He detected the four satellites or moons of Jupiter, and, in honour of his patron, gave them the name of the "Medicean Stars." The discovery of these little bodies circulating round the huge orb of Jupiter afforded him a strong analogical proof of the annual revolution of the earth, accompanied by its moon. He perceived spots on the disk of the sun, from the motions of which he deduced the rotation of that body about its axis in the space of 27 days. The singular appearances of Saturn were beheld by him with no less pleasure than astonishment. His telescope was not sufficiently powerful to separate the ring from the body of the planet; and to explain the appearances he supposed Saturn to be composed of three stars almost in contact with one another. These discoveries proved that the substances of the celestial bodies are similar to that of the earth, and demolished the Aristotelian doctrine of their divine essence and incorruptible nature. They enlarged the ideas of mankind respecting the planetary system, and furnished the most convincing arguments in favour of the doctrines of Copernicus.

Science is indebted to Galileo for two other discoveries of a different kind, less brilliant perhaps, but of far greater importance than those which we have yet enumerated. These are the isochronism of the vibrations of the pendulum, and the law of the acceleration of falling bodies. His telescopic discoveries could not have remained long unknown; in fact, with the exception of those of the phases of Venus, and of the triple form of Saturn, they were all fiercely disputed, even during his own lifetime. It is now universally admitted that he was the first who discovered the satellites of Jupiter, and the spots of the sun; but the very circumstance of other claimants to these discoveries having arisen, proves that they were within the reach of ordinary observers. For an account of his eventful life see GALILEO.

While astronomy was making these rapid advances in the hands of Kepler and Galileo, an event occurred in Scotland which contributed, though less directly, no less powerfully, to the acceleration of its progress. This was the invention of logarithms by Lord Napier, baron of Merchiston; "an admirable artifice," says Laplace, "which by reducing to a few days the labour of many months, doubles the life of the astronomer, and spares him the errors and disgust inseparable from long calculations,—an invention of which the human mind has the more reason to be proud, inasmuch as it was derived exclusively from its own resources." It may be added, that without this, or some equivalent artifice, the computations rendered necessary by more correct observations would far exceed the limits of human patience or industry, and astronomy could never have acquired that precision and accuracy by which it is now distinguished above all the other branches of human knowledge.

The same epoch presents to us a great number of excellent observers, who, although they did not produce any revolution in the state of astronomy, still rendered it useful service. Scheiner is celebrated for his observations of the solar spots, and his disputes with Galileo. John Bayer of Augsburg published a description of the constellations, accompanied by maps, in which the stars are marked by Greek letters,—a simple idea, which has been universally adopted. Lansberg, a Flemish mathematician, published in 1632 a set of astronomical tables, which, though filled with inaccuracies, rendered good service to science by

Horrox. apprising Horrox of the transit of Venus over the sun's disk, which that young astronomer and his friend Crabtree had the satisfaction of observing on the 24th of November 1639. They were the first who ever witnessed that rare phenomenon. Snellius is celebrated for his measurement of the earth. Gassendi, who had the merit along with Descartes of hastening the downfall of the Aristotelian philosophy in France, made some useful observations, particularly one of a transit of Mercury in 1631. His works, which fill six folio volumes, abound with curious and useful researches. Riccioli, a Jesuit, born at Ferrara in 1598, contributed to the progress of astronomy, not so much by his own discoveries, as by collecting and rendering an account of those of others. He rejected the system of Copernicus, and was more zealous in maintaining the doctrines of the church than in investigating nature; but his works form a vast repertory of useful information. His *Novum Almagestum* is a collection of the observations, opinions, and physical explanations of the phenomena, together with all the methods of computation then known. He was assisted in his labours by Grimaldi, who discovered the inflection of light, and he gave to the principal spots of the moon the names which are now used by astronomers.

Hevelius. The most accurate observations that were ever made prior to the adaptation of the telescope to astronomical instruments were those of Hevelius, a rich citizen of Dantzic, who devoted his life and a large fortune to the service of astronomy. Having fitted up an observatory, and furnished it with the best instruments which could be procured, he commenced a course of observations, which he followed assiduously upwards of forty years. In his *Selenographia* he has given an accurate description of the face and spots of the moon, accompanied with excellent delineations of her appearance in her different phases and librations. The idea of making drawings of the different phases of the moon had previously occurred to Gassendi and Peiresc, but they had not been able to execute the project; indeed, the difficulty attending it was such, that it occupied Hevelius, who was an excellent draughtsman, as well as observer, during a great number of years. Hevelius made an immense number of researches on comets; and finding that the observations could not be represented by rectilinear or circular orbits, he supposed them to move in parabolas. During a temporary absence from Dantzic he had the misfortune to lose, in a great fire which occurred in the city, his observatory, instruments, manuscripts, and almost the entire copy of the second volume of his *Machina Cœlestis*, which contained the results of his protracted labours. He was now in his old age, but his zeal did not give way under the terrible calamity. He patiently recommenced all his calculations, reconstructed tables of the sun, and prepared for publication his *Firmamentum Sobiescianum*, or celestial chart, which did not appear till after his death. Towards the latter part of his life the use of telescopic sights began to be generally adopted. Hevelius, however, resisted the innovation, and continued to employ plain sights. This preference given to the ancient method by so skilful an observer induced Dr Halley to visit him at Dantzic, for the purpose of ascertaining, by a comparison of observations made at the same time and place, which of the two methods gave the most correct results. Dr Halley observed with the telescope, and Hevelius with his own instruments; but such was the dexterity he had acquired through long practice, that the difference of their observations seldom amounted to more than a few seconds, and in no case to so much as a minute. Notwithstanding this agreement, it is to be regretted that Hevelius did not adopt the new method; for, on account of the greater precision given to instruments by the use of the telescope, his observations, which were made without it, cannot now be admitted in the construction of tables, and consequently are for the most part useless to astronomy.

Few individuals have rendered more important services

Huyghens. to science than Huyghens. His improvement of the telescope and his application of the pendulum to clocks were valuable additions to the machinery of astronomical investigation. By means of his telescopes he discovered that the extraordinary appearance exhibited by Saturn was occasioned by a ring surrounding the body of the planet, and inclined to the ecliptic in an angle which he estimated at 21°. He published his observations of this planet in a work entitled *Systema Saturnium*, which still shows some traces of that species of reasoning from final causes which so greatly disfigures the writings of Kepler. For example, on discovering the satellite, he conceived that as the number of satellites now equalled the number of planets, it was vain to look for more, the equality being necessary to the harmony of the system. He lived, however, to witness the discovery of four more satellites belonging to the same planet. (See HUYGHENS.)

The application of telescopes and micrometers to graduated instruments forms an important epoch in the history of astronomy. This happy improvement was first brought into use by Picard in 1667. Morin, indeed, had applied a telescope to the quadrant so early as 1634, and perceived the stars in full day in 1635. In 1669 Picard began to observe the stars on the meridian in the day time, with a quadrant, to which, in concert with Azout, he had applied an astronomical telescope having cross wires in its focus. Huyghens invented the plate micrometer in 1650; Malvasia that with the fixed wires in 1662; and Azout that with the movable wire in 1666. (See Delambre, *Astronomie du Moyen Age*, p. 618; note by Bouvard.) It is principally to these ingenious inventions and the fine application of the pendulum to clocks by Huyghens in 1656, that we must attribute the rapid progress since made in practical astronomy, and the extreme precision of modern observations. Picard was also the first who introduced the modern method of determining the right ascensions of the stars, by observing their meridional passages, and employed the pendulum for that purpose. He likewise introduced the method of corresponding altitudes, and is entitled to be regarded as the founder of modern astronomy in France. Roemer, the friend and pupil of Picard, discovered the progressive motion of light in 1675, and measured its velocity by means of the eclipses of Jupiter's satellites. He was the first who erected a transit instrument, which gave a new accuracy to observations of right ascension.

The Royal Observatory of Paris was completed in 1670, and its direction intrusted to Dominic Cassini, who enriched astronomy with a great number of valuable observations and new discoveries. He determined the motions of Jupiter's satellites from observations of their eclipses, and constructed tables of them, which were found to be remarkably exact. He observed that the ring of Saturn is double, and discovered four of the satellites of that planet. He also determined the rotation of Jupiter and Mars, and made a number of observations on Venus with the same view. He observed the zodiacal light, and made a near approximation to the parallax of the sun. We also owe to him the first table of refractions calculated on correct principles, and a complete theory of the libration of the moon. Galileo had only observed the libration in latitude; Hevelius explained the libration in longitude, by supposing that the moon always presents the same face to the centre of her orbit, of which the earth occupies a focus. Cassini made the important remark, that the axis of rotation of the moon is inclined to the ecliptic, and that its nodes coincide with those of the lunar orbit, so that the poles of the orbit, ecliptic, and equator of the moon, are on the same circle of latitude, the pole of the ecliptic being situated between the other two. Though the greater number of these discoveries were only of secondary importance, Cassini, nevertheless, obtained an extraordinary reputation. Lalande remarks, that in his hand astronomy underwent the most signal revolutions, and that his name is, in France, almost synonymous with that of creator of the science. Delambre has, however, expressed a different and far more accurate view of the real services of Cassini in the following terms:—

> "The revolution in astronomy was brought about by Copernicus, by the laws of Kepler, by the pendulum of Huyghens, by the micrometers of Azout and Picard, by the sectors and mural of Picard and his method of corresponding altitudes, by the transit instruments of Roemer; and Cassini appears to us an entire stranger to all these innovations. He followed another route he devoted a long life to painful observations, which at last deprived him of sight. Let us not refuse him the praise which he has so well merited, but let us reserve a place in our esteem for labours less brilliant perhaps, but of greater and more permanent utility, and which evince at least equal talent and sagacity."

Cassini was assisted in his observations by his nephew, James Philip Maraldi, who determined the regression of the nodes, and the progressive motion of the apsides of the orbit of Jupiter. This astronomer also corrected the theory of Mars, and observed the sun's parallax. He rejected the hypothesis of the progressive motion of light, as being insufficient to explain the inequalities of Jupiter's satellites; and he conceived the design of forming a new catalogue of the stars, which, however, was never executed. He died in 1729. M[illegible]

There is no period in the history of mankind so distinguished by great and important discoveries, or so remarkable for the rapid development of the human intellect, as the 17th century. We have already noticed the invention of the pendulum, and its application to regulate the motion of timekeepers; the invention of the telescope, bringing within the range of vision the phenomena of new worlds; of logarithms, by which computations are so much abridged; and of the mechanical contrivances for measuring minute angles in the heavens. The same century witnessed the application of algebra to geometry, the discovery of the laws of the planetary motions, the infinitesimal calculus, the acceleration of falling bodies, the sublime theory of central forces, and the great principle of gravitation which connects the celestial orbs, and regulates the motions which it had been the business of the astronomer to observe since the earliest ages of the world. The service which the discovery of these primary laws rendered to the progress of astronomy can scarcely be exaggerated. Many of the inequalities of the planetary motions, in consequence of their minuteness and the slowness with which they occur, could not have been detected by observation; others might perhaps have been perceived, but we should still have been ignorant whether their constant accumulation might not ultimately change the state of the system, and, by destroying all confidence in the tables, demolish the fabric which had been reared at such a vast expense of time and labour. But when these inequalities are detected by theory, and separated from the mean motions with which they were blended, it becomes an object of the highest interest to confirm their existence by the most delicate and accurate observations. Hence, a more refined practice has constantly followed every theoretical discovery. Besides, it is the perfection of theory, and not the mere knowledge of isolated facts, which gives astronomy its greatest value in the eyes of the philosopher. Numerous and important as its applications are, they have but a subordinate interest, in comparison with the knowledge of those general laws to which every particle of matter in the universe is subject, and by the discovery of which man has penetrated so deeply into the mysteries of nature. Progress during the 17th century.

By the discovery of the law of gravitation, Newton laid the foundations of physical astronomy; and by the consequences which he deduced from that law, he proceeded far in Newton.

the erection of the superstructure. He showed that the motions of all the bodies of the planetary system are regulated by its influence; he determined the figure of the earth on the supposition of its homogeneity; he gave a theory of the tides, discovered the cause of the precession of the equinoxes, and determined some of the principal lunar inequalities and planetary perturbations. Many of his theories were left in an imperfect state; for it is not in matters of science that it is given to the same individual to invent and bring to perfection: their complete development required that several subsidiary sciences should be farther advanced; but it has been the triumph of his system, that every subsequent discovery has only tended to strengthen and confirm it.

While physical astronomy was undergoing a complete revolution in the hands of Newton, the practical part was receiving great improvement from Flamsteed, the first astronomer royal, who conducted the Greenwich Observatory. This celebrated institution, from which so many important discoveries have emanated, was erected under the reign of Charles II., in 1675. Flamsteed was appointed to it in 1676, and continued with indefatigable zeal to discharge the duties of the office during the long period of 33 years. In the course of this time he made an immense number of excellent observations, the results of which are given in the *Historia Cœlestis*, the first edition of which was published in 1712, at the expense of Prince George of Denmark, the husband of Queen Anne. The second appeared in 1723, some time after the death of the author, in three volumes folio. The first volume contains the observations which he made, first at Derby, and afterwards at Greenwich, of the fixed stars, planets, comets, spots of the sun, and Jupiter's satellites. The second volume contains the transits of the planets and stars over the meridian, and the places of the planets deduced from these observations. The third contains a historical notice, in which he gives a description of the instruments used by Tycho and himself; catalogues of fixed stars by Ptolemy, Ulugh Begh, Tycho, the landgrave of Hesse, and Hevelius; together with the British Catalogue, containing the places of 2884 stars. The labours of Flamsteed were, however, confined entirely to the practical part of astronomy. He made no improvements in theory; but he is entitled to the merit of having been the first who brought into common use the method of simultaneously observing the right ascension of the sun and a star, a method by means of which the determination of the positions of the stars is reduced to the observation of meridional transits and altitudes. He was likewise the first who explained the true principles of the equation of time; and he improved the lunar tables by introducing into them the annual equation which had been suggested by Horrox.

Halley. Flamsteed was succeeded in the observatory by Halley, who held a prominent place among English astronomers. From early youth he applied himself with ardour to the study of mathematics and astronomy; and having procured a few instruments, he began to make observations, by which he was led to remark the inaccuracy of the tables of Jupiter and Saturn. In his 19th year he published a direct and geometrical method of finding the eccentricities and aphelia of the orbits of the planets; and in the year following he undertook a voyage to St Helena, with a view to form a catalogue of the stars in the southern hemisphere. The station was unfortunately chosen, for, owing to the incessant rains and foggy atmosphere of that island, he was able to determine the places of only 360 stars in the course of a whole year. He had, however, the satisfaction of observing a transit of Mercury over the sun's disk, a phenomenon which suggested to him the important idea, that the transits of the inferior planets might be advantageously employed in determining one of the most essential elements of the planetary system, viz., the parallax of the sun, and consequently the diameters of the orbits. The method has since been successfully employed in the case of Venus: the transits of Mercury, though much more frequent, are not so well adapted to the purpose. The other additions which he made to astronomical knowledge are chiefly recorded in his *Synopsis Astronomiæ Cometicæ*,—a work abounding in profound and original views, and which, in respect of theory, formed perhaps the most remarkable accession to the science that had been made since the time of Kepler. In this work he revived an ancient opinion, that the comets belong to the solar system, and move in very eccentric orbits round the sun, returning after stated but long intervals. He also ventured to predict that the comet of 1681 would again return to its perihelion in 1759,—the first prediction of the kind ever verified. In 1720 Halley was appointed to succeed Flamsteed in the Royal Observatory; and though then in the 64th year of his age, he undertook, with a view to improve the lunar theory, to observe the moon through a whole revolution of her nodes, erroneously supposing that after such a revolution the errors of the tables would again appear in the same order. He was the first who, by a comparison of ancient and modern observations, remarked the acceleration of the mean motion of the moon, and thus called the attention of mathematicians to an important and curious phenomenon, the physical cause of which was at length detected by the powerful analysis of Laplace. He was also the first who pointed out the secular inequalities of Jupiter and Saturn, occasioned by their mutual perturbations,—a theory that formed the subject of several profound memoirs of Euler and Lagrange, and for the complete development of which astronomy is likewise indebted to Laplace. (See HALLEY.)

The discoveries of Bradley, who succeeded Halley as astronomer royal, form a memorable epoch in the history of the science. Bradley. It was reserved to him to give the theoretical explanation of a singular motion of the polar star which had been first observed by Picard, who had remarked that the inequality was annual, and amounted to about 40 seconds, but had been unable to refer it to any law. Hooke, in 1674, a few years after the observations of Picard, imagined that he had discovered a parallax in some of the stars, and Flamsteed, following the ideas of Hooke, explained, by means of parallax, the minute changes of position which he had observed in Polaris and some circumpolar stars. Manfredi and Cassini demonstrated the error of Flamsteed, but were not more successful in their attempts to explain the motion in question. Samuel Molyneux conceived the idea of verifying all that had been said respecting the supposed parallaxes, and for this purpose commenced a series of observations at Kew, with an excellent 24-feet sector constructed by Graham. Bradley, who happened at that time to reside at Kew, took part in these observations, the result of which was, that the remarks of Picard were confirmed beyond the possibility of doubt. It was, however, abundantly evident that the apparent motions observed were not connected in any manner with parallax, it therefore became an object of the greatest interest to determine their physical cause, and assign their law and period. The first idea that occurred was to inquire whether they arose from a change of position in the earth's axis; but this supposition was found to be inadequate to the explanation of the phenomena. Molyneux having been in the meantime appointed a lord of the Admiralty, the observations were discontinued at Kew; they were, however, shortly after resumed by Bradley at Wanstead, with a smaller but more convenient instrument, and after they had been continued several years, it was found that the star (γ Draconis) on which they were principally made, appeared to describe annually a small ellipse, the transverse axis of which amounted to 40″. This was an important determination; for the ellipse afforded the means of computing at all times the aberration of any star whatever, whether in longitude, latitude, declination, or right ascension. Bradley also pointed out the physical cause of the aberration, and demonstrated that it resulted from the combination of the motion of light with the annual motion of the earth. This very remarkable and important discovery was made in 1728.

Bradley, anxious to verify his ingenious theory, continued his observations, and soon felt the difficulty that had so much embarrassed Picard. The places of the stars, calculated according to his formula for the aberration, could not be reconciled with the observations. The errors continued to augment during nine years, after which they went on diminishing during the nine years following. This inequality, of which the period, like that of the nodes of the moon, was 18 years, was readily explained by supposing a slight oscillation of the earth's axis, occasioned by the action of the moon on the protuberant parts surrounding the equator of the terrestrial spheroid. After assiduously observing its effects during twenty years, Bradley found that the phenomena could be accurately represented by giving the pole of the equator a retrograde motion about its mean place in an ellipse whose axes are 18″ and 16″, and completing its revolution in the period of 18 years. This result was communicated to the Royal Society in 1748. To these two grand discoveries of Bradley, the aberration and nutation, modern astronomy is greatly indebted for its accuracy and precision; and as Delambre remarks, they assure to their author a distinguished place, after Hipparchus and Kepler, among the astronomers of all ages and all countries. For the biography see BRADLEY, JAMES.

While England was witnessing the brilliant discoveries of Bradley, France produced a number of excellent astronomers, by whose successful labours every department of the science was signally promoted. Among these Lacaille is distinguished, both by his scientific zeal and the importance of his observations. In 1751 he undertook a voyage to the Cape of Good Hope, the primary objects of which were to determine the sun's parallax, by means of observations of the parallaxes of Mars and Venus, while similar observations were made in Europe, and to form a catalogue of the southern circumpolar stars. No undertaking for the benefit of science was ever more successfully executed. In the course of a single year, Lacaille, without assistance, observed upwards of 10,000 stars, situated between the tropic of Capricorn and the pole, and computed the places of 1942 of them. The details of his observations were published in the *Cœlum Australe Stelliferum*, which appeared in 1763. During the same time he measured a degree of the meridian, and made numerous observations of the moon simultaneous with those of Lalande (who observed at Berlin), in order to determine the moon's parallax by means of direct observations made at the extremities of a meridional arc of upwards of 85° Astronomy is likewise indebted to Lacaille for a table of refractions, which he computed from a comparison of above 300 observations made at the Cape and at Paris. In 1757 he published his *Astronomiæ Fundamenta*, in which he gave rules and tables for computing the apparent motions of the stars, which continued to be employed till Lambert supplied the corrections depending on the nutation, and Delambre those depending on the aberration.

The question of the figure of the earth furnished ample materials for the practical as well as the speculative astronomer during the 18th century. The results of the measurement of the meridian by Cassini were at variance with the theories of Newton and Huyghens; and the Academy of Sciences resolved on making a decisive experiment by the actual measurement of the lengths of two degrees, one at the equator, and another in as high a latitude as could be reached. In the year 1735, three astronomers—Godin, Bouguer, and La Condamine—were commissioned by the French Government to accomplish the first of these objects in Peru; and the year following, Maupertuis, Clairaut, Camus, and Lemonnier went to Lapland to execute the second under the polar circle. Notwithstanding the greater difficulties they had to contend with, the first party were the more successful; but the result of both operations established the compression of the earth at the poles Bouguer published the details of the Peruvian measurement in an admirable work *On the Figure of the Earth*, in which he has also inserted an account of a great number of experiments made by him in the same country to determine the length of the seconds' pendulum, and the effects of the attraction of mountains on the plumb-line. Bouguer is likewise the author of an excellent treatise on light. The details of the labours of numerous other observers in the various countries of Europe will be found under their respective names. Here it is sufficient to indicate briefly the share each had in the development of the science.

Delisle Delisle formed a school of astronomy in Russia, and left a method of computing the heliocentric places of the sun's spots and of Mercury and Venus in their transits over the sun's disk, and likewise of determining, by means of the stereographic projection, the directions of their paths when they enter and leave the disk. **Wargentin** Wargentin, secretary of the Academy of Sciences of Stockholm, devoted himself specially to the correction of the tables of the satellites of Jupiter. The theory of the satellites was not then far advanced; but when theory failed him, he profited by the remarks of others and by his own reflections, and endeavoured by repeated trials to find empirical equations capable of reconciling the tables with the best observations. By confining himself almost exclusively to this subject he acquired a high reputation, and was ranked among the first astronomers of an epoch which abounds in great names. His tables of the satellites have, on account of their superior accuracy, been employed in determining the masses and other elements, which serve as the basis of the analytical theories.

Maskelyne, the second English astronomer royal after Bradley, was appointed, in 1761, to observe the transit of Venus at the island of St Helena, and endeavour to verify the existence of a small parallax of the star Sirius, which seemed to be indicated by the observations of Lacaille at the Cape. Unfortunately, the state of the weather prevented him from observing the transit; and his observations on Sirius were abandoned in consequence of the discovery of a defect in the zenith sector which he had carried out with him for the purpose of making the observations in question. The main objects of his voyage were thus frustrated; but some indirect advantages, notably the improvement of the sector by Ramsden, resulted from it, which compensated in some measure for the disappointment. At St Helena he made several interesting observations of the tides, the variation of the compass, the moon's horary parallaxes, &c. In going out and returning home he paid particular attention to the different methods of finding the longitude at sea, and practised that which depends on observations of the lunar distances from known stars, taken with Hadley's sextant, or some other reflecting instrument. In the year 1765 he was appointed astronomer royal, and soon after recommended to the Board of Longitude the general adoption in the navy of the lunar method of finding the longitude, and proposed that tables for facilitating that method should be calculated and published in the *Nautical Almanac*. This recommendation was adopted, and the *Nautical Almanac* continued to be published under his superintendence during forty-eight successive years.

W. Herschel. Sir William Herschel, born in Hanover in 1738, has rendered his name immortal by the discovery of a new planet beyond the orbit of Saturn, and thereby doubling the ancient boundaries of the solar system. Having settled in England at Bath, he began to devote his leisure to the construction of telescopes and the polishing of reflecting mirrors. Endowed with equal skill and patience, he soon obtained instruments superior to any that had been known before, by means of which he was led to the most brilliant discoveries that have been made in the heavens since the time of Galileo. Being employed in making a review of the sky with a powerful telescope, he perceived, on the 13th of March 1781, near the feet of Gemini, a star of the fifth magnitude, having a disk perfectly well defined, and differing in appearance from other stars which afforded the same quantity of light. On observing it with a telescope whose magnifying power was 932, he perceived its diameter was enlarged while that of the stars underwent no change. These circumstances were sufficient to draw his attention to the star, and nothing more was requisite to enable him speedily to discover that it had a slow motion. He at first supposed it was a comet, and acquainted Dr Maskelyne with the discovery. The circumstance was soon made known at Paris; and it was gradually perceived, that as the distance of the star did not sensibly vary, it was necessary to regard it as a seventh planet. Herschel, in honour of his patron George III., gave it the name of the *Georgium Sidus;* but the mythological appellation of Uranus has prevailed. On the 11th of January 1787 he discovered two satellites revolving round the new planet, and subsequently found that it was accompanied by four others. It was soon noticed that Uranus had been observed by Flamsteed, Mayer, and Lemonnier, who had each supposed it to be one of the fixed stars. Their observations enabled Delambre to correct the elements of the orbit, and calculate tables of its motion. By means of his powerful telescopes Herschel determined the figure and rotation of Saturn, discovered the parallel belts on his surface, and perceived that the ring is double. In 1789 he discovered two new satellites belonging to this planet, revolving near the ring. From some appearances indicated by the fixed stars, Herschel was led to conclude that the whole solar system is in motion about some distant centre, and that its direction is at present towards the constellation Hercules,—a conclusion which recent investigations have verified. His observations on nebulæ and double stars opened up a new field of research, boundless in extent, and interesting by reason of the variety of the objects it presents to the attention of the observer. The extraordinary activity with which he pursued his favourite occupations is attested by 67 memoirs communicated by him from time to time to the Royal Society.

Delambre. Few individuals have contributed so much to the perfection of modern astronomy as Delambre, for many years perpetual secretary of the Academy of Sciences. Associated with Mechain, he was employed during the troubles of the French Revolution in measuring the meridian from Dunkirk to Barcelona,—a labour which was prosecuted with admirable zeal in the face of innumerable difficulties, and even dangers of the most formidable kind. By an immense number of excellent observations he determined the constants which enter into the formulæ deduced from theory by the profound researches of Lagrange and Laplace, and also formed a set of tables much more exact than any that had appeared before them. His *Astronomie Théorique et Pratique*, in three quarto volumes, contains the best rules and methods which have yet been devised for the guidance of the practical astronomer; and his *Histoire*, in six large quarto volumes, gives an account of every successive improvement which has been made in the science, and a full abstract of every work of celebrity which has been written respecting it, from the first rude observations of the Greeks to the end of the last century. It is invaluable to the historian, and will always attest the profound learning and laborious research of its author.

Piazzi. The observatory which was established at Palermo about the year 1790, under the active superintendence of Piazzi, holds a distinguished rank among the similar institutions of Europe. Piazzi, born in 1746, took the habit of the religious order of the *Theatins* at Milan, and finished his noviciate in the convent of St Anthony. Among his preceptors he had the advantage of counting Tiraboschi, Beccaria, Le Sœur, and Jacquier; and from these illustrious masters he speedily acquired a taste for mathematics and astronomy. After holding several professorships in the colleges of the Jesuits at Rome and Ravenna, he was appointed, in 1780, professor of the higher mathematics in the Academy of Palermo. A few years after his appointment he obtained from the prince of Caramanico, viceroy of the island, permission to found an observatory, and undertook a voyage to France and England in order to provide the instruments necessary for the new establishment. Having procured a vertical circle, a transit, and some other instruments from Ramsden, he returned to Palermo and commenced his observations. His first care was to prepare a new catalogue of stars, the exact positions of which he justly considered as the basis of all true astronomy. In prosecuting this object he did not content himself with a single observation, but before he fixed the position of any star, observed it several times successively; and, by this laborious but accurate method, he constructed his first great catalogue of 6748 stars, which was crowned by the Academy of Sciences of France, and received with admiration by the astronomers of all countries. His constant practice of repeating his observations led to another brilliant result, the discovery of an eighth planet. On the 1st of January 1801, Piazzi, searching for the star 87 of the catalogue of Mayer, cursorily observed a small star of the eighth magnitude between Aries and Taurus. On the following day he remarked that the star had changed its position, and accordingly supposed it to be a comet. He communicated his observations to Oriani, who, seeing that this luminous point had no nebulosity like the comets, and that it had been stationary and retrograded within comparatively small limits like the planets, computed its elements on the hypothesis of a circular orbit. He found that this hypothesis agreed with the observations, and other astronomers soon confirmed its accuracy. He gave the planet the name of *Ceres Ferdinandea*, in honour of Ferdinand, king of Naples, in whose dominions he had made the discovery, and who proposed to commemorate the event by a gold medal, struck with the effigy of the astronomer, but Piazzi, preferring the interests of science to vain honours which could add nothing to his glory, requested that the money destined for this purpose should be employed in the purchase of an equatorial, which was still wanting to his observatory. In 1814 he published a new catalogue, extended to 7646 stars,—a splendid monument of indefatigable zeal and activity. He made an uninterrupted series of solstitial observations from 1791 to 1816, for the purpose of determining the obliquity of the ecliptic, which, compared with those of Bradley, Mayer, and Lacaille, in 1750, give a diminution of 44″ in a year.

We will conclude this part of the article by briefly adverting to the researches of some illustrious mathematicians who have developed the theory of Newton, and by whose investigations physical astronomy has been raised to its present position. Although the law of gravitation, as proposed by Newton, had from the first been admitted by all the most eminent astronomers of Britain, it was for a long time either opposed or neglected on the Continent. In fact, great improvements were required both in analysis and mechanics before it admitted of other applications than had been made by its great author, or could be regarded as anything more than a plausible hypothesis. Newton demonstrated that if two bodies only were projected in space, mutually attracting each other with forces proportional directly to their masses and inversely to the squares of their distance, they would each accurately describe an ellipse round the common centre of gravity, and the spaces described by the straight line joining that centre and the moving body would be proportional to the time of description, according to the second law of Kepler. But when it is attempted to apply Newton's law to the case of the solar system, great difficulties immediately present themselves. Any one planet in the system is not only attracted by the sun, but also, though in a much smaller degree, by all the other planets, in consequence of which it is compelled to deviate from the elliptic path which it would pursue in virtue of the sun's attraction alone. Now, the calculation of the effects of this disturbing force was the problem which geometers had to resolve. In its most general form it greatly transcends the power of analysis, but there are particular cases of it (and those, too, the cases presented by nature), in which, by reason of certain limitations in the conditions, it is possible to obtain an approximate solution to any required degree of exactness. For example, the Sun, Moon, and Earth form in a manner a system by themselves, which is very slightly affected by the aggregate attractions of the other planets. In the same way the Sun, Jupiter, and Saturn, form another system, in which the motions are very little influenced by the action of any other body. In these two cases, then, the number of bodies to be taken into consideration is only three; and in this restricted form, the problem, celebrated in the history of analysis under the denomination of "the Problem of Three Bodies," is susceptible of being treated mathematically. With the hope of improving the lunar tables, and of completing the investigations which Newton had commenced in the *Principia*, three distinguished geometers—Clairaut, D'Alembert, and Euler—about the middle of the last century, undertook, simultaneously, and without the knowledge of each other, the investigation of the problem of three bodies, and commenced that series of brilliant discoveries which our own times have seen completed.

Clairaut. Clairaut's solution of the problem of three bodies was presented to the Academy of Sciences in 1747, and was applied to the case of the moon. From this solution he deduced with great facility, not only the inequality of the variation, which Newton had obtained by the application of a more complicated though very ingenious method, but also the evection, the annual equation, and many other inequalities which Newton had not succeeded in connecting with his theory. It happened, however, curiously enough, that in the calculation of one effect of the disturbing force, namely, the progression of the moon's apogee, Clairaut was led into an error which produced a result that threatened to overturn the system of gravitation. The error consisted in the omission of some of the terms of the series expressing the quantity in question, which he wrongly supposed to have only an insensible value; and by reason of this omission, his first approximation gave only half of the observed progressive motion of the apogee. As this result was confirmed by D'Alembert and Euler, who had both fallen into the same error, it seemed to follow, as a necessary consequence, either that the phenomenon depended on some other cause than the disturbing force of the sun, or that the law of gravitation was not exactly proportional to the inverse square of the distance. The triumph which this result gave to the Cartesians was not of long duration. Clairaut soon perceived the cause of his error, and by repeating the process, and carrying the approximations farther, he found the computed to agree exactly with the observed progression,—a result which had the effect of dissipating for ever all doubt respecting the law of gravitation. The researches of Clairaut were followed by a set of lunar tables, much more correct than any which had been previously computed.

The return of the comet of 1682, which Halley had predicted for the end of 1758 or beginning of 1759, afforded an excellent opportunity for putting to the test both the theory of gravitation and the power of the new calculus. Clairaut applied his solution of the problem of three bodies to the perturbations which this comet sustained from Jupiter and Saturn, and, after calculations of enormous labour, announced to the Academy of Sciences, in November 1758, that the comet would return in the beginning of the following year, and pass through its perihelion about the 15th of April. It returned according to the prediction, but passed its perihelion on the 13th of March. The correction of an error of computation reduced the difference to nineteen days, and if Clairaut had been aware of the existence of the planet Uranus, he might have come still nearer the truth.

Besides these important researches on the system of the universe, Clairaut composed an admirable little treatise on the figure of the earth, in which he gave the differential equations, till then unknown, of the equilibrium of fluids, whether homogeneous or heterogeneous, supposing an attractive force, following any law whatever, to exist among the molecules. He applied these equations to the earth; demonstrated that the elliptic figure satisfies the conditions of equilibrium; and assigned the ellipticity of the different strata of which the earth may be supposed to be formed, together with the law of gravitation at the exterior surface. He likewise discovered the important theorem which establishes a relation between the oblateness of the terrestrial spheroid and the increase of gravitation towards the poles, on every supposition which can be imagined relative to the interior construction of the earth. By means of this theorem the ellipticity of the spheroid is deduced from observations of the lengths of the seconds pendulum at different points of the earth's surface.

D'Alembert. D'Alembert, as has already been mentioned, presented a solution of the problem of three bodies to the Academy of Sciences at the same time as Clairaut. In the year 1749 he published his treatise on the precession of the equinoxes,—a work remarkable in the history of analysis and mechanics. By means of his newly invented "Calculus of Partial Differences," and the discovery of a fertile principle in dynamics, he determined from theory the rate of the precession, rather more than 50″ in a year. He also determined the nutation of the earth's axis, which had been discovered by Bradley, and assigned the ratio of the axes of the small ellipse which the true pole of the earth describes around its mean place in the same time in which the nodes of the lunar orbit complete a revolution. The solution of this problem led to the determination of the ratio of the attractive forces of the sun and moon, which D'Alembert found to be that of seven to three very nearly; whence he inferred that the mass of the earth is 70 times greater than that of the moon. He proved likewise that the precession and nutation are the same in every hypo thesis concerning the interior constitution of the earth. In 1754 he published the first two volumes of his *Researches on the System of the World.* In this work he applied the formulæ by which he had calculated the motions of the moon to the motions of the planets disturbed by their mutual attraction, and pointed out the simplest method of determining the perturbations of the motions of a planet occasioned by the action of its own satellites. D'Alembert also treated the subject of the figure of the earth in a much more general manner than had been done by Clairaut, who had confined his investigations to the case of a spheroid of revolution. He determined the attraction of a spheroid of small eccentricity, whose surface can be represented by an algebraic equation of any order whatever, even supposing the spheroid to be composed of strata of different densities.

The first memoir of Euler on the planetary perturbations was transmitted to the secretary of the Academy of Sciences in July 1747, some months before Clairaut and D'Alembert had communicated their solutions of the problem of three bodies, and it carried off the prize which the academy had offered for the analytical theory of the motions of Jupiter and Saturn. In this memoir Euler gave the differential equations of the elements of the disturbed planet, but withheld the analysis by which he had been conducted to them. This analysis, however, he subsequently expanded in two memoirs, the first of which appeared in the Berlin Memoirs in 1749, and the second in those of St Petersburg in 1750. Of these supplementary memoirs the first is remarkable on several accounts. It contains the first example of a method which has been fruitful of important consequences—namely, that of the variation of the arbitrary constants in differential equations, and the development of the radical quantity which expresses the distance between two planets in a series of angles, multiples of the elongations. The expressions which he gave for the several terms of this series were simple and elegant; and he demonstrated a curious relation subsisting among any three consecutive terms, by means of which all the terms of the series may be calculated from the first two. He was thus enabled to develop the perturbing forces in terms of the sines and cosines of angles increasing with the time, and thereby to surmount a very great analytical difficulty. Notwithstanding, however, the great merit of Euler's memoir, several of the formulæ expressing the secular and periodic inequalities were found to be inaccurate; and in order to procure a correction of these errors, and give greater perfection to so important a theory, the academy again proposed the same subject for the prize of 1752. This prize was also carried off by Euler. In the memoir which he presented on this occasion, he considered simultaneously the motions of Jupiter and Saturn, and determined, in the first instance, the amount of their various inequalities, independently of the consideration of the eccentricities of their orbits. Pushing the approximations farther, and having regard to the inequalities depending on the eccentricities, he arrived at a most important result relative to the periodic nature of the inequalities occasioned by the mutual perturbations of the planets; which laid the foundation of the subsequent discovery by Lagrange and Laplace of the permanent stability of the planetary system. He demonstrated that the eccentricities and places of the aphelia of Jupiter and Saturn are subject to constant variation, which is confined, however, within certain fixed limits; and he computed that the elements of the orbits of the two planets recover their original values after a lapse of about 30,000 years. In the year 1756 the Academy of Sciences crowned a third memoir of Euler on the same subject as the two former, namely, the inequalities of the motions of the planets produced by their reciprocal attractions. This memoir analytically considered is also of great value. The method which he followed and illustrated has since been generally adopted in researches of the same nature, and consists in regarding as variable, in consequence of the disturbing forces, the six elements of the elliptic motion, viz.,—1*st*, the major axis of the orbit, which, by the law of Kepler, gives the ratio of the differential of the mean longitude to the element of the time; 2*d*, the epoch of this longitude; 3*d*, the eccentricity of the orbit; 4*th*, the motion of the aphelion; 5*th*, the inclination of the orbit to a given fixed plane; and, 6*th*, the longitude of the node. By considering separately the variations introduced into each of these elements by the disturbing forces, Euler obtained some important results; but even in this memoir his theory was not rendered complete. He did not consider the variation of the epoch; and the expression which he gave for the motion of the aphelion did not include that part of it which depends on the ratio of the eccentricities of the orbits of the disturbed and disturbing planet. Besides, the third memoir, like the two former, contained several errors of computation, which, by leading to results known to be wrong, probably prevented the author himself from being aware of the full value of the ingenious methods of procedure which he had described. Euler concluded this important memoir by making an extended application of his formulæ to the orbit of the earth as disturbed by the action of the planets. From some probable suppositions, first employed by Newton, relative to the ratios of the masses of the planets to that of the sun, he determined the variation of the obliquity of the ecliptic at 48″ in a century,—a result which agrees well with observation. By this determination the secular variation of the obliquity of the ecliptic, which had been regarded by Lahire, Lemonnier, D'Alembert, and other eminent astronomers as uncertain, was placed beyond doubt. The three memoirs which we have mentioned contain the principal part of Euler's labours on the perturbations; but physical astronomy is indebted to him for many other researches. He gave a solution of the problem of the precession of the equinoxes, and made several important steps in the lunar theory, with which he seems to have occupied himself before he undertook the investigation of the planetary perturbations. In the year 1772, when entirely blind, he directed his son, Albert Euler, and two illustrious pupils, Krafft and Lexell, in the composition of a work of enormous labour on the same subject, which was undertaken with a view to discover the cause of the moon's acceleration. This work was concluded with a set of lunar tables deduced entirely from theory; but they were found to be far inferior to those of Mayer, and in some respects hardly equal to those of Clairaut.

The first theory of Euler formed the basis of the excellent lunar tables which were calculated by Tobias Mayer, **Mayer.** and first published in the Memoirs of the Academy of Göttingen in 1753. Mayer was a skilful astronomer, and determined the co-efficients of the arguments of the different lunar inequalities from his own observations. He continued to correct and improve his tables till the time of his death, which happened in 1762, when a copy of them, containing his last corrections, was presented by his widow to the Board of Longitude in London. They were printed along with the author's lunar theory in 1765. Subsequently, the Board of Longitude directed Mason, who had been assistant to Bradley, to revise them, under the superintendence of Dr Maskelyne. Mason compared them with about 1200 of Bradley's observations, corrected the co-efficients of Mayer, and introduced some new equations which had been indicated by that astronomer, but which he had considered as too uncertain, or of too small a value, to render it necessary to load his tables with them.

Mayer's tables, thus corrected, were published in 1784, and for a long time continued to be the most accurate that had appeared.

The solution of the problem of three bodies by Clairaut, D'Alembert, and Euler, gave rise to many other important works relative to the theory of the moon, into the merits of which, however, our limits will not permit us to enter. Thomas Simpson, Walmesley, Frisi, Lambert, Schulze, and Matthew Stewart treated the subject with more or less success; but the complete explication of the theory of the lunar and planetary perturbations was reserved for two mathematicians, whose discoveries perfected the theory of gravitation, and explained the last inequalities which remained to be accounted for in the celestial motions,—Lagrange and Laplace.

Lagrange.

In the year 1764, the Academy of Sciences of Paris, which had so successfully promoted the great efforts that had already been made to perfect the theory of attraction, proposed for the subject of a prize the theory of the libration of the moon. Lagrange had the honour of carrying off the prize; but although he treated the subject in a manner altogether new, and with extraordinary analytical skill, he did not on this occasion arrive at a complete solution of the problem. In 1766 he obtained another prize for a theory of Jupiter's satellites. In the admirable memoir which Lagrange presented to the academy on this subject, he included in the differential equations of the disturbed motion of a satellite the attracting force of the sun, as well as of all the other satellites, and thus, in fact, had to consider a problem of six bodies. His analysis of this problem is remarkable, inasmuch as it contained the first general method which was given for determining the variations which the mutual attractions of the satellites produce in the forms and positions of their orbits, and pointed out the plan which has since been so successfully followed in the treatment of similar questions.

Of all the grand discoveries by which the name of Lagrange has been immortalised, the most remarkable is that of the invariability of the mean distances of the planets from the sun. We have already mentioned that Euler had perceived that the inequalities of Jupiter and Saturn, in consequence of their mutual actions, are ultimately compensated, though after a very long period. In prosecuting this subject, which Euler had left imperfect, Laplace had discovered that, on neglecting the fourth powers in the expressions of the eccentricities and inclinations of the orbits and the squares of the disturbing masses, the mean motions of the planets and their mean distances from the sun are invariable. In a short memoir of 14 pages, which appeared among those of the Berlin Academy for 1776, Lagrange demonstrated generally, and by a very simple and luminous analysis, that whatever powers of the eccentricities and inclinations are included in the calculation of the perturbations, no secular inequality, or term proportional to the time, can possibly enter into the expression of the greater axis of the orbit, or, consequently, into the mean motion connected with it by the third law of Kepler. From this conclusion, which is a necessary consequence of the peculiar conditions of the planetary system, it results that all the changes to which the orbits of the planets are subject in consequence of their reciprocal gravitation, are periodic, and that the system contains within itself no principle of destruction, but is calculated to endure for ever.

In 1780 Lagrange undertook a second time the subject of the moon's libration; and it is to the memoir which he now presented to the Berlin Academy that we must look for the complete and rigorous solution of this difficult problem, which had not been resolved before in a satisfactory manner, either on the footing of analysis or observation. In the same year he obtained the prize of the Academy of Sciences on the subject of the perturbations of comets. In 1781 he published, in the Berlin Memoirs, the first of a series of five papers on the secular and periodic inequalities of the planets, which together formed by far the most important work that had yet appeared on physical astronomy since the publication of the *Principia*. This series did not, properly speaking, contain any new discovery, but it embodied and brought into one view all the results and peculiar analytical methods which had appeared in his former memoirs, and contained the germs of all the happy ideas which he afterwards developed in the *Mécanique Analytique*.

On account of the brilliant discoveries and important labours which we have thus briefly noticed, Lagrange must be considered as one of the most successful of those illustrious men who have undertaken to perfect the theory of Newton, and pursue the principle of gravitation to its remotest consequences. But the value of his services to science is not limited to his discoveries in physical astronomy, great and numerous as these were. After Euler, he has contributed more than any other to increase the power and extend the applications of the calculus, and thereby to arm future inquirers with an instrument of greater efficiency, by means of which they may push their conquests into new and unexplored fields of discovery.

Laplace.

With the name of Lagrange is associated that of Laplace, their rival labours dividing the admiration of the scientific world during half a century. Like Newton and Lagrange, Laplace raised himself at an early age to the very highest rank in science. Before completing his 24th year, he had signalised himself by the important discovery of the invariability of the mean distances of the planets from the sun, on an hypothesis restricted, indeed, but which, as we have already mentioned, was afterwards generalised by Lagrange. About the same time he was admitted into the Academy of Sciences, and thenceforward devoted himself to the development of the laws which regulate the system of the world, and to the composition of a series of memoirs on the most important subjects connected with astronomy and analysis. His researches embraced the whole theory of gravitation; and he had the high honour of perfecting what had been left incomplete by his predecessors.

Among the numerous inequalities which affect the motion of the moon, one still remained which no philosopher as yet had been able to explain. This was the acceleration of the mean lunar motion, which had been first suspected by Halley, from a comparison of the ancient Babylonian observations, recorded by Hipparchus, with those of Albategni and the moderns. The existence of the acceleration had been confirmed by Dunthorne and Mayer, and its quantity assigned at 10″ in a century, but the cause of it remained doubtful. Lagrange demonstrated that it could not be occasioned by any peculiarity in the form of the earth; Bossut ascribed it to the resistance of the medium in which he supposed the moon to move; and Laplace himself at first explained it on the supposition that gravity is not transmitted from one body to another instantaneously, but successively, in the manner of sound or light. Having afterwards remarked, however, in the course of his researches on Jupiter's satellites, that the secular variation of the eccentricity of the orbit of Jupiter occasions a secular variation of the mean motions of the satellites, he hastened to transfer this result to the moon, and had the satisfaction to find that the acceleration observed by astronomers is occasioned by the secular variation of the eccentricity of the terrestrial orbit. This conclusion has, however, been partly invalidated by the recent researches of Adams of Cambridge.

Another discovery relative to the constitution of the planetary system, which does infinite honour to the sagacity of Laplace, is the cause of the secular inequalities indicated by ancient and modern observations in the mean motions of Jupiter and Saturn. On examining the differential equations of the motions of these planets, Laplace remarked, that as their mean motions are nearly commensurable (five times the mean motion of Saturn being nearly equal to twice that of Jupiter), those terms of which the arguments are five times the mean longitude of Saturn, minus twice that of Jupiter, may become very sensible by integration, although multiplied by the cubes and products of three dimensions of the eccentricities and inclinations of the orbits. The result of a laborious calculation confirmed his conjecture, and showed him that in the mean motion of Saturn there existed a great inequality, amounting at its maximum to 48′ 2″·3, and of which the period is 929 years; and that in the case of Jupiter there exists a corresponding inequality of nearly the same period, of which the maximum value is 19′ 46″, but which is affected by a contrary sign, that is to say, it diminishes while the first increases, and *vice versâ*. He also perceived that the magnitude of the co-efficients of these inequalities, and the duration of their periods, are not always the same, but participate in the secular variations of the elements of the orbit.

The theory of the figures of the planets, scarcely less interesting than that of their motions, was also greatly advanced by the researches of Laplace. He confirmed the results of Clairaut, Maclaurin, and D'Alembert, relative to the figure of the earth, and treated the question in a much more general way than had been done by those three great mathematicians. From two lunar inequalities depending on the non-sphericity of the earth, he determined the ellipticity of the meridian to be $\frac{1}{306}$ very nearly.

Newton, in the *Principia*, explained the cause of the phenomena of the tides, and laid the foundations of a theory which was prosecuted and extended by Daniel Bernouilli, Maclaurin, Euler, and D'Alembert; but as none of these geometers had taken into account the effects of the rotatory motion of the earth, the subject was in a great measure new when it was taken up by Laplace in 1774. Aided by D'Alembert's recent discovery of the calculus of partial differences, and by an improved theory of hydrodynamics, he succeeded in obtaining the differential equations of the motion of the fluids which surround the earth, having regard to all the forces by which these motions are produced or modified, and published them in the memoirs of the academy in 1775. By a careful examination of these equations, he was led to the curious remark, that the differences between the heights of two consecutive tides about the time of the solstices, as indicated by Newton's theory, are not owing, as Newton and his successors had supposed, to the inertia of the waters of the ocean, but depend on a totally different cause, namely, the law of the depth of the sea, and that it would disappear entirely if the sea were of a uniform and constant depth. He also arrived at the important conclusion, that the fluidity of the sea has no influence on the motions of the terrestrial axis, which are exactly the same as they would be if the sea formed a solid mass with the earth. The same analysis conducted him to the knowledge of the conditions necessary to ensure the permanent equilibrium of the waters of the ocean. He found that if the mean density of the earth exceeds that of the sea, the fluid, deranged by any causes whatever, from its state of equilibrium, will never depart from that state but by very small quantities. It follows from this, that, since the mean density of the earth is known to be about five times greater than that of the sea, the great changes which have taken place in the relative situation of the waters and dry land must be referred to other causes than the instability of the equilibrium of the ocean.

The chief steps in the progress of the study of tides since the time of Laplace have consisted in co-ordinating the results of observation, and analysing them into their partial phenomena, by the help of Newton's and Bernouilli's theory. This labour has been greatly advanced by Dr Whewell, and also by Sir John Lubbock. The former has constructed maps of "cotidal lines," which, indicating the relative time of high water in different parts of the globe, give us a graphic conception of the course and propagation of the tidal wave. The tides of the Eastern Pacific are but little known; but a vast wave advances northwards between Australia and Africa, diverted or retarded by the obstacles it meets with in the Indian Archipelago. Another (and to us the most important) branch sets from south to north up the vast canal of the Atlantic, where it is gradually complicated by local tides, having their origin in the wide expanse between Africa and the Gulf of Mexico. The two sets of waves sometimes reinforce, sometimes oppose one another; they are prolonged to the western shores of England and Norway, where the tidal impulse arrives twenty-four hours after it passed the Cape of Good Hope. It is propagated most rapidly at a distance from coasts, and is retarded in narrows and shallows. It sends offshoots into every bay and strait, always greatly retarded in point of time (apparently by friction), but often increased in elevation by concentration of the effect in a gradually narrowing channel, as we see in the exaggerated tides of the river Amazon, the Severn, and the Bay of Fundy. The same place may be the seat of several tides at once, which may increase or destroy one another; thus, a small tide is propagated through the Straits of Dover as far as the Dutch coast, where it only arrives simultaneously with the principal wave, which has made the entire tour of Great Britain.

As regards the progress of theory, Dr Thomas Young, one of the greatest philosophers of this century, next after Laplace grappled with the difficulties of this arduous subject. Employing mathematical methods of inferior power but greater directness, and taking into account causes of local action which Laplace had not ventured to include in his analysis, he gradually matured a theory adequate to represent many of the results of experience, of which Laplace gives no account. He distinguishes the results of the *forced* and *free* oscillations of the sea: the former resulting from the direct action of the sun and moon combined with the rotation of the earth, and whose periods of rise and fall are determined solely by those external causes; the free waves, on the contrary, derived from the former, are transmitted with velocities depending on the mechanism of the fluid itself, on its depth, and on the resistances arising from friction to which those motions are exposed. These all-important modifications of the dynamical theory of the tides were deduced by Young from the general theory of oscillations and resistances, and from the laws of fluids detected by Du Buat, and he applied them with no ordinary skill to the solution of the problems of tides in oceans, estuaries, and rivers. It is satisfactory to find that by an independent and very different method Airy subsequently arrived at substantially the same results as Young. Young.

Closely connected with the problem of the tides is that of the precession of the equinoxes, which also received similar improvements in passing through the hands of Laplace. He demonstrated, as has been mentioned, that the fluidity of the sea has no influence on the phenomena of precession and nutation. He considered some of the effects of the oblate figure of the earth which had not been attended to by D'Alembert, and showed that the annual variation of the precession causes a corresponding variation in the length of the tropical year, which at present is about 9 or 10 seconds shorter than it was in the time of Hipparchus. He proved that the secular inequalities of the motions of the earth and moon have no sensible effect in displacing the axis of the earth's rotation; and he determined the nutation of the lunar orbit corresponding to the nutation of the terrestrial equator.

Physical astronomy is also indebted to Laplace for a complete theory of the system of Jupiter's satellites, from which Delambre constructed a set of tables representing the motions of these bodies with all desirable accuracy. And when to these numerous and most important researches we add the mathematical theories of molecular attraction, and the propagation of sound, together with many great improvements in analysis,—and reflect, besides, that he is the author of the *Mécanique Céleste*, the *Système du Monde*, and the *Théorie des Probabilités*,—we shall not hesitate to rank him next to Newton among the greatest benefactors of the mathematical and physical sciences.

By the brilliant discoveries of Laplace, the analytical solution of the great problem of physical astronomy was completed. The principle of gravitation, which had been found by Newton to confine the moon and the planets to their respective orbits, was shown to occasion every apparent irregularity, however minute, in the motions of the planets and satellites; and those very irregularities which were at first brought forward as objections to the hypothesis have been ultimately found to afford the most triumphant proofs of its accuracy, and have placed the truth of the Newtonian law beyond the reach of all future cavil. Such is the state to which analysis has now attained, that the geometer embraces in his formulæ every circumstance which affects the motions or positions of the different bodies of the planetary system; and the conditions of that system being made known to him at any given instant of time, he can determine its conditions at any other instant in the past or future duration of the world. He ascends to remote ages to compare the results of his theories with the most ancient observations, he passes on to ages yet to come, and predicts changes which the lapse of centuries will hardly be sufficient to render sensible to the observer. But notwithstanding the comparative perfection to which the theory of astronomy has been brought, it is still far from having reached the limit beyond which further refinement becomes superfluous. The masses of the planets, and some other elements, remain to be determined with still greater precision, by a diligent comparison of the analytical formulæ with good observations; and the labours of the geometer may still be beneficially employed in giving greater simplicity to the calculus, or in extending its power over subjects which have hitherto eluded its grasp. The observation of periodic comets that complete their revolutions in comparatively short intervals of time, opens up an interesting field for speculation and research, and will doubtless be the means of throwing light on some curious and as yet very obscure points, respecting the appearances, motions, and physical constitution of those strange bodies.

In the other departments of astronomy, also, numerous questions still remain to be discussed, the solution of which will occupy and reward the future labours of astronomers, and in which much progress has been made during the present century, by means of the powerful instruments now employed at the great observatories of every civilised country, and the improved methods of analysis brought to bear upon the results of observation. The curious phenomena of double and multiple stars, some of which are found to form connected systems of bodies revolving about one another, or a common centre of motion,—the variable stars,—the proper motions of the stars,—the translation of the solar system in space,—the progressive condensation of nebulæ,—are subjects still in a great measure new; for it is only of late years that observers have begun to direct the requisite attention towards them, or indeed have been in possession of instruments of sufficient power and delicacy to observe and measure the minute changes which take place beyond the boundaries of our own system. The discoveries in astronomy during the present century have been so brilliant and numerous, and the progress in every department is so rapid, and involves so many details, that it would be impossible to give here a detailed account of that progress. Moreover, there is a reason for not attempting this, in the circumstance that we have brought the history of our subject as far as is possible without considering the work of men still living. For although some to whom the astronomy of the present day is indebted, and not a few who must always be regarded as among the leading astronomers of the century, have passed away, yet the consideration even of their work would necessarily introduce the discussion of the labours of those whose labours are still in progress. It seems on all accounts better, therefore, to content ourselves with the discussion of the various results obtained during recent years, without attempting the invidious task of apportioning to the several workers their relative positions.

Part II.—Theoretical Astronomy

Chapter I.—*Apparent Motion of the Star-sphere.*

When we look at the heavens on a clear night, we perceive a concave hemisphere on which are strewn multitudes of bright points. As we watch these hour after hour, we find that they are carried round precisely as though they were fixed on the interior surface of a spherical shell turning on a fixed axis. New groups are seen to rise above the eastern horizon, while those above the western horizon descend and finally disappear. Turning towards the south, we see that the groups of stars which pass above the horizon somewhat to the east of the south attain but a slight elevation when at their highest in the south, and then descending set as far to the west of the south point as they had risen to the east of it. Turning to the north, we see that there are groups of stars which remain visible the whole night, wheeling around a fixed point, and describing circles of greater or less magnitude according as they are at a greater or less distance from that point. Supposing our stand point to be in or near London, the point thus remaining fixed is due north, and about $51\frac{1}{2}°$ above the horizon,—therefore, about $38\frac{1}{2}°$ from the point directly overhead. If the heavens be observed night after night, similar phenomena are seen; and we recognise the uniformity of the motion of the (imaginary) star-sphere about its (imaginary) axis; for in any assigned interval, on any night in the year, the star-sphere turns by the same amount. It is soon found that the rate of turning is such that a complete rotation is effected in the course of about one day. But before many days have passed we find that this uniform turning motion does not correspond exactly to our common day. For though on several successive nights the stars may appear to be nearly in the same situation with respect to the horizon at any assigned hour, yet before long (or even in twenty-four hours if exact observation be made) it is found that the stars occupy the same position, *not* at the same hour on successive nights, but about four minutes earlier night after night. Thus, in the course of about fifteen days the star-sphere has gained one hour's rotation; in about thirty days, two hours' rotation, and so on: until in the course of a year the star-sphere has gained a complete rotation, and the stars have the same apparent position at any assigned hour of the night as they had when the observations were commenced.

Limiting our attention for the present to the stars,—though already, in speaking of the common day, we have in fact referred to the sun,—the idea suggested by the observed phenomena is that the apparent star-sphere revolves around the earth precisely as it seems to do, turning about an axis, with a perfectly uniform motion, completing one rotation in twenty-four hours, less about four minutes. The natural steps for determining whether this really is the case, are—first, a series of careful observations at one fixed station; and, secondly, a study of the effects produced by change of station.

For the former purpose we require to adopt certain fixed points or circles on the concave hemisphere visible above the horizon, in order that we may refer the apparent motions to these points or circles as unmoving standards.

Definitions. Let, then, NESW (fig. 1) represent the seemingly circular horizon line around the observer at O; N being the north point, S the south, E the east, and W the west, so that the lines SON and WOE are at right angles to each other. Let Z be the point immediately overhead; and let P, so placed on the quadrant ZPN that PN is an arc of $51\frac{1}{2}^\circ$, be the apparently fixed point on the heavens already described, so that POP′ is the imaginary axis about which the star-sphere appears to revolve. Then the points P and P′ are called the *poles* of the heavens. P is distinguished as the *visible pole* from P′, which is the *invisible pole*, for the station of the observer at O; PP′ is called the *polar axis*.

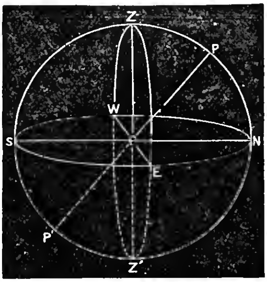


Fig. 1.

Poles.

Zenith. The point Z immediately overhead, or geometrically defined by the fact that OZ is perpendicular to the *plane of the horizon* NESW, is called the *zenith*; and Z′, the point in which ZO produced intersects the invisible hemisphere, is called the *nadir*. The line OZ is called the *vertical*. Any great circle of the sphere, whose plane passes through ZZ′, as the circle SZNZ′ or the circle EZWZ′, is called a *vertical circle*. The vertical circle SZPNZ′, which passes through the pole, is called the

Meridian. *meridian circle*, and its plane is called the *meridian*; because when the sun is on this circle it is true mid-day. The points N and S, in which the meridian circle meets the horizon, are called the *north* and *south points of the horizon*, the north point being distinguished from the south as being the extremity of the quadrant ZPN, on which is the visible pole P. (Reference is here made to the pole seen at the supposed station of the observer; that pole is the north pole of the heavens, and the north point of the horizon is N on the quadrant ZPN through the north pole.) The points N and S divide the horizon into halves, SEN, SWN—the former being the half along which the stars rise, the latter being the half along which they set. A vertical circle EZWZ′, having its plane at right angles to the meridian, is called the *prime vertical*, and intersects the horizon in two points, E and W, called respectively the *east* and *west points of the horizon*, the east being distinguished from the west as being on the part of the horizon crossed by rising stars, while the west is on the part crossed by setting stars.

Next, let EMWM′ (fig. 2) represent the path of a star which rises due east. Then EMWM is a circle whose plane passes through WOE, and is therefore a great circle of the sphere. The diameter WOE divides this circle into the semicircles EMW and WM′E, one above, the other below the horizon circle NESW,—that is to say, a star which rises in the east has one-half of its course above the horizon, and the other half below the horizon. Again, since the circle SZNZ′ has the points E and W for its poles, the arcs EM, MW, WM′, and M′E are quadrants,—that is to say, when a star rises in the east, one-fourth of a complete rotation brings it to the meridian, another fourth brings it to the west point, the next fourth part brings it again to the meridian at M′ below the horizon, and the remaining fourth part brings it to the east point again. The circle EMWM′ is called the *celestial equator*. It is the great circle having for its poles the points P and P′, which are the poles of the heavens. (It is sometimes, but perhaps not very correctly, called the *equinoctial*, because when the sun is on this circle, one-half of his course is above and the other below the horizon, and therefore day and night are equal; but, strictly speaking, the term equinoctial is applied to the geographical equator because there all the year round the nights are of equal length.) Equator

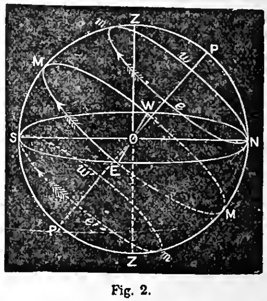


Fig. 2.

A star at N will clearly be carried by the diurnal motion round the circle N*emw* to N again, not passing below the horizon; and any star on the segment of the sphere PN*emw* will be always above the horizon. Hence the circle of N*emw* is called the *circle of perpetual apparition*, as limiting the region of the stars which never set. Such stars are called *circumpolar* stars. There is evidently an equal opposite region, P′S*w′m′e′*, around the invisible pole, the stars in which are never seen above the plane of the horizon. It is clear that any circle parallel to the equator, between the circle of perpetual apparition and the equator, has more than its half above the horizon, and so much the more as it lies nearer to the circle of perpetual apparition; that is to say, stars rising in the quadrant EN are above the horizon for more than half the time of a complete rotation of the star-sphere, and the nearer they rise to N the longer they continue above the horizon. In like manner stars rising in the quadrant ES are above the horizon for less than half the time of a complete rotation, and the nearer they rise to S the shorter is the time during which they are above the horizon.

Let us suppose the sphere of fig. 2 so placed (fig. 3) that the horizon plane appears as a straight line SON, O being the place where the east and west points coalesce. Thus the equator appears as the straight line MOM′ at right angles to the polar axis POP′; the circles *m*N, S*m′* of fig. 2 become the straight lines *m*N, S*m′* parallel to MM′ in fig. 3. And parallel circles intermediate between these two and the equator appear as the parallel straight lines ACB, A′C′B′; while parallel circles outside the circles *m*N and S*m′* appear as the parallel straight lines *acb* and *a′c′b′* All these parallels being at right angles to PP′ are bisected by PP′. Now, if we consider that the straight line AHB represents a circle seen edgewise, we perceive that AH represents two equal arcs of the circumference of this circle, one arc being that on which a star moving along that circle by the diurnal motion is carried from the horizon to the meridian at A, and the other being the arc on which the star is carried from A to the horizon again. In like manner H′A′ represents two equal arcs of a star's diurnal course,—that is to say, the arcs of a star's visible path on the two sides of the meridian are equal to one another. Similarly the meridian divides the invisible part of a star's course into equal parts. In the case of a star within the circle of perpetual apparition we perceive that *acb* represents two semicircles of such a star's diurnal circuit, one-half lying on the east of the meridian, the other lying on the west; in this case, then, as in the former, the meridian separates the ascending from the descending paths, which are equal, but the ascent is from a point on the meridian below the pole, *not* from the horizon, and the descent is to the same point of the subpolar meridian. It will be noticed that a in fig. 3 lies to the north of the zenith Z; but it is also clear from the figure that some of the circumpolar stars cross the meridional arc SMP to the south of the zenith.

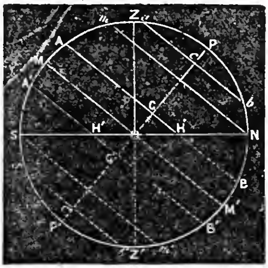


Fig. 3.

We see from fig. 3 that a star is always at its highest above the horizon when on the part PZS of the meridional circle. A star is said to *culminate*, or to reach its *culmination*, when on the meridian. The arc of the meridian intercepted between the star and the south point is called the star's *meridian altitude;* and the arc of the meridian between the star and the zenith is called the star's *zenith distance*, or more correctly, the *meridional zenith distance*. The arc-distance of a star from the equator is called its *declination*, and is northern or southern according as the star is in the northern or southern of the two hemispheres into which the equator divides the celestial sphere. The arc-distance of a star from the north pole is called the *north polar distance*, the supplement of this arc (the arc-distance from the south pole) being called the south polar distance. It is evident that the north polar distance of a star having northern declination is complementary to the declination,—that is, N.P.D. = 90° − N. Dec. But when a star has southern declination N.P.D. = 90° + S. Dec. When we know the declination or polar distance of a star, we know where it will culminate. For we see from fig. 3 that

$$\text{Arc SA} = \text{SM} + \text{MA}.$$

In other words, the altitude of a star culminating at A is equal to the altitude of the equator on the meridian added to the northern declination of the star. (The arc SM is obviously equal to ZP, the zenith distance of the pole, or the complement of the pole's altitude above the horizon.) Again

$$\text{Arc SA} = \text{SM} - \text{MA}',$$

or the altitude of a star culminating at A′ is equal to the altitude of the equator on the meridian diminished by the southern declination. These relations hold so long as the star culminates on the arc SZ. For a star culminating at a we have still

$$\text{S}a = \text{MS} + \text{M}a.$$

But the altitude of the star, being in this case measured from the north point N, is the supplement of the arc obtained by thus adding the north declination to the meridional altitude of the equator.

We see then that the declination of a star (or its north polar distance) determines the altitude of its culminating point. To determine the time at which the star culminates it is necessary that another co-ordinate should be known.

As we measure the declination from the equator, or in other words, determine the altitude of culmination by a reference to the equator, it is manifestly convenient to measure the time of a star's culmination by referring it to the time of culmination of some selected point on the equator. This is the course adopted by astronomers. The point selected for the purpose is one of the two points in which a great circle on the celestial sphere, called the ecliptic, and presently to be more particularly described, cuts the equator. This point is called the first point of Aries, and is indicated by the sign ♈. At present it is only necessary to note that this point is in reality affected by a slow motion on the star-sphere, due to the fact that the axis on which the star-sphere apparently turns undergoes a slow change of position within the star-sphere itself, so that the equator is not really a fixed circle on the heavens. But for the purpose we have at present in view this slow change may be neglected; and we assume that the observer on earth has the equator as a fixed circle from which to measure the declination of stars, and that he also has a fixed point on the equator by which to time the culmination of each star. Knowing the declination of a star, he knows at what altitude it will culminate as viewed from the fixed station at which thus far we have supposed him to be placed. Let him now note the exact moment at which the first point of Aries culminates, and let him observe the precise interval in time between that moment and the moment when a star of known declination culminates; this interval is constant, and thereafter he will always know not only at what altitude that star will culminate, but at what time after the culmination of the point ♈. The interval in time between the culmination of ♈ and the culmination of a given star is called the *right ascension* of the star. It may be measured, indeed, as an arc, viz., as the arc on the equator intercepted between ♈ and that point in which a meridian circle through the star intersects the equator, the arc being measured in the direction opposite to that in which the star-sphere rotates. But the right ascension is more conveniently and now almost always measured in time.

The time measurement employed is the rotation of the star-sphere itself. The interval in time between the successive culminations of ♈ is called a *sidereal day*. It is divided into 24 hours (numbered 0, 1, 2, 3 . . . to 24), each hour into 60 minutes, each minute into 60 seconds. If we have a clock showing 24 hours, and so rated as always to show 0 hour 0 min. 0 sec., when ♈ is at its culmination, that clock will always show true sidereal time. Such a clock would gain nearly 4 min. a day as compared with an ordinary clock; but we need not at present dwell upon this point. Now the right ascension (or, as it is written, the R.A.) is indicated in sidereal time, and therefore corresponds to the time shown by the sidereal clock when that star is culminating. Thus, if a star's right ascension is 3 h. 2 m. 6 s., then when the sidereal clock shows time 3 h. 2 m. 6 s., that star is culminating. Whether it be day or night the astronomer knows this certainly, that is, if his sidereal clock is trustworthy.

It will be manifest that an observer at a fixed station as we have thus far supposed our observer to be, requires to have the means of determining—(1) the moment at which a star culminates (or is on the meridian), and (2) the star's altitude when at its culmination. We have seen how the movement of the star-sphere determines the *cardinal points* of the horizon. Suppose now a telescope or pointer, so set as to turn upon a horizontal axis lying exactly east and west, as in fig. 4. We see that when the telescope is rotated on this axis, the line of sight, *es*, or the optical axis of the telescope, sweeps round in the plane of the meridian. It can be directed due south towards S, or to Æ (the culminating point of the celestial equator), or to *s*, a star on the meridian, or to the zenith Z, or to the pole P, or to the north point N,—in fine, to any point on the celestial meridian.

Transit instrument.

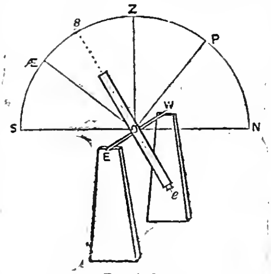


FIG. 4.—Transit Instrument.

Now, if any contrivance be adopted to enable the observer to note the exact moment of sidereal time when a star crosses the middle of the field of view of such a telescope, then the right ascension of that star is known at once. If also the angle ZO*s* can be determined, we learn the star's zenith distance. This added to ZP, the zenith distance of the pole, is the star's north polar distance, PZ*s*; and in this instance the complement of the zenith distance is the north declination. Such an instrument, if devised simply or mainly for noting the moment of culmination, is called a *transit instrument.* If arranged with circles so that angles—as the zenith distance Z*s*—can be determined, the instrument is called a *transit circle.* An arrangement, now little used, in which a meridional circle bearing a telescope works against a fixed plane surface or wall (necessarily standing in a north-and-south position) is called a *mural circle.* At present, however, we need not discuss these varieties of construction. The point to be specially noted in this plan is that, from observations of the star-sphere, we determine the cardinal points; and then the position of any star in the heavens can be determined by an instrument contrived so as to swing in the plane of the meridian. This done, a clock, carefully rated to show sidereal time, enables the astronomer at a fixed station to turn his transit instrument to the point of culmination of a star at the exact time when the star will culminate, and at the true place of such culmination.

CHAPTER II.—*The Earth shown to be a Globe within the Star-Sphere.*

But now let us suppose our observer to travel in a north-and-south direction, in order to determine what change, if any, will be produced by such voyages. The first effect noticed is that the pole of the heavens rises higher and higher above the northern horizon, as he travels farther and farther north, whereas the pole sinks lower and lower down towards the northern horizon the farther the observer travels towards the south. Close observation shows that the change of the pole's elevation is either exactly proportional to the observer's change of place in a north-and-south direction, or so nearly so that any discrepancy will require the closest and most exact scrutiny. The observer also notices that the stars retain their relative positions absolutely unaltered, but that new stars are seen in the south when he travels southward. This shows that the star-sphere is either truly a spherical enclosure,—all the stars lying at the same distance,—or else that the distances of the stars are so enormous that the displacement of the observer on the earth, even by several hundred miles, is as nothing by comparison. The uniform change in the pole's elevation cannot be explained, however, by merely supposing the stars very far away compared with terrestrial distances. For let us suppose that A, B, C, D (fig. 5) represent four equidistant stations along a *straight* north-and-south line SN, and that AP is the direction in which the polar axis seems to lie, as seen from the station A, then from D it is seen at a greater elevation, or as in direction DP. Now, if we suppose P to be the actual pole of the heavens, then BP and CP should represent the polar axis as observed at B and C; but the angles PAN, PBN, PCN, PDN, do not increase uniformly, for this would imply that the angles APB, BPC, and CPD are equal, which we know from geometry not to be the case. Moreover, the star-sphere cannot rotate uniformly about two different axes, as PA and PD.

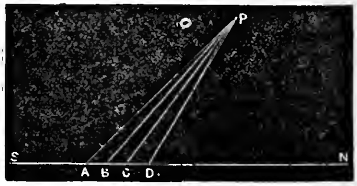


Fig. 5.

It is manifest that we can only explain the observed facts by assuming that the course pursued by the supposed observer is not a straight line as SN (fig. 5), but curved, and that it is curved uniformly, since the polar elevation changes uniformly when the observer travels at a uniform rate. It follows, therefore, that the path of the observer must be part of a circular arc such as d a g in fig. 6. Here suppose a the first position of the observer, and that when

Earth's surface curved north and south.

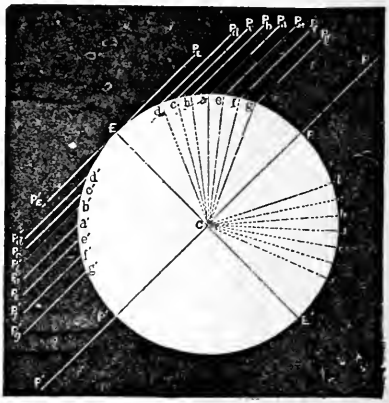


FIG. 6.—Diagram to show Curvature of Earth.

he travels southwards he passes over the equal arcs a b, b c, c d, &c., while his northward course from a carries him over the equal arcs a e, e f, f g. From a let the north pole of the heavens be seen in the direction aP$_a$, and for convenience, instead of drawing the south-and-north horizon line at a (which would be a tangent to the arc d g at a, and would be confused with other tangents required to be drawn from b, c, d, &c.), let us draw a vertical line downwards from a to C, that is, towards the *nadir*, and let us draw C*a* at right angles to aC, meeting the circle EaE′, of which dg is an arc, in *a*. Through C, the centre of this circle, draw PCP′ parallel to aP_a. Then we suppose throughout that the pole of the celestial sphere is so far off compared with the dimensions of the circle EaE′, that the apparent direction of the polar axis at all points of the arc d g is the same, and therefore parallel to CP. Thus the polar axis at b is represented by the line bP_b, at c by the line cP_c, and so on. Draw the vertical lines bC, cC, dC, &c., and at right angles to them, through C, draw C*b*, C*c*, C*d*, &c.; then clearly the angular elevation of the pole at a, or the angle $P_a ac$, is equal to the angle PC*a*; at b the elevation of the pole, or the angle $P_b ba$, is equal to the angle PC*b*; at c to PC*c*, and at d to PC*d*. But these angles PC*a*, PC*b*, PC*c*, PC*d*, diminish uniformly. In other words, to an observer travelling uniformly along an arc a b c d towards the south, the angular elevation of the pole would diminish uniformly, as it is observed to do, *if* (1) the arc d a is circular, and (2) the pole of the heavens so far from the observer that lines drawn to it are appreciably parallel. Similarly the uniform increase of the polar elevation, to an observer travelling northwards along the arc a g, is explained, since the elevation of the pole, as he passes to the stations e, f, and g, changes through the values PC*e*, PC*f*, PC*g*, increasing therefore uniformly.

Continuing this voyage beyond ad, southwards, the observer finds the pole continues to sink, until at length when he has arrived at a station E, the north pole of the heavens is on the horizon due north, or in direction EP_E. All the phenomena of celestial rotation continue unchanged, except that towards the south many new stars have come into view. Moreover, the south pole of the heavens has now risen to the horizon, and lies due south, or in direction EP'_E. If the observer were now to retrace his course, he would, of course, find the north pole of the heavens rising uniformly again. But if instead of this he continue his journey southwards, he finds the south pole of the heavens rising uniformly. As he travels onwards to the successive stations d′, c′, b′, a′, &c., so placed that Ed′ = Ed, Ec′ = Ec, &c., the phenomena presented may be described exactly as for the northern stations d, c, b, a, &c., respectively, except that for northern must be written southern, and for southern northern, throughout.

The difference in the position of observers on the northern and southern sides of E, fig. 6, may be conveniently illustrated as in fig. 7, where G represents the place of an observer near Greenwich, and C the place of an observer near Cape Town, but due south of the former, and HZ*h*, H′Z′*h*′, are supposed to represent the apparent hemispherical dome of the heavens above and around these respective observers. (These hemispherical domes should, of course, be very much larger in proportion, each being here represented with a radius of about 3500 miles, whereas the nearest of the celestial bodies, our moon, is nearly 240,000 from us.) G*p* represents the apparent direction of the northern celestial pole as seen from Greenwich, raised about $51\frac{1}{2}°$ above the north point of the horizon at *h*, and G*e* is the direction of the southern or culminating point of the celestial equator, about $38\frac{1}{2}°$ above the south point H of the Greenwich horizon. (The east and west points of the horizon-circle are projected at the point G.) At C, C*p*′ is the direction of the southern celestial pole, about $34\frac{1}{2}°$ above the southern horizon at H′; C*e*′ is the direction of the culminating or north point of the celestial equator, about $55\frac{1}{2}°$ above the northern horizon at *h*′.

Measurement of the earth. We see that journeys taken in a north-and-south direction lead to apparent changes of the dome of the heavens, only explicable on the assumption that the path traversed is a circular arc, or nearly so. It is clear also that the radius of this circular arc is determinable if the observer notes how much the elevation of the pole is

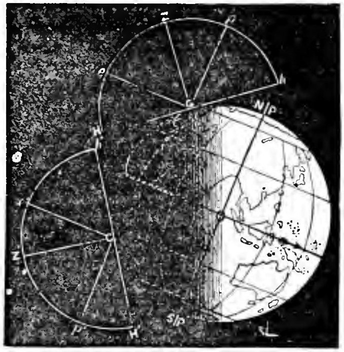


FIG. 7.—Domes of Heavens near Greenwich and near Cape Town.

changed for any given distance traversed by him in a north-and-south direction. Suppose, for instance, that in travelling from a to b (fig. 6) he finds the elevation of the pole diminished by 7°, and that he has travelled about 480 miles, then (as already shown) he knows that ab = *ab* = change in polar elevation = an arc of 7° of the circumference of the circle along which he is travelling. Hence the whole circumference $= \frac{360}{7} \times 480$ miles = 24,686 miles; whence the diameter of the circle = (roughly) $24{,}686 \times \frac{7}{22} = 7855$ miles. This is not the true diameter of the earth's globe, being supposed to be the result of only a rough observation; but the method serves sufficiently to show how in very early times astronomers obtained a measure of the earth. For from whatever station the observer starts on north-and-south journeys, the same uniform elevation or depression of the visible pole as he travels towards or from it is observed; and the inference, therefore, is that the earth is a globe, since all the lines drawn on it in a north-and-south direction are circular arcs of equal radius. The points corresponding to E, where the poles are both on the horizon, mark the place of the *terrestrial equator*; and the points on the earth, P and P′ (which have never yet been reached), where the north and south celestial poles are respectively vertical, are the *terrestrial* or *geographical poles*.

Earth's surface curved east and west. Thus far we have considered only journeys made along a north-and-south course. Journeys pursued due east or due west, that is, always towards the point of the horizon which is 90° to the right or to the left of the north point, show equally that the observer is travelling on the surface of a globe, though they produce no apparent change either in the elevation of the pole or in the position of the points at which known stars rise, culminate, and set. We have seen that the observer who remains always at one station can determine the absolute time when any given star will culminate. Let us suppose that when journeying eastward or westward he can carry with him his sidereal time-measurer, and that this continues throughout to show the true sidereal time of his original station. Then if he is travelling eastward he will find that any given star, instead of culminating at the time noted for that star as observed at his original station, will culminate earlier. The right ascension of the star will remain unchanged, for this is the difference between its time of culmination and the time when the point ♈ culminates. But instead of ♈ culminating when the clock points to 0 h. 0 m. 0 s. of sidereal time, it will culminate *before* the clock so points; and each star will culminate as much before *its* sidereal time, that is, before the sidereal time corresponding to its right ascension. On the contrary, if the observer travels westwards from his original station, he finds that each star culminates later. Moreover, the observer finds that the amount of change in point of time corresponds to the distance he travels. Suppose a, fig. 8, to be his original station, and let aa' be a small circle of a globe, having P and P′, as before determined (see fig. 6), for poles. Then the observer finds that the change in the time of a star's culmination corresponds exactly to the length of arc traversed by him round the circle aa', on the assumption that a complete circumference of this circle corresponds to 24 hours of sidereal time. Thus, if a is at Greenwich, the polar elevation is $51\frac{1}{2}°$, and, therefore, Ea (from what has been already shown in explaining fig. 6), is an arc of $51\frac{1}{2}°$; ao, the radius of aa', = EO sin. $51\frac{1}{2}°$, and the observer finds that T, the change of time in the culmination of ♈, or any given star, for a given easterly or westerly distance d traversed from Greenwich, is such that

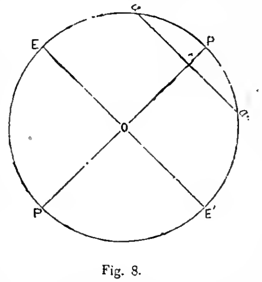


Fig. 8.

$$T : \text{a sidereal day} :: d : 2\pi . \text{EO} . \sin. 51\tfrac{1}{2}°$$

This corresponds with the result of the former series of observations in showing that the earth is a globe, suspended, as it were, within the star-sphere; and that either the star-sphere turns uniformly around this terrestrial globe from east to west once in 24 sidereal hours, or else the terrestrial globe turns uniformly round the axis PP′ (fig. 6) once in 24 sidereal hours from west to east.

Chapter III.—*Of the Apparent Motions of the Sun.*

The earth has now been shown to be a globe within the star-sphere, and whether the earth rotates within the star-sphere, or the star-sphere rotates round the earth, or both the earth and the star-sphere rotate, it is known that, *relatively to the earth*, the star-sphere rotates from east to west once in 24 sidereal hours. This rotation, whether apparent or real, takes place without any appreciable change in the relative position of the fixed stars. And the law of rotation having once been ascertained, it follows that the time of culmination of any star, and the position of the star at the time, are known, insomuch that a telescope or pointer can be directed to the place of the star at the moment of culmination with perfect exactness. Moreover, a star can be followed by an instrument properly devised, in such sort that a pointer shall continue directed upon the star all through the 24 sidereal hours. Suppose, for example, that

Equatorial instrument.

PP′ (fig. 9) is a rod turning on pivots P and P′ so placed that the axis of the rod points to the pole of the heavens; then if TT′ be a telescope so attached to an axis in or on PP′ (as at O) that it can be turned in any angle to PP′; then if this telescope be placed so that $e\,s$, its optical axis, is directed towards a star (in which case, necessarily, the angle POs will be equal to the star's north polar distance), it is clear that by rotating the axis PP′ uniformly once in 24 sidereal hours, and in the direction corresponding to the rotation of the heavens, the optical axis es will continue to be directed towards the star throughout the whole of those 24 hours, even when the star is below the horizon. If a star's north polar distance be known, a telescope thus mounted can be placed so that POs is the proper angle, without seeing the star. If, further, we know the star's right ascension, and also the true sidereal time, we can not only set the telescope so that POs shall be the proper angle, but can rotate the axis PP′ in such sort that the telescope shall be pointed directly towards the star. Suppose, for example, that the star's N.P.D. = 75°, and the R.A. = 1 hour 26 min. (or $21\frac{1}{2}°$), (in other words, the star is close to η of the constellation Pisces); and let the time indicated by the sidereal clock be 3 hours 10 min. Then set TT′ (fig. 9) so that the angle POs = 75°, turn the axle PP′ so that TT′ or es lies in the meridian,—in other words, let the telescope be directed due south, only with an elevation of $53\frac{1}{2}°$, which is the supplement of 75° + the polar elevation at Greenwich, where the observation is made. Then, since the sidereal time is 3 hours 10 min., we know that the point ♈ was on the meridian 3 hours 10 min. before the moment of observation; and since the star's R.A. = 1 hour 26 min., we know that the star was on the meridian 1 hour 26 min. after ♈; hence the star was on the meridian 1 hour 44 min. (3 hours 10 min. − 1 hour 26 min.) before the moment of observation. We have then only to rotate the axis PP′ so as to follow the rotation of the star-sphere through an angle of 26° (the angle corresponding to 1 hour 44 min., since 360° corresponds to 24 hours) to have the telescope directed upon the star. And as we can thus direct a telescope, mounted as shown in fig. 9, towards a star at any hour (even when a star is below the horizon, in which case, of course, the telescope will be directed downwards), so conversely, it is clear that when the telescope is directed in any manner we can tell towards what point of the star-sphere the tube is turned. Thus, if the time shown by the sidereal clock is 3 hours 10 min., and the telescope be in such a position that, in order to bring it to the meridian, it would have to be turned round the polar axis backwards through an arc of 26°, corresponding to the rotation of the heavens in 1 hour 44 min., then we know that it is directed to a point in the star-sphere whose right ascension is 3 hours 10 min. − 1 hour 44 min., or 1 hour 26 min. If, further, we note that the angle POs is one of 75°, we know that the north polar distance of the point towards which the telescope is directed is 75°. The point, therefore, is known, and is close to the star η Piscium.

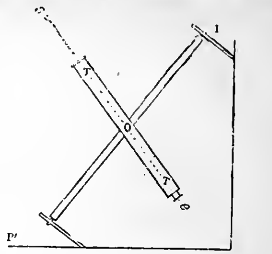


Fig. 9.—Equatorial Instrument.

We perceive, then, that if any celestial object is visible, whether by day or night, then by simply directing towards it such a telescope as is shown in fig. 9, we can ascertain in what part of the stellar heavens that celestial object lies. And if the object is moving upon the stellar heavens,—or, in other words, if it is other than one of these fixed stars with which we have hitherto been dealing,—then by turning a telescope towards it from time to time we can determine its apparent path among the stars. So that in the case of the sun, which is never seen in company with the stars simply because his light, by illuminating our air, veils the stars from view, we can nevertheless ascertain exactly along what path on the star-sphere he seems to move, at what rate, and whether the rate is uniform or variable.

Refraction. But before we examine the results of observations carried out for this purpose, it will be well to consider a circumstance affecting observations made in this manner. We refer to the refractive action of the earth's atmosphere, by which the apparent positions of the celestial bodies are to some degree affected. This is the proper place to mention the effects of refraction, because there can be little doubt that it was during observations of the sun that the refractive action of the atmosphere was first discovered. However, in explaining this action reference will be made to the stars as heretofore, in order that the inquiry into the sun's apparent motions may be referred solely to the sphere of the fixed stars.

By a well-known optical law, a ray of light in passing obliquely from one medium to another of greater density is refracted or bent towards the normal to their common surface. We may regard our atmosphere as composed of an infinity of concentric spherical shells, whose densities increase the nearer they are to the earth's surface. When a ray of light from a star enters the atmosphere, therefore, it is inflected towards the earth, and the inflection is increased by every successive stratum of the atmosphere through which the light passes. In fig. 10, let AA′, BB′, CC′,

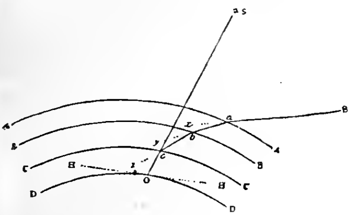


Fig. 10.

represent the boundaries of successive strata, supposed for convenience to have a finite thickness. A ray of light from S, reaching the highest stratum at a, leaves its original direction Sax, and travels in the direction aby; reaching the next stratum at b it is further bent, viz., from direction aby to the direction bz; and at c it is deflected in the direction cO. In its progress from a to O, it has therefore successively moved in the direction of the sides of the polygon abcO; and to the spectator at O, the star from which it proceeded, instead of appearing in its true place at S, will appear to be at S, or in the last direction of the visual ray. Now if AA is the most elevated stratum of the atmosphere into which the ray enters in the direction Sa, it is clear that the whole effect is produced by the atmospherical strata situated below AA, and that the length of Sa is perfectly indifferent; hence the refraction is entirely independent of the distance of the stars, provided they are beyond the limits of the earth's atmosphere.

The decrease of the density of the atmosphere, from the surface of the earth upwards, follows the law of continuity, or takes place by insensible degrees; so that the luminous ray, in traversing the atmosphere, enters at every instant into a denser medium, and is therefore continually brought nearer and nearer to the vertical direction. Hence the true path of the ray is curvilinear, and concave towards the earth, as represented in fig. 11. This is equivalent to the supposition that the thickness of the different concentric strata of uniform density is infinitely small, and that the light, as it successively penetrates each, deviates from its former path by an infinitely small angle, which may be considered as the differential of the refraction, the total amount of which will therefore be obtained by integration. The direction of the ray, when it reaches the eye of the observer, is the tangent to the last portion of its curvilinear path; and the apparent zenith distance of the star will be ZOS, while the real zenith distance is ZOS. The difference of these two angles, namely S′OS, is what is denominated the *Astronomical Refraction*. It is evident that the whole path of the ray is confined to the vertical plane in which the star and the eye of the observer are situated; for the earth and its atmosphere being very nearly spherical, that plane will divide the strata symmetrically; there will, therefore, be no displacement in a lateral direction, *i.e.*, no refraction out of the vertical plane. When the observed star is due north or south, the vertical plane is the plane of the meridian; hence, in meridional observations, the whole of the refraction takes place in declination, while the right ascension remains unaltered.

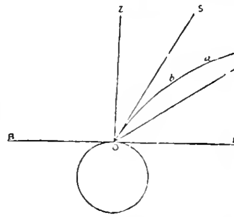


Fig. 11

It is evident that the amount of the refraction is greater in proportion as the observed star is nearer to the horizon; for in this case the luminous rays strike the tangent planes of the atmospherical strata more obliquely, and have besides to traverse a greater extent of atmosphere before they arrive at the eye of the observer. On determining by experiment the refraction at every altitude from zero to 90°, tables of *Refraction* may be constructed, which will furnish the means of discovering the law of its diminution; but as such a process would be exceedingly tedious, and likewise apt to lead to erroneous results on account of the inevitable errors of observation, it is found more convenient to assume some hypothesis for a basis of calculation, and to verify the results which it leads to by comparing them with observation. In regard to media which may be said to be permanent,—such, for instance, as water and glass,—the determination of the refraction is not attended with great difficulty; but the circumstances are greatly altered when we come to make experiments on the atmosphere. In this case the difficulty arises from the incessant changes which the atmosphere is undergoing relatively to its refractive power,—changes which it is impossible for the observer fully to appreciate, inasmuch as he can only determine its physical state within a short distance of the earth, while that of the upper strata remains wholly unknown to him. The refractive power of the atmosphere is affected by its density and temperature. The effects of the humidity are insensible; for the most accurate experiments seem to prove that the watery vapours diminish the density of the air in the same ratio as their refractive power is greater. It is therefore only necessary, even in delicate experiments, to have regard to the state of the barometer and thermometer at the time the observation is made. At a medium density, and at the temperature of melting ice, it was found by Biot and Arago, from a great number of exact experiments, that at any altitude between 10° and the zenith the refraction is very nearly represented by the formula $r = 60''\cdot 6$ tan. $(Z - 3\cdot 25 \times r)$, in which r is the refraction corresponding to a given zenith distance Z. With the exception of the numerical coefficients, this formula was first given by Bradley; but whether it was deduced from theory by that astronomer, or was only empirical, is uncertain. Bradley's formula was $r = 57'' \tan. (Z - 3 \times r)$. When the direction of the luminous rays makes a smaller angle than 10° with the horizon, it becomes indispensable to take into account, in the calculation of the refraction, the law of the variation of the density of the atmosphere at different altitudes,—a law which is subject to incessant variation, from the operation of winds and other causes which agitate the atmosphere, as well as the decrease of temperature in the superior regions. For this reason all astronomical observations which have not refraction directly for their object, or which are not by their nāturo independent of its influence, are made at an elevation exceeding 10°. For lower altitudes it is to be feared that no theory will ever be found sufficiently exact to entitle the observations to much confidence.

[It may be explained here in passing that the refraction of the rays of light in traversing the earth's atmosphere is the cause of *Twilight*, which sensibly lengthens the duration of the day, and prevents a sudden transition from light to darkness on the disappearance of the sun. When the sun is more than 33′ below the horizon, the refraction is not powerful enough to bring his rays sufficiently near the earth to reach our eyes; they pass over our heads, and are irregularly reflected by the molecules of the atmosphere. By this means a portion of the celestial vault is enlightened, while the sun is invisible. This illumination of the upper regions is called the twilight. It commences as soon as objects can be distinguished before sunrise, and terminates when they cease to be visible after the sun has set. The time, however, at which the twilight commences and terminates cannot be assigned with any degree of precision. It is generally supposed to be limited by the depression of the sun 18° below the horizon. Lacaille found the limit in the torrid zone to be between 16° and 17°. According to Lemonnier, it varies in France between 17° and 21°. The duration of the twilight will evidently be longer or shorter according as the inclination of the sun's motion to the horizon is more or less oblique.

Enlargement of sun and moon near horizon.

The apparent enlargement of the sun and moon near the horizon is an optical illusion, connected in some measure with the atmosphere, of which various explanations have been given since the time of Ptolemy. According to the ordinary laws of vision, the celestial bodies, particularly the moon, which is nearest to the earth, ought to appear largest in the meridian, because their distance is then less than when they are near the horizon; yet daily experience proves that the contrary takes place. To an observer placed at E (fig. 12), the visual angle subtended by the moon, in the horizon at M, is somewhat less than that under which she appears in the zenith at O; and this fact, a consequence indeed of her circular motion, is proved by accurate measurement of her diameters in those circumstances by the micrometer. The mean apparent diameter of the moon, at her greatest height, is 31′ in round numbers, but in the horizon she seems to the eye two or three times larger. The commonly received explanation of this phenomenon was first given by Descartes, and after him by Dr Wallis, James Gregory, Malebranche, Huyghens, and others, and may be stated as follows:—The opinion which we form of the magnitude of a distant body does not depend exclusively on the visual angle under which it appears, but also on its distance; and we judge of the distance by a comparison with other bodies. When the moon is near the zenith there is no interposing object with which we can compare her, the matter of the atmosphere being scarcely visible. Deceived by the absence of intermediate objects, we suppose her to be very near. On the other hand, we are used to observe a large extent of land lying between us and objects near the horizon, at the extremity of which the sky begins to appear; we therefore suppose the sky, with all the objects which are visible in it, to be at a great distance. The illusion is also greatly aided by the comparative feebleness of the light of the moon in the horizon, which renders us in a manner sensible of the interposition of the atmosphere. Hence the moon, though seen under nearly the same angle, alternately appears very large and very small. Desaguliers illustrated the doctrine of the horizontal moon by the supposition of our imagining the visible heavens to be only a small portion of a spherical surface, as *mnop* (fig. 12), in which case the moon, at different altitudes, will appear to be at different distances, and will therefore seem to vary in magnitude, as at *m*, *n*, *o*.]

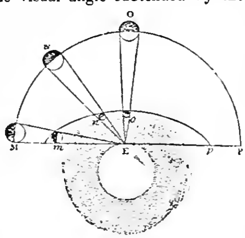


Fig. 12.

Correction being made for refraction, the true position of the sun on the star-sphere can be ascertained day after day; and thus his apparent motions, as we have said, can be determined.

Apparent motion of the sun. The year.

The result of such observations is to show that in a period of about 365 days the sun traverses a great circle of the star-sphere inclined to the equator. This period is called a *year*, and is familiar to all as the period in which the sun's varying positions, alternately north and south of the equator, bring about the circuit of the seasons. For we have already seen that a star to the north of the equator is above the horizon more than half the sidereal day, and at its meridian culmination has an altitude exceeding that of the south point of the equator. When the sun is north of the equator he has a daily arc like that of a star similarly placed, so that day lasts longer than night, and at mid-day the sun pours his heat more directly on the earth than if he were on the equator. In like manner it is shown that, when the sun is south of the equator, night lasts longer than day, and the sun at mid-day has a smaller altitude than if he were on the equator. The result of constant experience shows, that the sun's declination reaches its maximum on the south side of the equator about the 22d of December, when it amounts to 23°·465. From this time it gradually diminishes till about the 21st of March, when the sun reaches the plane of the equator. At this time the days and nights are of equal length all over the earth, and the instant of time at which the sun's centre is in the equatorial plane is called the instant of the equinox. The sun then passes to the northern side of the equator, and his declination or meridional altitude continues to increase till about the 22d of June, when he becomes stationary, and then again shapes his course towards the equator. His maximum declination on the north side of the equator is exactly equal to that on the south, amounting to 23°·465. The sun now continues to approach the equator till about the 24th of September, when he again reaches that plane, and a second equinox succeeds. Continuing still to move in the same direction, he declines from the equator southward, till he reaches his former limit about the 22d of December; and so on continually.

Tropics.

The two small circles of the sphere, parallel to the equator, which pass through the two points where the declination is greatest, are called the *Solstices* or the *Tropics*; that on the northern hemisphere is called the *Tropic of Cancer*, and the other is called the *Tropic of Capricorn*.

These two parallels, which mark the extreme limits of the sun's declination, are, as has just been stated, equally distant from the equator, with regard to which the variations of declination on either side are perfectly symmetrical and uniform.

The observations of the sun's right ascensions and meridional altitudes, which have been made daily during so great a number of years, and under so many different meridians, furnish complete proof that the projection of the sun's orbit is a great circle of the celestial sphere, and that the orbit itself is wholly confined to the same plane.

Ecliptic. The great circle which the sun describes in virtue of his proper motion is called the *Ecliptic.* It has received this name from the circumstance that the moon, during eclipses, is either in the same plane or very near it. These phenomena can, in fact, only happen when the sun, earth, and moon are nearly in the same straight line, and, consequently, when the moon is in the same plane with the earth and the sun. The angle formed by the planes of the ecliptic and equator, which is measured by the arc of a circle of declination intercepted between the equator and **Definitions** tropic, is called the *Obliquity of the Ecliptic.* The two points in which the equator and ecliptic intersect each other are called the *Equinoctial Points;* they are also denominated the *Nodes of the Equator;* and the straight line conceived to join them is the *Line of the Equinoxes,* or the *Line of the Nodes.* The node through which the sun passes on coming from the south to the north of the equator is called the *Ascending Node,* and is usually distinguished by the character ☊; the opposite node is the *Descending Node,* and is marked by ☋. A straight line passing through the centre of the earth, perpendicular to the plane of the ecliptic, is called the *Axis of the Ecliptic,* and the points in which its prolongation meets the sphere are called its *Poles*—these denominations being analogous to those of the axis and poles of the equator. The two small circles of the sphere which pass through the poles of the ecliptic, and are parallel to the equator, are called the *Polar Circles.*

Zodiacal signs. The ecliptic has been divided by astronomers, from time immemorial, into twelve equal parts, called *Signs,* each of which consequently contains 30 degrees. The names and symbols by which they are characterised are as follows :—

North of the Equator.		South of the Equator.	
Aries, ...	♈	Libra, ...	♎
Taurus, ...	♉	Scorpio,..............	♏
Gemini,............	♊	Sagittarius,.........	♐
Cancer, ...	♋	Capricornus, ...	♑
Leo, ...	♌	Aquarius............	♒
Virgo,....	♍	Pisces, ...	♓

In each of these signs the ancients formed groups of stars, which they denominated the *Zodiacal constellations* (*ζώδια, animals*), not confined to the ecliptic, but included within an imaginary belt, extending 9° on each side of it, to which they gave the name of *Zodiac* (*ζωδιακός κύκλος, circle* or *zone of the animals*). The term *sign* is now employed only to denote an arc of 30°, and will probably soon be banished entirely from astronomical tables. It is now seldom used even for tables of the planets. Formerly, to denote that the longitude of a planet is 276° 12′, it was usual to write $9^s\ 6°\ 12'$; or even to employ the characteristic symbol, and to write ♑ 6° 12′, meaning that the planet was 12′ in the 6th degree of Capricornus, or the tenth sign. The latter inconvenient practice is now laid aside, and the signs, when they are employed, are simply distinguished by the ordinal numbers.

As the greater part of the celestial phenomena connected with the planetary system take place either in the ecliptic or in planes not greatly inclined to it, it is found to be most convenient to refer the positions of the planets, and frequently those of the stars also, to that plane. The first point of Aries, which is the technical expression for the intersection of the ecliptic and equator, or the place of the sun at the vernal equinox, is assumed as the origin from which the degrees of the ecliptic, as well as of the equator, are counted from west to east, or in the direction of the sun's annual motion. The angular distance of the sun **Celestial latitude and longitude.** from this point is called his *Longitude,* and the longitude of a star is the arc intercepted on the ecliptic between the same point and a great circle passing through the star perpendicular to the ecliptic. The arc of this circle intercepted between the star and the ecliptic, or, which is the same thing, the complement of the star's distance from the pole of the ecliptic, is called the *Latitude* of the star; so that longitude and latitude bear the same relation to the ecliptic that right ascension and declination bear to the equator.

The sun's motion along the ecliptic is found not to be strictly uniform, a circumstance into which we shall have to inquire more particularly farther on. In this place, let it suffice to notice that the sun is found to move more quickly in winter than in summer, the rate of motion changing from its maximum nearly in mid-winter to its minimum nearly in midsummer, and thence to its maximum again. But at no time does the motion differ greatly from its mean rate of very nearly 59′ in a sidereal day. If we call the mean rate 10,000, then the greatest and least rates of motion are represented by the members 10,336 and 9664 respectively.

The direction in which the sun travels round the ecliptic, and in which longitude is measured, is from west to east, that is, it is contrary to the direction in which the star-sphere rotates.

CHAPTER IV.—*The Solar Day—Equation of Time—The Seasons.*

Since the sun travels thus around the celestial sphere, it is manifest that the successive returns of the sun to the meridian cannot recur after the same interval of time as the successive returns of any given star. If on any day the sun's centre when he is crossing the meridian has a particular position on the star-sphere, then when that point of the star-sphere next returns to the meridian,—that is, one sidereal day later,—the sun has travelled about 1° from that point, moving along the ecliptic in a direction opposed to that in which the star-sphere rotates. The star-sphere must, therefore, rotate a little further round before the sun will be on the meridian. As a convenient first approximation to the actual effects, let us make the supposition that the sun moves along the equator instead of the ecliptic, and that he moves exactly 1° in a sidereal day. In this case he would be exactly 1° from the meridian when the point he had occupied on the meridian the day before had reached the meridian. That point on the star-sphere would have completed the full circuit of 360° of rotation while the sun had completed only 359°, and his diurnal motion being therefore only $=\frac{359}{360}$ of the star-sphere's, it follows that the solar day (or the interval between the sun's successive returns to the meridian) would be greater than the sidereal day in the ratio of 360 : 359. Therefore, the solar day being divided into 24 × 60 minutes, the sidereal day would manifestly be 4 min. shorter.

But as the sun moves in a circle inclined more than 23° to the equator, and as the sun's motion is slightly variable, and the mean rate less than 1° per sidereal day, these relations are not exactly presented.

Let us, as a next approximation, suppose the sun to move uniformly round the equator once in the course of a year of $365\frac{1}{4}$ days, and determine the length of a solar day on this assumption. It is clear that whatever the sun's daily retardation may be, he loses one complete circuit of the heavens in a year of $365\frac{1}{4}$ solar days. In other words, while the sun has been carried round $365\frac{1}{4}$ times by the diurnal rotation, the star-sphere has been carried round $366\frac{1}{4}$ times. Therefore, on our assumption

$$365\tfrac{1}{4} \text{ solar days} = 366\tfrac{1}{4} \text{ sidereal days}$$

$$\text{and a sidereal day} = \frac{365\frac{1}{4}}{366\frac{1}{4}} \text{ solar day}$$

$$23 \text{ h. } 56 \text{ m. } 4 \text{ s., approximately.}$$

This, in fact, indicates roughly the manner in which the mean solar day is connected with the sidereal day. It is only necessary in the above process to substitute the true length of the year for the value $365\frac{1}{4}$ days,—meaning by the year, the year of seasons, measured by the successive returns of the sun to the equator as he crosses that circle with northward motion. But it will not be until we consider the actual nature of the motion by which the sun's annual apparent motion is explained, that we need inquire into the exact relation between the mean solar day and the sidereal day.

Variations of sun's motion.

As the sun moves at a varying rate, it is manifest that the actual solar day measured by the successive returns of the sun to the meridian could not be constant in value, even if the sun moved round the equator. For the excess of a solar day over the sidereal day is caused by the motion of the sun on the star-sphere, and will be therefore greater or less according as the sun's motion on the star-sphere is greater or less. The actual solar day, therefore, exceeding the constant sidereal day by a variable quantity, must necessarily be itself variable. It is greater than the mean in December and January, when the sun is moving at a rate greater than his mean rate, and less in June and July when he moves at a less rate. And it is clear that if at the end of December the moment of the real sun passing the meridian were taken as the beginning of the mean solar day of twenty-four hours, then the next passage of the meridian by the actual sun would occur after the twenty-four hours of mean solar time had elapsed. Day after day the sun would come to the meridian at a later and later hour of mean solar time, until towards the end of March, when, the sun's rate having acquired its mean value, the actual sun would not lag any farther behind. From this time he would gain, until towards the end of June he would come to the meridian at noon of mean solar time. In the remaining half year he would be in advance, that is, he would cross the meridian before noon of mean solar time. Towards the end of September he would have made his greatest advance compared with mean time, and in the remaining quarter of the year he would gradually lose more and more of that gain, until at the end of December he would again cross the meridian at noon of mean solar time.

But besides this cause of variation in the length of the true solar day, there is another depending on the inclination of the sun's apparent path on the heavens to the celestial equator. To conceive the effect of this cause, it is necessary to have regard to the motion of the sun with reference to the equator. The sun describes every day a small arc of the ecliptic. Through the extremities of this arc suppose two meridians to pass; the arc of the equator, which they intercept, is the sun's motion for that day referred to the equator, and the time which that arc takes to pass the meridian is equal to the excess of the astronomical day over the sidereal. But it is obvious that at the equinoxes the arc of the equator is smaller than the corresponding arc of the ecliptic, in the proportion of the cosine of the obliquity of the ecliptic; at the solstices, on the contrary, it is greater in the proportion of the secant of the same obliquity. The astronomical day is diminished in the first case, and lengthened in the second.

Mean sun.

To have a mean astronomical day independent of these causes of inequality, astronomers have supposed a second sun to move uniformly on the ecliptic, and to pass over the extremities of the axis of the sun's orbit at the same instant as the real sun. This removes the inequality arising from the inequality of the sun's motion. To remove the inequality arising from the obliquity of the ecliptic, conceive a third sun to pass through the equinoxes at the same instant with the second sun, and to move along the equator in such a manner that the angular distances of the two suns at the vernal equinox shall be always equal. The interval between two consecutive returns of this third sun to the meridian forms the *mean astronomical day. Mean time* is measured by the number of the returns of this third sun to the meridian; and *true time* is measured by the number of returns of the real sun to the meridian.

Equation of time.

The arc of the equator, intercepted between two meridian circles drawn through the centres of the true sun and the imaginary third sun, when reduced to time, is what is called the *Equation of Time.* This will be rendered plainer by the following diagram.

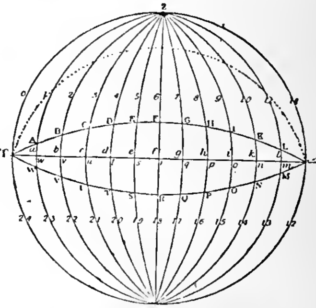


FIG. 13.—Motions of real and mean Sun.

Let Z ♈ z ♎ (fig. 13) be the star-sphere; Zz its axis; *abcde*, &c., the equator; ABCDE, &c., the northern half of the ecliptic from ♈ to ♎, on the side of the globe next the eye; and MNOP, &c., the southern half on the opposite side from ♎ to ♈. Let the points at A, B, C, D, E, F, &c., mark off equal portions of the ecliptic gone through in equal times by the real sun, and those at *a*, *b*, *c*, *d*, *e*, *f*, &c., equal portions of the equator described in equal times by the fictitious sun; and let Z ♈ *z* be the meridian.

As the real sun moves obliquely in the ecliptic, and the fictitious sun directly in the equator, any point between ♈ and F on the ecliptic must be nearer the meridian Z ♈ *z*, than the corresponding point on the equator from ♈ to *f*, that is to say, than the point whose distance from ♈ is expressed by the same number of degrees; and the more so, as the obliquity is greater; and therefore the true sun comes sooner to the meridian every day whilst he is in the quadrant ♈ F, than the fictitious sun does in the quadrant ♈ *f*; for which reason the solar noon precedes noon by the clock, until the real sun comes to F, and the fictitious to *f*: which two points being equidistant from the meridian, both suns will come to it precisely at noon by the clock.

Whilst the real sun describes the second quadrant of the ecliptic FGHIKL from Cancer to ♎, he comes later to the meridian every day than the fictitious sun moving through the second quadrant of the equator from *f* to ♎; for the points at G, H, I, K, L, being farther from the meridian, their corresponding points at g, h, i, k, l, must come to it later; and as both suns come at the same moment to the point ♎, they come to the meridian at the moment of noon by the clock.

In departing from Libra through the third quadrant, the real sun going through MNOPQ towards ♑ at R, and the fictitious sun through $mnopq$ towards r, the former comes to the meridian every day sooner than the latter, until the real sun comes to R, and the fictitious to r, and then they come both to the meridian at the same time.

Lastly, as the real sun moves equably through STUVW, from R towards ♈, and the fictitious sun through $stuvw$, from r towards ♈, the former comes later every day to the meridian than the latter, until they both arrive at the point ♈, and then they make it noon at the same time with the clock.

It is now easy to conceive the effect of taking into account the variable motion of the sun in his annual circuit of the ecliptic. The effect already explained as arising from this cause, on the supposition that the sun moved in the equator, must simply be added to that just shown to arise from the obliquity of the ecliptic.

Let us combine the two causes, starting from December 31, on the assumption (near enough to the truth for our present purpose), that the sun moves most rapidly when at his greatest southerly declination. The effect due to variation of the sun's motion may be called A, and that due to the obliquity of the ecliptic may be called B; and each may be considered positive or negative according as, considered alone, it sets the real sun later or earlier than the mean sun.

We find, then, from January 1 to March 31, A and B both positive, A increasing from 0 to its maximum, B passing from 0 through its maximum to 0 again. All this time, then, $A+B$ is positive. At the beginning $A+B=0$. About the middle of February B has its maximum value, and A a value less than its maximum; at March 31, B is zero and A has its maximum value.

From April 1 to June 30, A is positive and B negative, A diminishing from its maximum to zero, B passing from 0 through its maximum negative value to 0 again. At the beginning, then, of this quarter, $A+B$ is positive and equal to the maximum value of A. In the middle of May, B has its maximum negative value, and A has a value less than its maximum positive value. The maxima due to A and B being not far from equality, it follows that $A+B$ is now negative, and therefore some time before this $A+B$ must have passed through the value 0. At the end of the quarter $A+B$ is again 0, because $A=0$ and $B=0$.

From July 1 to September 30, A is negative and B positive, A increasing from 0 to its maximum negative value, B passing from zero through its maximum positive value to zero again. Hence, at the beginning of the quarter $A+B=0$; at the end $A+B=$ the maximum negative value of A. But about the middle of August, B has its maximum positive value while A has not its maximum negative value; hence at this time $A+B$ is positive, and therefore between then and September 30, $A+B$ vanishes.

Lastly, from October 1 to December 31, both A and B are negative, A passing from its maximum value to zero, and B from zero to its maximum value, and thence to zero again. Throughout the quarter, then, $A+B$ is negative. About the middle of November $A+B$ is the sum of the maximum value of B and a value of A less than the maximum. At the end of the quarter $A+B=0$.

Owing to the fact that the time when the sun moves most rapidly follows by a few days the date (December 21) when the sun is at his greatest distance from the meridian, the dates above given are not strictly correct. The equation of time, or $A+B$, is zero nearly midway between December 21 and the end of the year, or about Christmas day, and it vanishes again on or about April 16, June 16, and September 1st. The equation of time has four maxima. On February 11, the real sun is later than the mean sun by a maximum interval of 14 min. 31 sec.; on May 14, the real sun is earlier than the mean sun by a maximum interval of 3 min. 53 sec.; on July 16, the real sun is later than the mean sun by a maximum interval of 6 min. 13 sec.; and lastly, on November 3, the real sun is earlier than the mean sun by a maximum interval of 16 min. 19 sec.

The inclination of the ecliptic to the equator results necessarily, as already mentioned, in a difference of seasons. The seasons.
When on the equator, the sun, like an equatorial star, is above the horizon during one-half of the day, and below the horizon during the other half. When he is north of the equator he is above the horizon for more than half the day, and reaches a higher altitude at noon than when on the equator. When south of the equator he is below the horizon for more than half the day, and does not reach so great an altitude at noon as when he is on the equator. As he is perceptibly the source of light and heat, it follows that when he is north of the equator we receive (in our northern latitudes), more light and heat than when he is on the equator, and so much the more as his northerly declination is greater; while when he is south of the equator we receive less light and heat than when he is on the equator, and so much the less as his southerly declination is greater. These results are equally accounted for whether we regard the earth as fixed, and the sun as really travelling round the heavenly sphere on his inclined path, or whether we suppose the sun to be fixed, and the earth to travel around him on a correspondingly inclined path after the manner illustrated in fig. 14. Here, while the earth

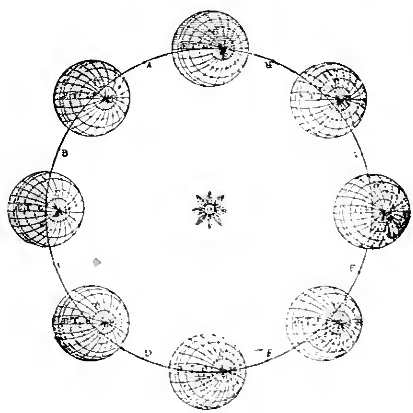


FIG. 14.—Diagram illustrating the Seasons

goes round the sun in the order of the letters A, B, C, D, its axis preserves its obliquity and always continues parallel to its first direction. At c the north pole inclines towards the sun, and brings all the northern places more into the light than at any other season of the year. But when the earth is at g, the opposite point of the orbit, the north pole declines from the sun, and a less portion of the northern hemisphere receives his light and heat. At *a* and *e* the axis is perpendicular to the plane of the orbit, so that the poles are situated in the boundaries of the illuminated hemisphere, and, the sun being directly over the equator, the days and nights are equal at all places. In this figure Æ is the terrestrial equator, T the tropic of Cancer, the dotted circle the parallel of London, U the arctic or north polar circle, and P the north pole, where all the meridians or hour-circles meet. The spectator is supposed to be placed at the pole of the ecliptic.

It is also manifest that if the earth circles around S, as in fig. 14, the observed phenomena of apparent solar motion will be precisely the same as though the sun circled around the fixed earth. Let us follow the earth round from the position *a*, noting how the sun would appear to move on the ecliptic, and also how the length of day would be affected by the varying position of the earth's axis with respect to the sun. When the earth is at *a*, the beginning of Libra, about the 20th of March, the sun, as seen from the earth, appears at the beginning of Aries in the opposite part of the heavens, the north pole is just coming into light, and the sun is vertical to the equator, which, with all its parallels, is divided into two equal parts by the circle which forms the boundary between the dark and illuminated hemispheres, and therefore the days and nights are equal all over the earth. As the earth moves in the ecliptic, according to the order of the letters A, B, C, D, &c., the north pole P comes more and more into the light, and the days increase in length at all places north of the equator Æ. When the earth comes to the position between B and C, or the beginning of Capricorn, the sun, as seen from the earth, appears at the beginning of Cancer about the 21st of June; and the north pole of the earth inclines towards the sun, so as to bring into light all the north frigid zone, and more of each of the northern parallels of latitude in proportion as they are farther from the equator. As the earth advances from Capricorn towards Aries, and the sun appears to move from Cancer towards Libra, the north pole recedes from the light, which causes the days to decrease and the nights to increase in length till the earth comes to the beginning of Aries, and then they are equal as before,—the boundary of light and darkness cutting the equator and all its parallels equally. The north pole then goes into the dark, and does not emerge till the earth has completed a semi-revolution of its orbit, or from the 22d of September till the 20th of March. Similar changes occur, *mutatis mutandis*, in the southern hemisphere.

It may be well to advise the reader not to allow his mind to be led astray by the *proportions* indicated in such pictures as fig. 14. It is absolutely impossible to illustrate the seasons, either by diagrams or by the use of a globe, without introducing incorrect relative dimensions; but by combining two sets of pictorial illustrations, the mental error apt to arise from the study of such pictures as fig. 14 may be got rid of. Thus, after carefully studying the relations illustrated in that figure, the reader should turn to Plate XXVII., and after noting that the figure of the earth there shown is the same as that in fig. 14 (held so as to have G*g*F uppermost), he should endeavour to picture to himself such a figure of the earth as is shown in the plate, travelling around the path EE′, but so reduced in dimensions that its whole disk would have a diameter less than the hundredth part of that of the small white disk, at the centre of the plate, which represents the sun. It will then be instructive to extend this method to Mars, as figured in Plate XXVII., carrying this planet (after first imagining his disk reduced 5000 times) round his path MM′, with constant axial pose. The planets pictured in Plate XXVIII. can be dealt with in like manner. From a careful study of the two plates, with special reference to the indicated scales, the general relations of the entire solar system can be inferred, and to some degree conceived. But for the purpose of actually picturing these relations to his mind, the reader may conveniently use Sir J. Herschel's illustration, as follows:—Choose any well-levelled field. On it place a globe 2 feet in diameter to represent the sun; Mercury will be represented by a grain of mustard seed, on the circumference of a circle 164 feet in diameter for its orbit; Venus a pea, on a circle 284 feet in diameter; the earth a [somewhat larger] pea, on a circle of 430 feet, Mars a rather large pin's head, on a circle of 654 feet; the asteroids grains of sand, in orbits of from 1000 to 1200 feet; Jupiter a moderate-sized orange, on a circle of half a mile; Saturn a small orange, on a circle of $\frac{4}{5}$ths of a mile; Uranus a full-sized cherry, on a circle more than $1\frac{1}{2}$ miles; Neptune an extra-sized cherry, on a circle of $2\frac{1}{2}$ miles in diameter.

CHAPTER V.—*Apparent Motions of the Moon and Planets—Parallax.*

We have seen that while the stars remain fixed, to all appearance, on the celestial concave, the sun circuits around a great circle of the star-sphere, moving always in one direction, and at a rate which, though variable in different parts of the circuit, does not vary largely, and is constant for each part of the ecliptic. Moreover, to ordinary observation, continued for periods of a few years, the sun's path in the heavens appears to remain always the same, and to bear the same relation to the poles and equator of the rotating star-sphere.

But we have now to consider bodies which neither remain fixed like the stars, nor move in a constant apparent path like the sun.

The moon is the most noteworthy of these bodies, because of her apparent size and brightness, and also because of the remarkable changes of appearance which she presents according to her varying position with reference to the sun. When she is seen near him in the heavens, she appears always like a fine sickle of light, with the horns turned away from him. When she is in the part of the heavens directly opposite to the sun, she appears with a full orb. When she is exactly midway between the point occupied by the sun and that opposite to him, she appears as a semicircle of light, with the convexity towards the sun; and in positions intermediate to these she appears with more or less of her circle illuminated, according as she is nearer to or further from the point directly opposite the sun. All this corresponds with what would happen if the moon were an opaque orb nearer to the earth than the sun, and illuminated by him. Moon's phases.

Now, when the moon is watched, even for a few hours only, she is found to be travelling on the star-sphere in the same direction as the sun (and, like him, on a path inclined to the equator), but much more rapidly than the sun travels. It is impossible to watch the moon completely round the heavens, because she is found to pass close to the sun once in each circuit, and when very near to him cannot be seen. But while she is visible, she travels continuously in one direction, and when she reappears, after having been for a day or two lost in the sunlight, she is seen to have shifted her place as though, during that interval, she had travelled continuously onwards.

The moon's circuit of the star-sphere is found to be completed in about $27\frac{1}{3}$ solar days. But her circuit, considered with reference to the sun, occupies a longer interval. Thus, suppose we observe her when she is opposite to the sun, or "full." Then she is in the same (or very nearly the same) place among the stars about $27\frac{1}{3}$ days later. But in the meantime the sun has advanced along the ecliptic Sidereal month.

about 27°, and the point now directly opposite the sun has, of course, advanced by the same amount. The moon has, therefore, to travel further on before she is again exactly opposite the sun. It is found that this happens rather more than 2 days later; or in other words, that the interval between successive full moons amounts to about $29\frac{1}{2}$ days. This interval is called a *lunar month*, or *lunation;* the period during which the moon completes the circuit of the heavens being called a *sidereal month.* The lunation is also called a *synodical month.*

Lunar orbit. The path in which the moon travels is found to be inclined at an angle of about 5° 9′ to the ecliptic. But continued observation shows that the path, while retaining this inclination, shifts slowly in position—the points where it intersects the ecliptic gradually retrograding (on the whole) until, in the course of about $18\frac{1}{2}$ years, they have made a complete circuit of the ecliptic. It is also found that the moon moves, like the sun, with variable velocity in her apparent course. The parts of her path, however, where she moves most and least rapidly are not fixed in position like the corresponding parts of the sun's apparent circuit, but advance, travelling round in 8·85 years.

It follows, from the varying position of the moon's apparent path with respect to the ecliptic, that her range north and south of the equator is variable. When she crosses the ecliptic, at or near the two points where the ecliptic crosses the equator, the inclination of her path to the ecliptic is either added to or subtracted from the inclination of the ecliptic to the equator, so that her range in declination is, in one case, 23° 27′ + 5° 9′, or 28° 36′, and in the other, 23° 27′ − 5° 9′, or 18° 18′. When she crosses the ecliptic at or near the two points where the ecliptic is furthest from the equator, the inclination of her path to the equator is nearly the same as that of the ecliptic, the two paths—the ecliptic, or sun's path, and the apparent lunar path—crossing the equator at different points.

Thus far there is nothing in the observed celestial motions which opposes itself to the belief that the earth is a fixed centre around which the celestial bodies are carried—the star-sphere by the diurnal rotation, the sun circling round the earth in his yearly course on the ecliptic, and the moon in her monthly (lunar) course on a variable path, and both these orbs partaking in the diurnal rotation of the star-sphere, just as bodies in a moving vehicle partake in the motion of the vehicle, even though they may also be in motion among themselves.

One circumstance in the moon's apparent motions serves, however, to show that the bodies thus far observed lie at different distances, and falls properly to be considered in this place, seeing that the attention of astronomers must first have been directed to it when they were engaged in determining the moon's motions.

The earth being, as we have seen, a globe, and the sun and moon being apparently carried round this globe by the daily rotation, which is uniform, it would naturally occur to astronomers that, if these motions take place around the centre of the earth, they cannot appear altogether uniform as seen from the eccentric position of an observer placed anywhere on the surface. The stars, indeed, seem to be carried uniformly round, but that has been explained as due to their enormous distance. The sun moving manifestly within the stellar concave, and the moon travelling

Lunar parallax apparently within the sun's orbit (as may be inferred from her phases), it might well be that their motions would be found affected by the eccentricity of the observer's position. Suppose, for example, that the centre of the earth is at P, fig. 15, and the observer is at E, and let EM_h represent a line of sight from E to the moon's centre when she is in the horizon (refraction being neglected). Then a line PM_h from the centre of the earth to the moon is inclined to the horizon line EM_h; and if we draw Pm_h parallel to EM_h so that either line represents the direction of the moon as observed from E, we see that, if she were observed from P, she would appear *raised* by the angle included between the lines PM_h and Pm_h. From E, then, she is seen lower down than her true geocentric position by the angle M_hPm_h; and similarly it is seen that, if the moon be at M, the direction EM in which she is seen is lower down

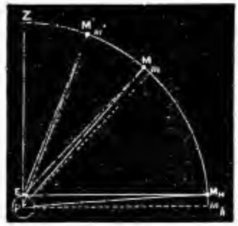


Fig. 15.—Diagram illustrating Lunar Parallax.

—that is, is less inclined to the horizon line Em_h—by the angle EMP, or its equal, MPm; if the moon were at M′, the displacement would be equal to the angle EM′P, and only when she is at the zenith Z does her direction EZ agree with her geocentric direction PZ. Her observed path from horizon to horizon, when she rises high in the south, but does not reach the zenith, will be as the path $m_1m_3m_5$ (fig. 16), where her geocentric path is as $M_1M_3M_5$. This will happen if she is near enough to the earth for the angle EM_hP (fig. 15), to be appreciable; and all that has here been said of the moon is equally true of the sun.

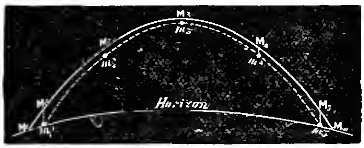


Fig. 16.—Observed and Geocentric Paths of the Moon.

or any other celestial body. But in their case no appreciable displacement occurs (at least none which the earlier modes of observation could indicate). In the case of the moon the displacement is very marked, being found to amount nearly to a degree when the moon is on the horizon. Such displacement is called *parallax.* Thus, when any celestial body is at M (fig. 15), the angle EMP (or MPm), between the geocentric direction PM, and the apparent direction EM, is called the parallax of the body. When the celestial body is at M_h, so that its true direction is horizontal, the parallax EM_hP, is manifestly greater than for any other position of the body at the same distance from P. This maximum parallax is called the *horizontal parallax*, and may be defined as the maximum angle subtended by the earth's radius, as supposed to be seen from the body.

It may be noticed, in passing, that if the geocentric distance of a celestial body $= d$, the earth's radius $= r$, and the horizontal parallax $= p$, then Parallax.

$$\sin p = \frac{r}{d} \qquad (1).$$

This is manifest from fig. 15, where $\sin PM_hE = \frac{EP}{PM_h}$.

Again, in the case of a body at M, using the same symbols, and calling the apparent altitude MEM, a, and the parallax p', we have

$$p' = MPm$$

$$\sin p' = \frac{EP \sin EPm}{MP} = \frac{r \sin a}{d}$$

That is, $\sin p' = \sin. a \ \sin. p \quad . \quad . \qquad (2).$

For every celestial body, except the moon, the parallax is so small that its arc-measure may be substituted for its sine; hence, for (1) and (2) we may write

$$p = \frac{r}{d} \quad . \ . \ . \ . \ (3); \quad \text{and } p' = p \sin. a \quad . \ . \ (4),$$

for all the heavenly bodies except the moon.

From the observed parallactic displacement of the moon it is manifest, apart from the lunar phases, that the moon's orbit relatively to the earth lies within the sun's.

We have now, however, to consider bodies which, if they be regarded as moving around the earth, must move in orbits of very singular shape.

Planetary motions.

While observing the stars, which maintain apparently a constant position on the uniformly rotating star-sphere, the ancients early noted five bodies, which seem to travel among the stars like the sun and moon, but not always in one direction. To these bodies they gave the name of planets, or wanderers (a term which also included the sun and moon, so that there were seven in all). Three could be seen sometimes throughout the night, sometimes in the

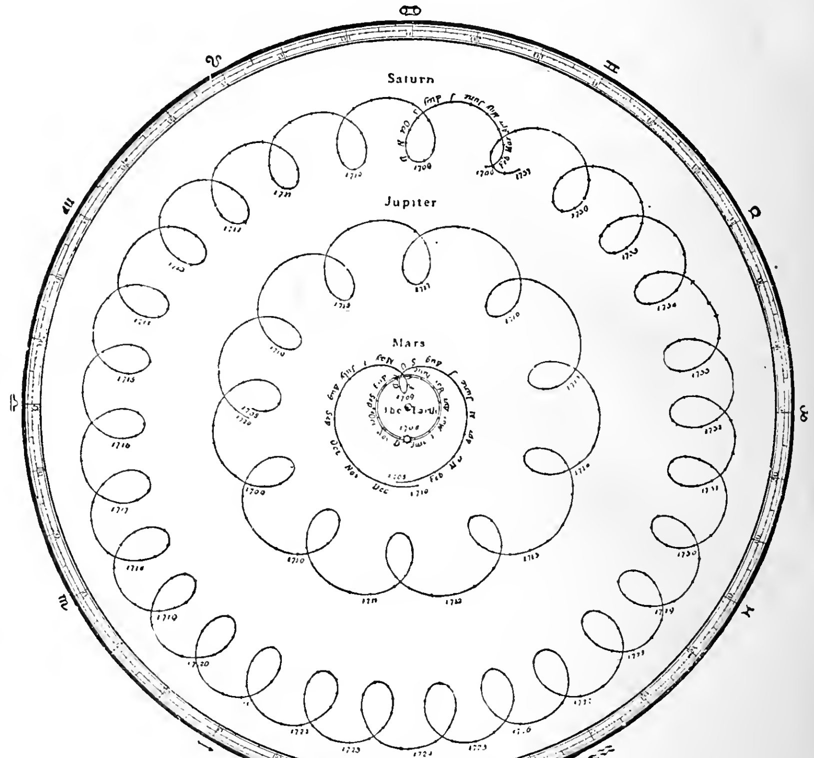


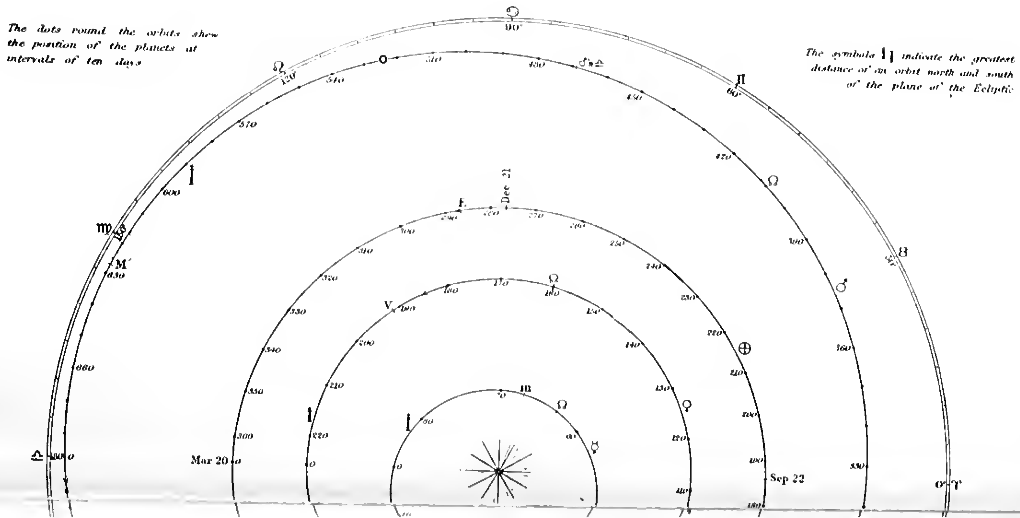
FIG. 17.—The Motion of Saturn, Jupiter, and Mars with respect to the Earth.

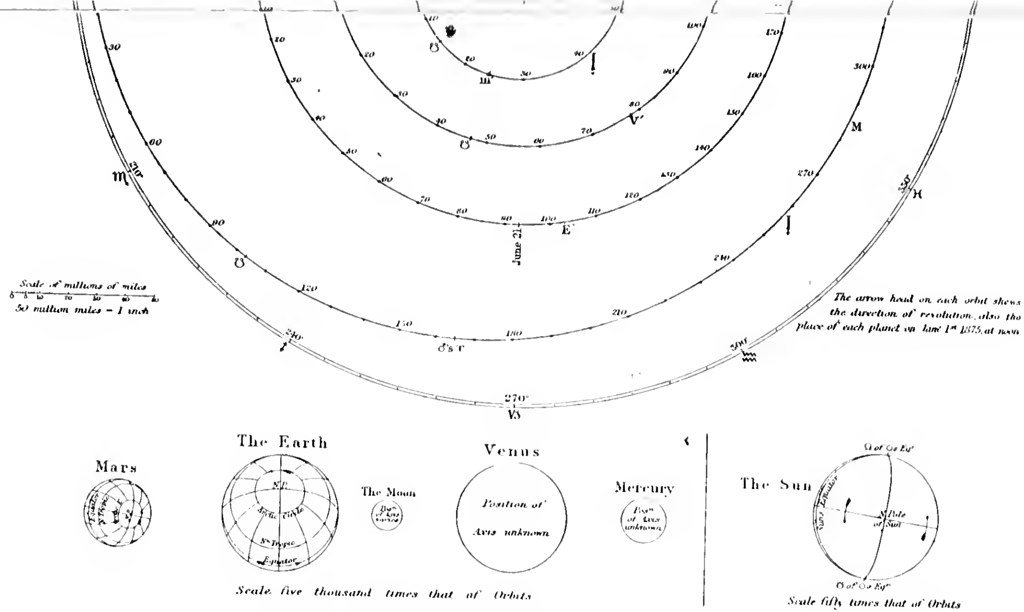
morning, sometimes in the evening. To these were given the names Saturn, Jupiter, and Mars; and careful observation showed that these bodies, when visible all through the night, always travel among the stars in a direction contrary to that of the sun's yearly and the moon's monthly motion, but that this retrograde motion continues only for a certain length of time, being preceded and followed by an advancing motion, which is greater in amount than the retrograde motion, so that, on the whole, these bodies are carried round in the same direction as the sun and moon. The nature of these apparent motions will best be understood by referring to fig. 17, and supposing an observer on the earth to watch Saturn, Jupiter, and Mars respectively traversing the twisted paths there indicated, in the order shown by the dates, the loops being supposed to lie very nearly but not quite in the level of the paper, which represents the plane of the ecliptic. But this peculiarity was noticed, that when any planet was at the outermost parts of the successive loops (as, for instance, when Jupiter was as where the date 1712 is placed on his loops), the planet was lost to view in the sun's rays, lying nearly in the same part of the sky, whereas, when a planet was at

ASTRONOMY

ORBITS OF MARS (♂), THE EARTH (⊕), VENUS (♀), AND MERCURY (☿)

Nodes ☊ ☋, Nearer Apses M E V m





The Earth, Mars, and the Sun, are shewn in their true axial position)

R.A. Proctor del^t

J. Bartholomew sculp^t

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the innermost parts of the successive loops (as, for instance, when Saturn was as where the date 1710 is placed on his loops), the planet was always opposite the sun. This exact agreement between the times when the planet and sun were in *conjunction* or in *opposition*, and the tracing out of the apparent planetary loops, should have suggested, it would seem, a connection between the sun and planets; for we see from fig. 17, that if the earth were the centre of the sun's motion, and each of the three planets had its looped path wherein to travel around the earth, there could be imagined no reason why the planet's motion round its loops should synchronise with the sun's motion on his nearly circular path.

This view should have been confirmed by the apparent motions of two other planets, Venus and Mercury, which were found to remain always within a certain apparent distance from the sun, never being seen on the part of the sky opposite to him. Venus, the brighter, was observed to have the greater range on either side of the sun, moving from about 46° on the east of the sun, when she is seen as the Evening Star, to about the same distance on the west of the sun, when she is seen as the Morning Star; while Mercury's greatest range on either side of the sun is more variable, being sometimes as great as 27°, and at other times not greater than 18°. So far as the motion of these planets on the star-sphere could be traced (by using such an instrument as in fig. 9 to determine their right ascension and declination), they appeared to follow looped paths, somewhat like the outer planets; but the nearer and farther parts of the successive loops were *both* lost to view, the two planets being always too near the sun's place in the heavens to be visible when tracing those parts of their paths.

The five planets were found to travel always within a certain range on either side of the ecliptic. Venus, which has the greatest range, being sometimes as far as 9° north, or 9° south of the equator. A zone, or band, having the ecliptic for its central circle, and bounded by circles 9° north and south of the ecliptic, so as to be 18° wide, came thus to be regarded as a sort of celestial roadway, outside of which the planets were never seen. This zone was called the *zodiac*, and it was probably in connection with the planetary rather than the solar motions that the zodiacal constellations were originally formed.

Considering the observed relation between the motions of all the five planets and those of the sun, it is remarkable that any of the astronomers of old time should have regarded the earth as the common centre of solar and planetary movement. It is true that, by supposing each planet to travel around a centre which itself travelled round the earth, the looped paths of the planets might be explained; of this no further evidence need be given than fig. 17, where it is manifest that the loops are such as might be traced by bodies moving round small circles, these being carried round the central earth in large circles. Yet the synchronism between all the movements in these small circles and the sun's supposed motion round the earth was left wholly unexplained by that theory. If the Ptolemaic system could have been really presented as it is commonly pictured (fig. 18), it would have compared not unfavourably with the simplicity of the modern system. But the circles depicted in this figure for the paths of Saturn, Jupiter, Mars, Venus, and Mercury, represent only the paths of moving centres, round which those bodies were supposed to travel, each in a circle of its own, and all synchronising in these subordinate movements with the sun circling in his special orbit; while the movements of the moon, travelling in a different circle, neither corresponded in any way with those of the sun, nor, like his, seemed to influence any of the planetary motions.

Ptolemaic system.

Far more reasonable was the ancient Egyptian system, by some described as identical with, but in any case closely

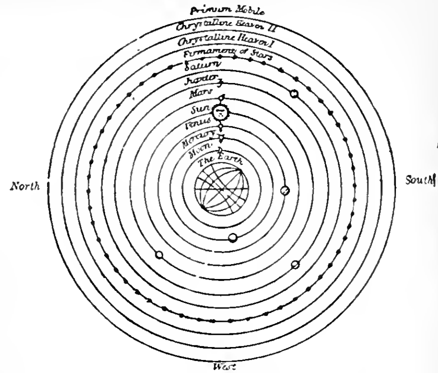


Fig. 18.—Ptolemaic System.

resembling in essentials, the system of Tycho Brahe, shown in fig. 19. Here the earth is the centre of the motions of the sun and moon, but all the planets circle around the sun, Venus and Mercury moving in orbits passing between the earth and sun, while Mars, Jupiter, and Saturn move in orbits passing outside the earth. All the observed movements, and all the peculiarities of the observed relations, were fully explained by this system. Indeed, a

Tychonic system.

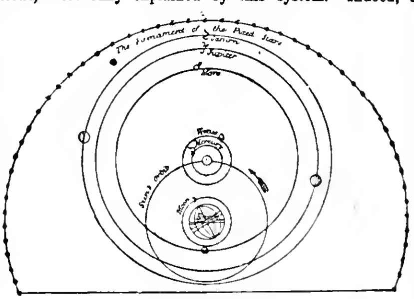


Fig. 19.—Tychonic System.

little consideration will show that the geometrical relations are precisely the same for such a system as is depicted in fig. 19, as they would be in the system pictured by removing the circle showing the sun's orbit in fig. 19, and substituting a circle of equal size around the sun as centre and passing therefore through the centre of the earth. It is not too much to say that Tycho's system is not only fully equal to the Copernican in its fitness to explain the observed relations, but that, until the law of gravitation had been established, the arguments for the Tychonic system, modified so as to correspond to Kepler's discovery of the shapes of the different orbits, were almost equal in weight to those used by the disciples of Copernicus. The slight advantage of the Copernican system in point of simplicity was counterbalanced by the difficulty of accepting, in those days, the belief that the stars lie at so inconceivably vast a distance that the motion of the earth in an enormous orbit around the sun (for the sun was known even then to lie many millions of miles from ns) produces no perceptible change in the appearance and rotation of the star-sphere. That the whole span of the earth's orbit was as a mere point compared with the distance of the stars, so that the earth on one side of the sun was, in effect, at the centre of the star-sphere, while it was equally at the centre when on the opposite side, or many millions of miles from its former position, was not unreasonably regarded by Tycho Brahe as scarcely credible.

CHAPTER VI.—*Copernican System—Kepler's Laws—Gravitation—The Laws of the Solar System.*

Leaving the rotation of the star-sphere out of consideration, the apparent motions of the sun, the moon, and the five planets known to the ancients, are most naturally explained by regarding the sun as the centre around which Mercury, Venus, the earth, Mars, Jupiter, and Saturn revolve in that order as to distance, while the moon revolves round the earth. For though there are thus two centres of motion yet only a small body travelling in a relatively small orbit is set revolving round the earth, now presented as a subordinate orb in the system; and the whole family, including the moon, are set revolving around the sun, for the moon accompanies the earth in her circuit. In the Tychonic system the sun, though presented as a subordinate orb, because travelling round the earth, was yet set as the centre round which all the planets revolved. Either system was, however, altogether more reasonable than the Ptolemaic, in which all the planets were supposed to move around imaginary centres. Copernicus well indicated the superiority of his system when he said, "We find in this arrangement what can be discerned in no other scheme, an admirable symmetry of the universe, an harmonious disposition of the orbits. For who could assign to the lamp of this beautiful temple a better position than the centre, whence alone it can illuminate all parts at once? Here the sun, as from a kingly throne, sways the family of orbs that circle around him."

Theory of Copernicus. It is hardly necessary to point out that the arrangement suggested by Copernicus explains the motions of the sun and moon as readily as the system which presents both these bodies as moving around the earth. Peculiarities in the motions of the earth and moon are indeed left unaccounted for by a simple theory of uniform circular motion around the sun and earth as centres; but so they were in the Ptolemaic system until eccentric and epicyclic movements were provided, and these were as admissible in the Copernican theory as in the Ptolemaic. It is easy to show also that the general motions of the planets—their progressions, stations, retrogressions, &c.—were explained by the Copernican system. Thus, let S (fig. 20) be the sun, $E_1E_2E_3$, &c., the earth's orbit, $P_1P_2P_3$, &c., part of the orbit of a superior planet; and when the earth is at E_1 let the planet be at P_1, so that the planet is in opposition to the sun when at P_1. Starting from these positions, suppose that the earth and planet in the same interval of time pass over the arcs E_1E_2 and P_1P_2, E_1E_2 being greater than P_1P_2. Then obviously E_2P_2 is inclined to E_1P_1; and if these two lines are produced they will meet beyond P_1. Let them be produced beyond their point of intersection O to K_1, K_2 respectively; then the observer on the earth sees the planet in direction E_1K_1 when the earth is at E_1, and in direction E_2K_2 when the earth is at E_2. Hence the planet appears to have moved in direction K_1K_2 or backwards, though it has really moved in direction P_1P_2. Carrying the earth on with her more rapid motion, it is obvious that we come to a part E_3E_4 of the earth's orbit, where her motion is so inclined to the line of sight E_3P_3 or E_4P_4 to the planet, that the effect of the earth's more rapid motion is neutralised, and these lines of sight are parallel. At this time, then, the planet neither seems to advance nor retrograde, but appears to be *stationary*. After this it is manifest that

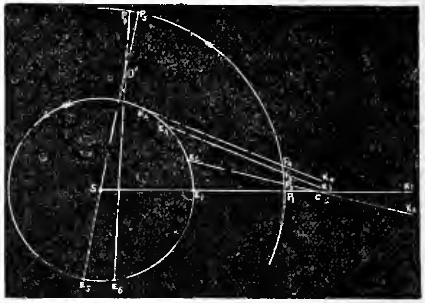


FIG. 20.—Diagram illustrating Apparent Paths of Planets.

the planet will seem to advance, and with gradually increasing rapidity, until when the earth is at E_5 and the planet at P_5 (the planet, however, being then in *conjunction* with the sun, and therefore invisible), the planet lies in direction E_5P_5 far in advance of K_1, K_2. At this time the unseen planet is advancing most rapidly, because the earth's motion, as from E_5 to E_6, and the planet's motion, as from P_5 to P_6, *combine* to cause the advance of the direction of the line E_6P_6,—the centre round which for the moment the direction-line to the planet is turning lying at O′ between the earth and planet, instead of beyond the planet, as at O in the position first considered. Passing from conjunction to opposition, the planet goes through similar changes in a reverse order. Its progressive motion gradually diminishes, till it becomes stationary; thence the planet retrogrades through opposition to its next station; and so on continually, the total result of its motion in each synodical revolution being a progression from west to east. We see also that the planet is in opposition when in the middle of its retrograde arc, while it is in conjunction when in the middle of its larger arc of progression. All this corresponds precisely with the observed relations.

The same reasoning applies to the case of an inferior planet. In fact, we may employ the same figure for this case as for that of a superior planet. Thus, suppose $P_1P_2P_3$ (fig. 20) the earth's orbit, and $E_1E_2E_3$, &c., that of an inferior planet, and let the motions be as in the former case, then the same lines represent the direction-lines, only the observer looks along these lines in the contrary direction. Now we see that the direction-lines P_1E_1, P_2E_2 are carried *backwards* as viewed from P_1, P_2, until they reach the parallel positions P_3E_3, P_4E_4, at which time the observer on P sees the planet E at a stationary point. After that the direction-lines are carried forward, until, when the earth is at P_5 and the interior planet at E_5, this planet is seen in direction P_5E_5, or far in advance of its former direction P_1E_1. And at this time, as is seen by the position of the lines P_5E_5 and P_6E_6, the inferior planet is advancing most rapidly. In fact, all the motions of an inferior planet viewed from a superior one are precisely the same as those of the superior planet viewed from the inferior one, but are traced out on opposite parts of the heavens,—a thesis which needs no other proof than the fact, that the line of sight from the inferior to the superior planet is also the line of sight from the superior to the inferior planet; so that, whatever point the superior planet viewed from the inferior appears to occupy in the star-sphere at any moment, the point directly opposite is that occupied by the inferior planet as viewed from the superior.

The only difference in the apparent motions of the inferior planet is that resulting from the position of this planet with respect to the sun. When P_1 is viewed from E_1 (fig. 20), it is seen directly opposite the sun; but E_1 viewed from P_1 lies in the same direction as the sun, and is therefore invisible. This corresponds with the observed fact that Venus and Mercury are in conjunction with the sun, not only in the middle of their advancing arcs, but also in the middle of their arc of retrogradation.

But although the Copernican theory explains the general features of planetary motion, it could not, as originally advanced, explain those features which had rendered necessary the eccentrics and the subordinate epicycles of the Ptolemaic system. It was known to Copernicus that the earth does not move uniformly in a circle around the sun as centre, but on an eccentric path with varying velocity. He might, therefore, reasonably assume that the other planets have paths similarly eccentric, and move with varying velocities. But he thought it necessary to explain the planetary motions by uniform motion in circles, using such contrivances to save appearances as the Ptolemaic system had rendered familiar to astronomers. Suppose, for example, that S (fig. 21) is the sun, A the place of a planet when at its greatest distance from the sun, and A′ its

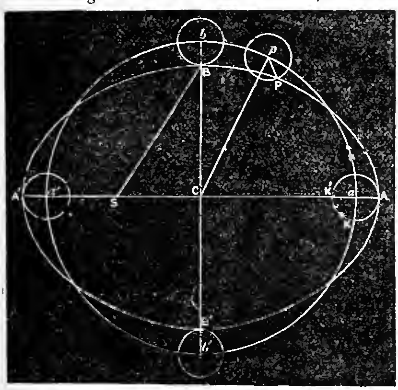


Fig 21.

place when nearest to the sun, C being the bisection of AA′; draw a circle $aba'b'$ with centre C, and any radius less than CA, and with a as centre draw circle AKK′; then if a point revolve round the circle AKK′ in that direction *in the same time* that the centre of this circle travels round the circle $aba'b'$ in that direction, the point will trace out an ellipse, having C as centre. This is easily proved. For let $Ca = R$, $aA = r$, and put $CA = R + r = a$ and $CK' = R - r = b = CB$. When the moving point is at P, let the centre of the small circle be at p. The angular velocities being equal, pC and pP are inclined to aC at the same angle; let this be α. Then the co-ordinates of P parallel to CA and Cb are—

$$x = (R + r)\cos.\alpha = a\cos\alpha$$
$$y = (R - r)\sin.\alpha = b\sin.\alpha$$

Whence $b^2x^2 + a^2y^2 = a^2b^2$, the equation to an ellipse having C as centre, CA and CB as semi-axes. S will not be the focus of this ellipse, unless $SB = CA$; and even then the velocities will not be those observed of a planet revolving around S in the elliptic orbit ABA′B′—for the time from A to B will be one-fourth of the period, whereas in the case of a planet the time from A to B bears to the period the ratio of the area ASB to the area of the ellipse, a ratio exceeding one-fourth. Nevertheless, observed appearances were to some degree explained by the motion illustrated in fig. 21, seeing that at A, or when farthest from the centre S, the tracing point moves most slowly, having there the difference of the velocities due to the two circular motions; while at A′ the point moves most quickly, having there the sum of these velocities. And when Copernicus advanced his theory, observations had not been made with sufficient exactness to prove the insufficiency of such an explanation in any case save that of the moon's motion round the earth.

Tycho Brahe, however, having completed a series of observations of Mars, the nearest planet moving on a manifestly eccentric orbit, Kepler tested the theory of Copernicus in order to ascertain whether any ellipse, described as ABA′B′ in fig. 21, could account for the observed positions of the planet. It will be seen that, while the points S, A, and A′ in his inquiry were fixed, and therefore C also fixed, the point a might be taken nearer or further from A within certain limits, these limits being determined by the observed fact, that when near B and B′ the planet was not nearer to C by a distance Bb exceeding a certain moderate amount, such as the probable error of Tycho Brahe's observations permitted Kepler to assume.

Laws of Kepler

It was after trying nineteen such arrangements, and rejecting them one after the other as he found them disproved by Tycho Brahe's observations, that Kepler was led at last to abandon the attempt to explain the motions of Mars by combining circular uniform motions. Passing to the ellipse, as the curve which Mars appeared to follow, and testing various empiric laws of motion in an elliptic orbit, he at length lighted upon the actual relation, presented in his first two laws as true for all the planets, though actually proved only in the case of Mars. The laws are these—

1. *Every planet moves in an elliptical orbit, in one focus of which the sun is situated.*

2. *The line drawn from the sun to a planet, or the radius vector of the planet, sweeps over equal areas in equal times.*

The second law may be thus illustrated. Let ABA′B′ (fig. 22) be the elliptic path of a planet about the sun S, in the focus of the ellipse whose axes are ACSA′ and BCB′

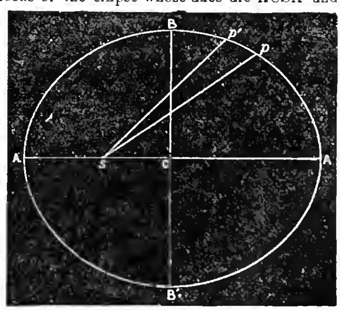


Fig 22.

Let P be the period in which the planet performs the complete circuit of its orbit, and let T be the time occupied by the planet in traversing any arc pp' of its orbit. Then joining Sp, Sp',

T : P : : sectorial area pSp' : area of the ellipse ABA′B′.

It remained now to discover if any law connected the periods in which the planets pursue their different paths. He did not at first try to connect the periods and the distances by any direct numerical relation, probably because he had recognised in the second law the probable existence of geometrical relations. But after many years of inquiry he arrived at the conclusion, that probably the required law connected the powers of the numbers representing the periods and the distances. It affords a strange evidence of the ponderous nature of Kepler's movements, that after this idea had occurred to him, ten weeks, instead of some ten minutes, elapsed before he had verified it. The law connecting the periods and distances—Kepler's third law—is this—

3. *The square of the numbers representing the periodic times of the planets vary as the cubes of the numbers representing their mean distances.*

Or thus, If D, d be the distances of any two planets, and P, p their respective periods, then

$$P^2 : p^2 :: D^3 : d^3 . \quad . \quad . \quad . \quad (1).$$

From this law we can deduce a convenient relation between the velocities in circular orbits (a relation holding approximately for the mean velocities in orbits nearly circular like those of the planets). Let V, v be the velocities in the orbits of planets whose distances are D, d respectively; then, obviously,

$$= c\frac{D}{P}, \text{ and } v = c\frac{d}{p}, \text{ where } c \text{ is some constant.}$$

$$\frac{V}{v} = \frac{D}{d} \cdot \frac{p}{P} = \frac{D}{d} \cdot \frac{d^{\frac{3}{2}}}{D^{\frac{3}{2}}} = \frac{d^{\frac{1}{2}}}{D^{\frac{1}{2}}} \quad . \quad . \quad . \quad (2),$$

that is, *the velocities in circular orbits vary inversely as the square roots of the distances.*

And also,

$$\frac{V}{v} = \frac{P^{\frac{2}{3}}}{p^{\frac{2}{3}}} \quad \frac{p}{P} = \frac{p^{\frac{1}{3}}}{P^{\frac{1}{3}}} \quad . \quad . \quad . \quad . \quad (3),$$

that is, *the velocities in circular orbits vary inversely as the cube roots of the periods.*

It may be well also to notice the following relation between the angular velocities in such orbits. Let these, for the respective planets just dealt with, be Ω and ω. Then,

$$\frac{\Omega}{\omega} = \frac{p}{P} = \frac{d^{\frac{3}{2}}}{D^{\frac{3}{2}}}$$

(It is manifest that $\frac{\Omega}{\omega} = \frac{p}{P}$, because the periods must be inversely proportional to the angular velocities with which they are uniformly described.)

The three laws of Kepler are approximately true for bodies circling around the same centre. They do not apply to bodies circling around different centres. For instance, the moon's distance and period could not be used for p and d in (1). Nor could the distance and period of any one of the satellites of Jupiter pair, according to Kepler's third law, with the distance and period either of our moon or of any planet; but the motions of the satellites were found to accord with the law when compared together.

Gravitation. It was probably the recognition of this fact which first put astronomers on the track of the theory that the law depends on some force residing in the centres round which different bodies move. Newton certainly had given attention to this influence before he dealt with the moon's attraction earthwards as a case of the action of terrestrial gravity. But, be that as it may, it is certain that so soon as the action of the earth's attraction on the moon had been demonstrated by him he extended the law of gravitation to all cases of motion around a central orb. It then became clear that the laws of Kepler are consequences of the general law of gravitation—the law, viz., that

Every particle of matter in the universe attracts every other particle with a force varying directly as the masses, and inversely as the square of the distances.

The proof of the law of gravitation divides itself into three distinct parts:—

First, The proof that the force acting on the moon is equal to the force of terrestrial gravity, reduced as the inverse squares of the distances of the moon and of a point on the earth's surface, from the centre of the earth.

Secondly, The proof that a system of bodies circling around a central body like the sun, attracting them with a force inversely proportionate to their respective distances, would obey the laws of Kepler, or some modification of those laws, giving results according with the motions actually observed.

Thirdly, The proof that the mutual attractions of the several members of any system, and the attractions of members of one system on bodies belonging to another system (as, for instance, of the sun upon the moon regarded as a dependent of the earth), would result in such perturbations from the paths due to the attractions of the central body as are observed actually to take place.

Neither the second nor the third of these arguments can be given here, though certain simple relations involved in them, as also certain consequences, will be mentioned.

The first part of the proof is altogether simple.

The moon is, roughly, at a distance from the earth's centre equal to 60 radii of the earth, and therefore the earth's moving force is less on her than on a body at the earth's surface as 1 to 3600. Now, regarding the moon's orbit as a circle, it is easily shown that, if at any moment the earth's attraction ceased to act, so that for the next second the moon moved on a tangent to her present course, her distance from the earth's centre at the end of that second would be rather more than $\frac{1}{19}$th of an inch greater than at the beginning of the second. It follows that her fall towards the earth in a second on account of the earth's attraction amounts to rather less than $\frac{1}{19}$ of an inch. But the fall of a body near the earth's surface is about $16\frac{1}{10}$ feet, or nearly 193 inches per second, or nearly 193×19 times greater than the fall of the moon towards the earth per second; that is, about 3600 times greater. In other words, the moon is attracted towards the earth precisely as she would be if the force of gravity acting on bodies near her surface ruled her also, the law of variation of the force with distance being that of the inverse squares.

The second part of the proof is simple for cases of circular motion of various bodies around a common centre. The law of the equable description of areas, indeed, is true for a body moving around a centre attracting according to any law, since it simply implies that there is no force perpendicular to the radius vector. It is easily seen that the increase of the area during any exceedingly short interval of time depends solely on the distance attained by the moving body during that interval from the line representing the position of the radius vector at the beginning of the interval, this distance being measured in a perpendicular direction; for the area of a triangle is measured by the base × perpendicular. Accordingly, if, during the short interval of time, there is no force tending to increase or diminish the perpendicular distance of the moving body from the original radius vector, as compared with the distance which would have been attained had no force at all acted, the area described will be the same as though no force had acted. But if no force acted, the body would move uniformly in a straight line, and the radius vector would sweep out equal areas, because triangles having the same vertex and their bases in one straight line have areas proportional to their bases. Hence, under a force not tending to change at any instant the rate of the moving body's perpendicular departure from the radius vector, the areas swept over in equal times will be equal. But a central force acts always in the direction of the radius vector, and is therefore a force of the kind supposed. Accordingly, a body travelling round an attracting centre will move so that the radius vector sweeps over equal areas in equal times.

Suppose next two bodies describing circles with uniform motion in periods P, p, at distances D and d from a centre of attraction whose force varies inversely as $(\text{distance})^2$. It is required to determine the relation between P, p, D, and d. The velocities of the bodies are $c\frac{D}{P}$ and $c\frac{d}{p}$, where c is some constant. Represent these velocities by V and v respectively for convenience; also call the forces acting on the bodies respectively F and f, which we know to be proportional to $\frac{1}{D^2}$ and $\frac{1}{d^2}$. Clearly, if a body moving in any direction receives a very slight impulse in a direction at right angles to its motion, its direction of motion will be changed through an angle proportional directly to the impulse and inversely to the velocity of the body. So that if we regard the attractive force on the planets as acting by a succession of small impulses, the momentary variation of direction is proportional to $\frac{F}{V}$, and the time, therefore, of completing any given change of direction is proportional to $\frac{V}{F}$. Now, in times P, p respectively, the two planets have their direction changed through four right angles. Hence

$$P : p :: \frac{V}{F} : \frac{v}{f} :: \frac{D}{P} \cdot D^2 : \frac{d}{p} \cdot d^2 .$$

That is, $P^2 : p^2 :: D^3 : d^3$, which is Kepler's third law.

Let us now compare the periods P and p of two bodies, moving at distances D and d, around unequal centres of force, which exert attractions A and a respectively at equal distances, so that instead of the forces F and f actually exerted on the two bodies being proportional to $\frac{1}{D^2}$ and $\frac{1}{d^2}$, they are proportional to $\frac{A}{D^2}$ and $\frac{a}{d^2}$ respectively.

Then the above proportion becomes

$$P : p :: \frac{D}{P} \cdot \frac{D^2}{A} : \frac{d}{p} \cdot \frac{d^2}{a}$$

That is, $$P^2 : p^2 :: \frac{D^3}{A} : \frac{d^3}{a}, \quad \text{or } P^2 \propto \frac{D^3}{A},$$

corresponding to a law which may be thus expressed: *The squares of the periods about different centres of force vary directly as the cubes of the distances, and inversely as the attractions of the centres of force at a unit of distance.*

This relation which is true for elliptic orbits, is general for all systems, and gives the means of comparing the masses of different systems. But it is necessary to observe a modification which Kepler's third law and this extension of it have to undergo to make them strictly true (as regards, at least, the unperturbed motions of the planets). The masses of the planets, though very small, yet bear definite relations to the sun, and instead of considering each planet as swayed by the sun's mass, we must regard each as swayed by the sum of its own mass and the sun's, supposed to be gathered at the sun's centre. Thus we must regard the planets as revolving around centres of different attractive energy; Jupiter round a centre equal in mass to Jupiter and the sun; Saturn round a centre equal in mass to Saturn and the sun, &c. Instead, then, of the ratio $\frac{(\textit{mean distance})^3}{(\textit{period})^2}$ being constant for the solar system, we find that this ratio for any given planet is proportional to the sun's mass added to that planet's. Extending the law to bodies travelling around different centres, it runs as follows:—

If a body of mass m revolves round a centre of mass M in time P, and at a mean distance D, and another body of mass m' revolves round another centre of mass M′ in time P′, and at a mean distance D′, then

$$\frac{D^3}{P^2(M+m)} = \frac{D'^3}{P'^2(M'+m')}$$

This law enables us at once to compare the sums of the masses when we know the mean distances and periods. For it may be written

$$\frac{M+m}{M'+m'} = \frac{D^3}{D'^3} \cdot \frac{P'^2}{P^2}$$

Also, where m and m' are both small, compared with M and M′ respectively, the law becomes simplified into

$$\frac{M}{M'} = \frac{D^3}{D'^3} \cdot \frac{P'^2}{P^2}$$

These laws suffice to enable us to deduce from the observed periods of the planets their true mean distances, velocities, &c., and from the observed period of the satellite of any planet, the ratio of the planet's mass to the sun's. The eccentricities of the planetary orbits are partly deduced from observation, and partly from the law of the equable description of areas. The inclinations of the orbits, and, of course, all elements relating to the planets' own globes, their dimensions, compression, inclination, rotation, and so on, are obtained by telescopic observation and measurement.

The following tables of elements are brought into one place for convenience of reference, and include many items of information referred to in the chapters on the several planets. The illustrative Plates numbered XXVII. and XXVIII. should be studied in combination with the table of planetary elements.

Stability of the Solar System.

We may conveniently add here to the laws of planetary motion presented above the two following theorems (enunciated by Lagrange, but first established by Laplace).

First, *If the mass of each planet be multiplied by the square of the eccentricity, and this product by the square root of the mean distance, the sum of the products thus formed will be invariable.*

Secondly, *If the mass of each planet be multiplied by the square of the tangent of the orbit's inclination to a fixed plane, and this product by the square root of the mean distance, the sum of the products thus formed will be invariable.*

These laws ensure the stability of the system. It is true that the whole eccentricity, if it could by any possibility fall on any one planet (except Jupiter or Saturn), would cause the planet's orbit to interfere with the orbits of other planets, or even, in the case of a small planet, to intersect the sun's globe. Yet the interchange of eccentricities can never lead to this result. In fact, the sum of the products $(\textit{mass}) \times (\textit{eccentricity})^2 \times (\textit{mean distance})^{\frac{1}{2}}$ for Jupiter and Saturn will always largely exceed the sum of all such products for the remaining planets.

The fixed plane from which the inclination is to be measured, in the second law, is nearly identical with the plane of Jupiter's orbit. Its inclination to the ecliptic is about 1° 35½′, and the longitude of the node (in 1850) was about 104° 21′. Comparing these values with the corresponding elements on next page, we see that the inclination of the planetary orbits would have a smaller mean value if estimated from the invariable plane than they had as estimated from the plane of the ecliptic.

General Elements of the Solar System. Epoch, January 0[d] (noon), 1850.

Elements.

Name	Symbol	Distance from the Sun in Miles. Mean.	Greatest.	Least.	Mean distance—Earth's as 1.	Eccentricity.	Sidereal Revolution in Days.	Synodical Revolution in Days.	Mean daily Motion.
Mercury,....	☿	35,392,000	42,669,000	28,115,000	0·387099	0·205618	87·9693	115·877	14732″·419
Venus, ...	♀	66,134,000	66,586,000	65,682,000	0·723332	0·006833	224·7008	583·920	5767·668
Earth, ...	♁	91,430,000	92,963,000	89,897,000	1·000000	0·016771	365·2564	..	3548·193
Mars, ...	♂	139,311,000	152,304,000	126,318,000	1·523691	0·093262	686·9797	779·936	1886·518
Asteroids,.	(1) (33) (127) &c.	200,000,000 to 315,000,000	215,000,000 to 370,000,000	164,000,000 to 276,000,000	2·200000 to 3·500000	0·04 to 0·34	1200· to 2400·	...	...
Jupiter,. . .	♃	475,692,000	498,639,000	452,745,000	5·202798	0·048239	4332·5848	398·887	299·129
Saturn, ...	♄	872,137,000	920,973,000	823,301,000	9·538852	0·055996	10759·2198	378·090	120·455
Uranus, ...	♅	1,753,869,000	1,835,561,000	1,672,177,000	19·182639	0·046578	30686·8208	369·656	42·233
Neptune,...	♆	2,745,998,000	2,771,190,000	2,720,806,000	30·036970	0·008720	60126·7200	367·488	21·406

Name.	Longitude of Perihelion.	Annual Variation.	Same referred to Vernal Equinox.	Longitude of Ascending Node.	Annual Variation.	Same referred to Vernal Equinox.	Inclination of Orbit.	Annual Variation.	Diameter. Apparent at Mean Distance from Earth.	Diameter. In Miles.
Mercury, . ..	75° 7′ 0″·0	+ 5″·81	+0′ 55″·91	46° 33′ 3″·3	−10″·07	+40″·03	7° 0′ 8″·2	+0″·18	6″·90	3,058
Venus, ...	129 23 56·0	− 3·24	−0 47·14	75 19 4·2	−20·50	+29·60	3 23 30·8	+0·07	16·94	7,510
Earth, ...	100 21 40·0	+11·24	+1 1·34	...	−50·10	...	...	...	...	7,926
Mars, ...	333 17 50·5	+15·46	+1 5·56	48 22 44·8	−25·22	+24·88	1 51 5·1	−0·01	6·46	4,363
Asteroids,....	...	...	...	...	...	...	...	...	...	...
Jupiter,....	11 54 53·1	+ 6·65	+0 56·75	98 54 20·5	−15·90	+34·20	1 18 40·3	−0·23	37·91	84,846
Saturn, ...	90 6 12·0	+19·31	+1 9·41	112 21 44·8	−19·54	+30·56	2 29 28·1	−0·15	17·52	70,136
Uranus, ..	168 16 45·0	+ 2·28	+0 52·38	73 14 14·4	−36·05	+14·05	0 46 29·9	+0·03	3·91	33,247
Neptune, ...	47 14 37·3	Unknown	Unknown	130 6 51·6	Unknown	Unknown	1 46 59·0	Unknown	2·80	37,276

Name.	Volume. Earth's as 1.	Mass. Earth's as 1.	Density. Earth's as 1.	Light received from Sun at Perihelion.	Light received from Sun at Aphelion.	Compression.	Gravity at Surface. Earth's as 1.	Bodies fall in one Second.	Time of Rotation upon Axis.	Inclination of Equator to Orbit.	Longitude of the Vernal Equinox.
								ft.	h. m. s.	° ′ ″	° ′ ″
Mercury, .	0·058	0·065	1·12	10·58	4·59	...	0·432	6·953	24 5 28 ?	?	?
Venus, ...	0·855	0·885	1·03	1·94	1·91	...	0·982	15·805	23 21 15 ?	50 + ?	?
Earth, ...	1·000	1·000	1·00	1·034	0·967	[illegible]	1·000	16·095	23 56 4	23 27 24	180 0 0
Mars, . .	0·168	0·108	0·70	0·524	0·360	[illegible]	0·387	6·229	24 37 23	28 27	79 15
Asteroids,. .	...	...	...	...	...	...	...	...	...	...	...
Jupiter,. .	1233·205	300·860	0·24	0·0408	0·0336	[illegible]	2·611	45·024	9 55 26	3 5 30	314
Saturn, ...	696·685	89·692	0·13	0·0123	0·0099	[illegible]	1·141	18·364	10 29 17	26 48 40	167 4 5
Uranus, . .	74·199	12·650	0·17	0·0027	0·0025	...	0·716	11·524	9 30 ??	?	165 25 ?
Neptune, ...	105·575	16·773	0·16	0·0011	0·0011	...	0·756	12·168	...	?	175 40 ?

ELEMENTS OF THE MOON. EPOCH, 1ST JANUARY 1801.

(Earth's equatorial diameter is taken as 7925·8 miles.)

Mean longitude of moon at epoch	118° 17′ 8″·3
Do. node	13° 53′ 17″·7
Do. perigee	266° 10′ 7″·5
Mean distance from the earth (earth's radius 1)	60·2634
Same in miles	238,818
Maximum distance in miles	252,948
Minimum do. do.	221,593
Eccentricity of orbit	0·05490807
Mean equatorial horizontal lunar parallax	57′ 2″·7
Maximum do. do.	1° 1′ 28″·8
Minimum do. do.	53′ 51″·5
Moon's mean apparent diameter	31′ 5″·1
Moon's maximum do.	33′ 30″·1
Moon's minimum do.	29′ 20″·9
Moon's diameter in miles	2159·6
Moon's surface in square miles	14,600,000
Moon's diameter (earth's equatorial diameter as 1)	0·2725
Earth's equatorial diameter (moon's as 1)	3·670
Moon's surface (earth's as 1)	0·0742
Earth's surface (moon's as 1)	13·471
Moon's volume (earth's as 1)	0·0202
Earth's volume (moon's as 1)	49·441
Moon's mass (earth's as 1)	0·01228
Earth's mass (moon's as 1)	81·40
Density (earth's as 1)	0·60736
Density (water's as 1, and earth's assumed = 5·7)	3·46
Gravity, or weight of one terrestrial pound	0·16547
Bodies fall in one second in feet	2·65
Inclination of axis	1° 30′ 11″·3

Mean inclination of orbit	5° 8′
Maximum do. do.	5° 13′
Minimum do. do.	5° 3′
Synodical revolution in days	29·53059
Sidereal do. do.	27·32166
Tropical do. do.	27·32156
Anomalistic do. do.	27·55460
Nodical do. do.	27·21222
Maximum evection	20′ 29″·9
Maximum variation	35′ 42″·0
Maximum annual equation	11′ 12″·0
Maximum libration in latitude	6° 44′
Do. do. in longitude	7° 45′
Maximum total libration (from earth's centre)	10° 16′
Maximum diurnal libration	1° 1′ 28″·8
Surface of moon never seen (whole as 10,000, and diurnal libration neglected)	4198
Surface seen at one time or other do. do.	5802
Do. never seen, if diurnal libration be taken into account	4111
Do. seen at one time or other do	5889
Mean revolution of nodes (retrograde) in days	6793·391
Do. do. do. in years	18·5997
Mean regression of nodes per annum	19° 21′ 18″·3
Mean regression of node between successive conjunctions of sun and rising node	18° 22′ 3″·2
Mean interval between such conjunctions in days	346·607
Mean revolution of perigee (advancing) in days	3232·575
Do. do. in years	8·8505
Mean advance of perigee per annum	40° 40′ 31″·1
Do. do. between successive conjunctions of sun and perigee	45° 51′ 23″·7
Mean interval between such conjunctions in days	411·767

Elements of Jupiter's Satellites.

No.	Sidereal Revolution.	Distance in Radii of Jupiter.	Inclination of orbit to Jupiter's equator.	Diameter.		Mass, that of Jupiter being 1.
				Apparent.	In miles.	
	d. h. m.		° ′	″		
1	1 18 20	6·05	0 7	1·02	2352	0·000017328
2	3 13 4	9·62	1 6	0·91	2099	0·000023235
3	7 3 43	15·35	5 3	1·49	3436	0·000088497
4	19 16 32	26·99	0 24	1·27	2929	0·000042659

Elements of Saturn's Satellites.

No.	Sidereal Revolution.	Distance in Radii of Saturn.	Diameter in miles (?).	Eccentricity.	Discoverer.
	d. h. m.				
1	0 22 37	3·360	1000	0·06889	Sir W. Herschel.
2	1 8 53	4·312	...	...	Do.
3	1 21 18	5·339	500	0·0051	J. D. Cassini.
4	2 17 41	6·839	500	0·02	Do.
5	4 12 25	9·552	1200	0·02269	Do.
6	15 22 41	22·145	3300	0·029223	C. Huyghens.
7	21 7 7	28·	...	...	W. Bond.
8	79 7 53	64 359	1800	0·115	J. D. Cassini.

Elements of Uranus's Satellites.

No.	Sidereal Revolution.	Distance in Radii of Uranus.	Maximum Elongation.	Discoverer.
	d. h. m.		″	
1	2 12 28	7·44	12	W. Lassell.
2	4 3 27	10·37	15	Do.
3	8 16 55	17·01	33	Sir W. Herschel.
4	13 11 6	22·75	49	Do.

Elements of Neptune's Satellite.

Sidereal Revolution.	Distance in Radii of Neptune.	Maximum Elongation.	Discoverer.
d. h. m. 5 21 8	12·00	″ 18	W. Lassell.

The following are the elements of Saturn's ring system according to the best authorities:—

Longitude of ascending node on ecliptic	167° 43′ 29″
Inclination	28° 10′ 22″
Exterior diameter of outer ring, in miles . ..	166,920
Interior do. do. do.	147,670
Exterior do. inner ring do.	144,310
Interior do. do. do.	109,100
Interior do. dark ring do.	91,780
Breadth of outer bright ring do.	9,625
Breadth of division between the rings do. ...	1,680
Breadth of inner bright ring do. ...	17,605
Breadth of dark ring do. ...	8,660
Breadth of system of bright rings do. ...	28,910
Breadth of entire system of rings do. ...	37,570
Space between planet and dark rings do. ...	9,760

CHAPTER VII.—*The Sun—Sun Spots—Rotation of the Sun—His Physical Constitution and Surroundings—Prominences—Corona—Zodiacal Light.*

The sun, the central and ruling body of the planetary system, and the source of light and heat to our earth and all the members of that system, is a globe about 852,900 miles in diameter. So far as observation extends, his figure is perfectly spherical, no difference having been observed between his polar and spherical diameters. It has been well remarked, indeed, by Sir G. Airy, that if any observer could by ordinary modes of measurement satisfy himself that a real difference existed between the diameters, that observer would have proved the inexactness of his own work; for the absence of any measurable compression comes out as the result of comparisons between thousands of observations of the sun's limbs made at Greenwich and other leading observatories. The volume of the sun exceeds the earth's 1,252,700 times. His mean density is almost exactly one-fourth of the earth's, and his mass exceeds hers about 316,000 times. Gravity at the surface of the sun exceeds terrestrial gravity about 27·1 times, so that a body dropped from rest near the sun's surface would fall through 436 feet in the first second, and have acquired a velocity of 872 feet per second.

Sun spots.

Viewed with the naked eye, the sun appears only as a luminous mass of intense and uniform brightness; but when examined with the telescope, his surface is frequently observed to be mottled over with a number of dark spots, of irregular and ill-defined forms, constantly varying in appearance, situation, and magnitude. These spots are occasionally of immense size, so as to be visible even without the aid of the telescope, and their number is frequently so great that they occupy a considerable portion of the sun's surface. Sir W. Herschel observed one in 1779, the diameter of which exceeded 50,000 miles, more than six times the diameter of the earth; and Scheiner affirms that he has seen no less than fifty on the sun's disk at once. Most of them have a deep black nucleus, surrounded by a fainter shade, or *umbra*, of which the inner part, nearest to the nucleus, is brighter than the exterior portion. The boundary between the nucleus and umbra is in general tolerably well defined; and beyond the umbra a stripe of light appears more vivid than the rest of the sun.

The discovery of the sun's spots has been attributed to Fabricius, Galileo, and Scheiner, and has been claimed for the English astronomer Harriot. Amidst these conflicting pretensions it is perhaps impossible to arrive at the truth; but the matter is of little importance; the discovery is one which followed inevitably that of the telescope, and an accidental priority of observation can hardly be considered as establishing any claim to merit.

Sun's rotation.

The solar spots furnish an extensive subject of curious speculation. They are, first, interesting on account of their establishing the fact of the rotation of the sun, and affording the means of determining its period. Let M, M′, M″, fig. 23, be the successive positions of a spot on the surface of the sun on different days. Then, correction being made for the earth's advance during these days, M, M′, M″ will represent the apparent path of the spot on the sun's disk. This path, as thus corrected, is in general an oval slightly differing from an eclipse; and it is found that all the spots observed at the same time describe similar and parallel curves. They also return to the same relative positions in the same time, and their period is about 27⅓ days.

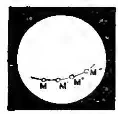


Fig. 23.

The paths described by the spots undergo very considerable changes, according to the season of the year at which they are observed. About the end of November and beginning of December they appear simply as straight lines, M*m*, M′*m*′, M″*m*″ (fig. 24), along which the spots move in

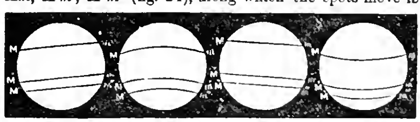


Fig. 24. Fig. 25. Fig. 26. Fig. 27

Diagrams showing motion of sun spots at different seasons.

the direction M*m*; that is, they enter on the eastern and disappear on the western edge of the sun's disk, and the points at which they disappear are more elevated, or nearer the north pole of the ecliptic than those at which they enter. After a certain time the lines M*m*, &c., begin to assume a curved appearance. During the winter and spring the convexity of the ovals is turned towards the north pole of the ecliptic; but their inclination, or rather the inclination of the straight lines joining their extreme points, to the plane of the ecliptic continues to diminish, and about the beginning of March disappears; so that the points at which they seem to enter and leave the sun's disk are equally elevated, as in fig. 25. From this time the curvature of the ovals diminishes; they become narrower and narrower till about the end of May or beginning of June, when they again appear under the form of straight lines (fig. 26): but their inclination to the ecliptic is now precisely in a contrary direction to what it had been six months before. After this they begin again to expand, and their convexity is now turned towards the south pole. Their inclinations also vary at the same time, and about the commencement of September they are seen as represented in fig. 27; the points at which they enter and disappear being again equally elevated. After this period the ovals begin to contract and become inclined to the ecliptic, and by the beginning of December they have exactly the same direction and inclination as they had the previous year.

These phenomena are renewed every year in the same order, and the same phases are always exhibited at corresponding seasons. Hence it is evident that they depend on a uniform and regular cause, which is common to all of them, since the orbits described by the various spots are exactly parallel, and subject in all respects to the same variations. The true explanation of the phenomena was early recognised by Galileo, who maintained that the spots belong to the surface of the sun, and that the sun uniformly revolves round an axis inclined to the axis of the ecliptic.

From four different combinations of equations, derived from eleven observations of the same spot, Delambre computed the following table of the elements of rotation:—

No.	Node.	Inclination.	Revolution.	Synodic Revol.
1	80° 45′ 7″	7° 19′ 17″	25 0h 17m	26d 4h 17m
2	79 21 35	7 12 37	...	...
3	80 33 40	7 16 33	...	...
4	79 47 55	7 29 4	...	...
Mean	80 7 4	7 19 23	Diurnal motion 14°·394	

With regard to observations of the sun's spots, for the purpose of determining the rotation, Delambre remarked that he attached little value to them,—first, because it is impossible to make them well; and secondly, because (as he erroneously supposed) they could only lead to results of little importance. He discussed a hundred different spots, each observed at least three times by Messier, and deduced thirty different determinations of the elements of rotation. The more he multiplied his calculations, the more certain he became of the impossibility of a good solution; of which, indeed, there is no other chance than in a compensation of errors, little probable on account of their enormous magnitudes. These discrepancies have been accounted for in recent times, chiefly through the labours of Mr Carrington. It had been suspected that the spots, besides partaking of the general motion of the solar globe, have also proper motions occasioned either by displacement or by a change of form. Carrington not only succeeded in proving that both these causes operate, but also in recognising systematic proper motions of the spots at rates depending on their solar latitude. It would not be possible to assign definitely the nature of such proper motions, simply because we do not know the normal rotation rate of the sun; and therefore we are compelled, in describing Carrington's results, to speak of varying rotation rates, although it can hardly be doubted that the sun's globe, as a whole, has a definite rate of rotation, and that all the seeming variations from this rate are due to proper motions of the spots. Adopting, however, the only available method of describing Carrington's results, the following table represents the various rotation rates for different solar latitudes in both hemispheres:—

Deg.	Sun's Rotation Period. d.	h.	m.	Rotation per Day
50 N. lat.	27	10	41	787
30	26	9	46	824
20	25	17	8	840
15	25	9	10	851
10	25	3	29	859
5	25	0	42	863
0 Equator	24	2	11	867
5 S. lat.	24	23	18	865
10	25	5	35	856
15	25	13	31	845
20	25	17	52	839
30	26	12	50	814
45	28	11	0	759

It is noteworthy that in each southern latitude the rotation is less than in the corresponding northern latitude, yet the difference is too small to admit of our attaching at present any considerable importance to this indication. Taking the mean between the results for the northern and southern hemispheres, Mr Carrington has deduced the following empiric formula for the rotation rates in different solar latitudes —

Let ξ be the angle through which a part of the sun in latitude λ rotates in one day; then

$$\xi = 14^\circ\, 25' - 165' \sin.^{\frac{7}{4}} \lambda$$

Spörer, who has made similar observations, deduces the law

$$\xi = 16^\circ{\cdot}8475 - 3^\circ{\cdot}3812\, (\sin.\lambda + 41^\circ\, 13')\,.$$

The following elements have been deduced from the results by Carrington and Spörer (for the year 1869):—

Elements.	Carrington.	Spörer.
Longitude of node of solar equator	73° 57′	74° 37′
Inclination of solar equator	7 15	6 57
Mean diurnal rotation	14 18	14 26 64
Mean rotation period.........	25d·38	25d·234

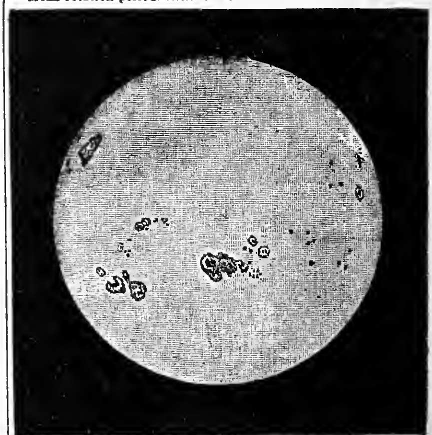


Fig. 28.—Sun Spots seen Sept. 25, 1870.

The general appearance of the sun's disk when much

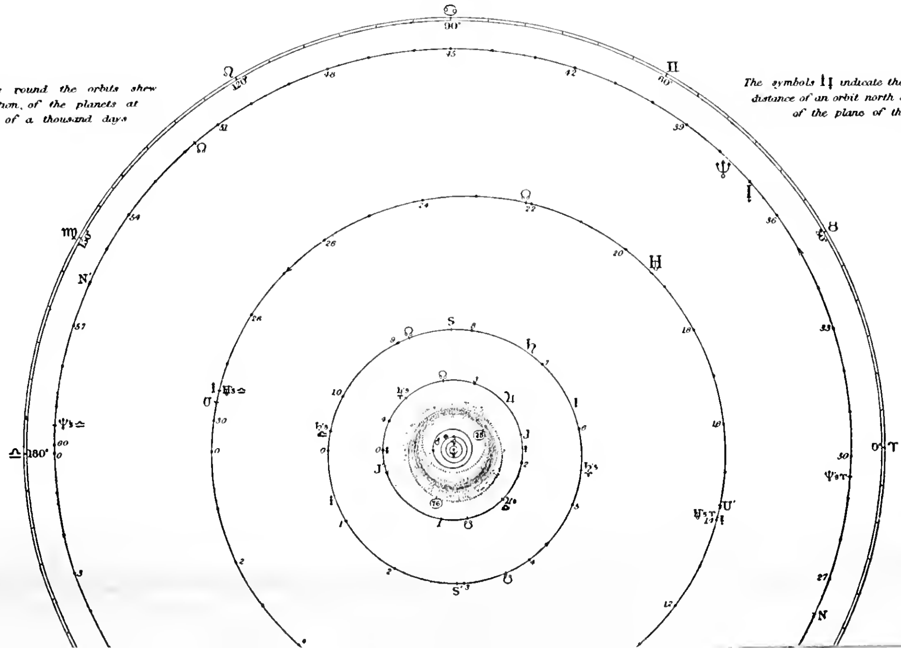
ASTRONOMY

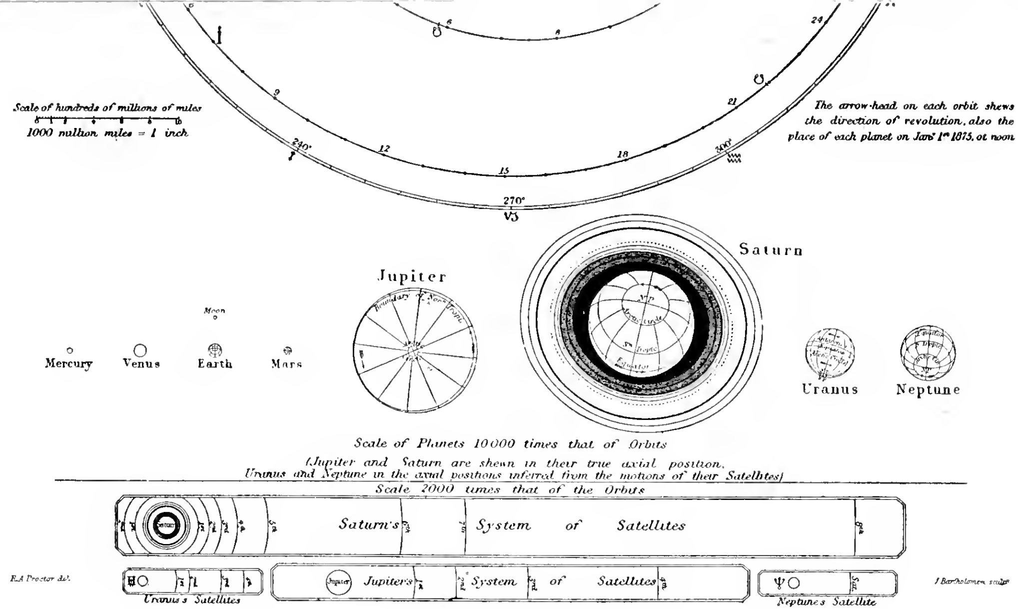
ORBITS OF NEPTUNE (♆), URANUS (♅), SATURN (♄) AND JUPITER (♃).

(Zone of Asteroids, and orbits of (76), (25), ♂, ⊕, ♀ and ☿). Nodes ☊ ☋. Nearer Apses N.U.S.J.

The dots round the orbits shew the position, of the planets at intervals of a thousand days

The symbols ⫯⫰ indicate the greatest distance of an orbit north and south of the plane of the Ecliptic





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marked with spots, is shown in fig. 28, which presents the aspect of the sun, seen with a small telescope on September 25, 1870, as drawn by Mr. Proctor. Three views of spots, as seen with large telescopes, are presented in figs. 29, 30,

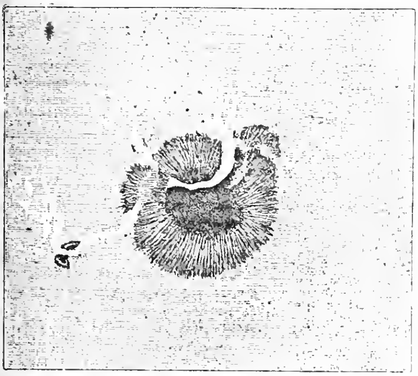


FIG. 29.—Sun Spot seen in 1870.

and 31, which show the same spot in different stages of its history, as observed at the Harvard Observatory, Cam-

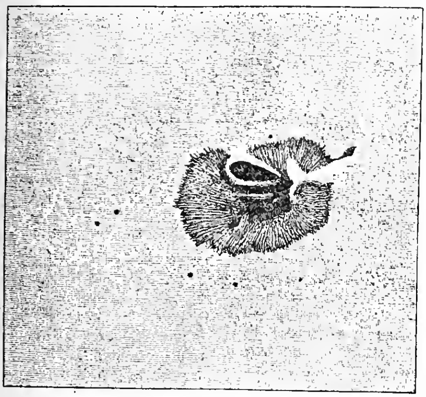


FIG. 30.—Another Phase of Spot, fig. 29.

bridge, U.S., in March and April 1870. These views, though showing the spots as they have only been seen with the improved instruments of our day, will serve to illustrate the following account of the history of research into these objects better than pictures resembling the imperfect drawings made by the first observers.

Telescopic study of sun spots. The phenomena of the solar spots, as observed by Scheiner and Hevelius, may be summed up in the following particulars:—1. Every spot which has a nucleus, or comparatively dark part, has also an umbra, or fainter shade surrounding it. 2. The boundary between the nucleus and umbra is always distinct and well defined. 3. The increase of a spot is gradual, the breadth of the nucleus and umbra dilating at the same time. 4. In like manner the decrease of a spot is gradual, the breadth of the nucleus and umbra contracting at the same time. 5. The exterior boundary of the umbra never consists of sharp angles, but is always curvilinear, how irregular soever the outline of the nucleus may be. 6. The nucleus of a spot, whilst on the decrease, often changes its figure

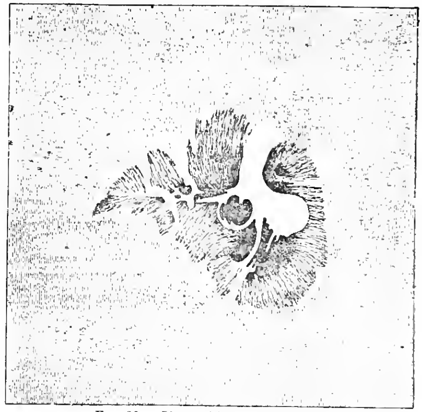


FIG. 31.—Phase of Spot, figs. 29, 30.

by the umbra encroaching irregularly upon it, insomuch that in a small space of time new encroachments are discernible, whereby the boundary between the nucleus and umbra is perpetually varying. 7. It often happens, by these encroachments, that the nucleus of a spot is divided into two or more nuclei. 8. The nuclei of the spots vanish sooner than the umbræ. 9. Small umbræ are often seen without nuclei. 10. An umbra of any considerable size is seldom seen without a nucleus in the middle of it. 11. When a spot which consisted of a nucleus and umbra is about to disappear, if it is not succeeded by a *facula* or spot brighter than the rest of the disk, the place where it was is soon after not distinguishable from the rest.

In the *Philosophical Transactions*, vol. lxiv. (1774), Dr Alexander Wilson, professor of astronomy at Glasgow, gave a dissertation on the nature of the solar spots, in which he mentioned the following appearances:—1. When the spot is about to disappear on the western edge of the sun's limb, the eastern part of the umbra first contracts, then vanishes, the nucleus and western part of the umbra remaining; then the nucleus gradually contracts and vanishes, while the western part only of the umbra remains. At last this disappears also; and if the spot remains long enough to become again visible, the eastern part of the umbra first becomes visible, then the nucleus; and when the spot approaches the middle of the disk, the nucleus appears environed by the umbra on all sides, as already mentioned. 2. When two spots lie very near to one another, the umbra is deficient on that side which lies next to the other spot; and this will be the case, though a large spot should be contiguous to one much smaller; the umbra of the large spot will be totally wanting on that side next the small one. If there are little spots on each side of the large one, the umbra does not totally vanish, but appears flattened or pressed in towards the nucleus on each side. When the little spots disappear, the umbra of the large one extends itself as usual. This circumstance, he observes, may sometimes prevent the disappearance of the umbra in the manner above mentioned; so that the western umbra may disappear before the nucleus if a small spot happens to break out on that side.

These observations led Dr Wilson to adopt the opinion, that the appearances of the spots are occasioned by real excavations in the solar globe. He supposed the sun to consist of a dark nucleus, covered only to a certain depth by a luminous matter, not fluid, through which openings are occasionally made by volcanic or other energies, permitting the solid nucleus of the sun to be seen; and that the umbra which surrounds the spot is occasioned by a partial admission of the light upon the shelving sides of the boundary opposite to the observer. It is evident that, in proportion as these excavations are seen obliquely, their apparent dimensions will be diminished; one of the edges will disappear as it approaches the sun's limb, or come more into view as it advances towards the middle of the disk; when the spot is about to leave the disk, the bottom of the excavation, or the nucleus seen through it, will first disappear, but a sort of faint or obscure spot will remain visible as long as the visual ray penetrates the cavity

Dr Wilson's theory was keenly combated by Lalande, who adduced several observations of his own, and some by Cassini, that could not be explained by means of it; and urged with reason that an hypothesis, founded on the uniformity of appearances which in reality are exceedingly variable, was entitled to little consideration. Lalande himself supposed the spots to be scoriæ which have settled or fixed themselves on the summits of the solar mountains; an opinion which he grounded on the circumstance that some large spots which had disappeared for several years were observed to form themselves again at the identical points at which they had vanished.

Sir William Herschel, with a view to ascertain more accurately the nature of the sun, made frequent observations upon it from the year 1779 to the year 1794. He imagined the dark spots on the sun to be mountains, which, considering the great attraction exerted by the sun upon bodies placed at its surface, and the slow revolution it has upon its axis, he thought might be more than 300 miles high, and yet stand very firmly. He says that in August 1792 he examined the sun with several powers from 90 to 500, when it evidently appeared that the dark spots are the opaque ground or body of the sun, and that the luminous part is an atmosphere, through which, when interrupted or broken, we obtain a view of the sun itself. Hence he concluded that the sun has a very extensive atmosphere, consisting of elastic fluids that are more or less lucid and transparent, and of which the lucid ones furnish us with light. This atmosphere, he thought, cannot be less than 1843 nor more than 2765 miles in height; and he supposed that the density of the luminous solar clouds needs not be much more than that of our aurora borealis, in order to produce the effects with which we are acquainted. The sun, then, if this hypothesis be admitted, "is similar to the other globes of the solar system with regard to its solidity, its atmosphere, its surface diversified with mountains and valleys, its rotation on its axis, and the fall of heavy bodies on its surface; it therefore appears to be a very eminent, large, and lucid planet, the primary one in our system, disseminating its light and heat to all the bodies with which it is connected."

Herschel supposed that there are two regions or strata of solar clouds; that the inferior stratum is opaque, and probably not unlike our own atmosphere, while the superior is the repository of light, which it darts forth in vast quantities in all directions. The inferior clouds act as a curtain to screen the body of the sun from the intense brilliancy and heat of the superior regions, and, by reflecting back nearly one-half of the rays which they receive from the luminous clouds, contribute also greatly to increase the quantity of light which the latter send forth into space, and thereby perform an important function in the economy of the solar system. The luminous clouds prevent us in general from seeing the solid nucleus of the sun; but in order to account for the spots, he supposes an empyreal elastic gas to be constantly forming at the surface, which, carried upwards by reason of its inferior density, forces its way through the planetary or lower clouds, and mixing itself with the gases which have their residence in the superior stratum, causes decomposition of the luminous matter, and gives rise to those appearances which he describes under the name of *corrugations*. Through the openings made by this accidental removal of the luminous clouds, the solid body of the sun becomes visible, which, not being lucid, gives the appearance of the dark spots or nuclei seen through the telescope. The length of time during which the spots continue visible renders it evident that the luminous matter of the sun cannot be of a liquid or gaseous nature; for, in either case, the vacuity made up by its accidental removal would instantly be filled up, and the uniformity of appearance invariably maintained.

Sun-spot period.

But, perhaps, the most important of all the discoveries which have been made respecting the sun spots, are those which relate to the variation of these objects in number, and in the amount of solar area which they cover. We owe the initiation of observations on these points to Schwabe of Dessau. They were commenced in the year 1826, and continued without intermission, except in one case, during the astronomer's illness, for forty-six years. Before many years had elapsed, Schwabe discovered that the spots wax and wane in frequency in a period of about eleven years. At the time of spot-minimum the sun remains often for several days not only clear of spots, but with a singular smoothness of aspect, even the minute mottlings ordinarily seen on his surface either passing away for a time or becoming less conspicuous than usual. From such an epoch there is a gradual return to the spotted condition, and usually in four or five years the maximum of spot-frequency is reached; then there is a more gradual reduction, until, in rather more than eleven years on the average, the minimum is reached. The table on page 787 indicates the facts actually observed by Schwabe between 1826 and 1868, supplemented by observations of a similar kind made at the Kew Observatory to the year 1871.

It will be seen that the law of variation is not uniformly periodic; the intervals between maximum and maximum are not strictly equal, and the maxima are neither equal nor similar.

The researches of M. De la Rue and his assistants Stewart and Loewy have indicated further laws of variation, apparently connecting the changes of spot-frequency with the movements of the planets Mercury, Venus, the earth, and Jupiter. According to their views the great eleven-year period would correspond with the periodic revolution of Jupiter. It is, however, noteworthy that Professor Wolf of Zurich estimates the spot period at 11·11 years,—a period differing too much from Jupiter's to accord with De la Rue's theory. And Carrington notes that, whereas certain epochs of spot-maxima accord with the passage by Jupiter of his perihelion, others accord almost as exactly with Jupiter's aphelion passage. Yet Wolf accepts the theory of planetary influence. "He finds," says Sir John Herschel, "that a perceptibly greater apparent activity prevails annually, on the average, in the months of September to January, than in the other months of the year; and, again, by projecting all the results in a continuous curve, he finds a series of small undulations succeeding each other at an average interval of 7·65 months, or 0·637 of a year. Now the periodic time of Venus, reduced to a fraction of a year, is 0·616,—a coincidence certainly near enough to warrant some considerable suspicion of a physical connection." A longer period, during which the spot-maxima would seem to vary, has been suspected by Wolf. It was suggested by Mr Proctor in 1865, and Prof. Loomis (of Yale College, U.S.) has since advocated the theory, that this period corresponds to the successive conjunctions of Saturn and Jupiter; but the connection is doubtful.

Year.	Days of Observation.	Days without Spots.	New Groups.
1826	277	22	118
1827	273	2	161
1828	282	0	225
1829	244	0	199
1830	217	1	190
1831	239	3	149
1832	270	49	84
1833	267	139	33
1834	273	120	51
1835	244	18	173
1836	200	0	272
1837	168	0	333
1838	202	0	282
1839	205	0	162
1840	263	3	152
1841	283	15	102
1842	307	64	68
1843	312	149	34
1844	321	111	52
1845	332	29	114
1846	314	1	157
1847	276	0	257
1848	278	0	330
1849	285	0	238
1850	308	2	186
1851	308	0	141
1852	337	2	125
1853	299	4	91
1854	334	65	67
1855	313	146	28
1856	321	193	34
1857	324	52	98
1858	335	0	202
1859	343	0	205
1860	332	0	211
1861	322	0	204
1862	317	3	160
1863	330	2	124
1864	325	4	130
1865	307	26	93
1866	349	76	45
1867	312	195	25
1868	301	12	101
1869[1]	196	0	224
1870[1]	213	0	403
1871[1]	219	0	271
1872[1]	153	3	186

Connection of sun spots with terrestrial phenomena.

One of the most interesting results following Schwabe's great discovery was the recognition of an association between the sun-spot period and magnetic disturbances on the earth. Lamont of Munich had independently discovered, in 1850, that the mean daily range of the magnetic declination varies in a period of about ten years. Two years later, General Sabine and Professors Wolf and Gautier noted the coincidence of this period and that of the solar spots. Wolf afterwards proved that the true period of magnetic variation amounts to 11·11 years approximately. Some still regard the association between the sun-spot period and auroral phenomena as non-existent; but all doubt on the subject appears to be removed by the evidence adduced in two able papers by Professor Loomis (*American Journal of Science and Arts*, September 1870 and April 1873). In the same papers Professor Loomis indicates the evidence of association between the number of auroras observed each year, and the two orders of phenomena—solar spots and magnetic variations. He remarks that, "the auroral maximum generally occurs a little later than the magnetic maximum, the average difference amounting to one year; while the time of auroral minimum either coincides with the magnetic minimum or slightly precedes it, the average difference amounting to about half a year. On the whole," he proceeds, "there seems to be no room for question that the number of auroras seen in the middle latitudes of Europe and America exhibits a true periodicity, following very closely the magnetic periods, but not exactly copying them. In particular, we notice that during those periods in which the range of the magnetic declination was unusually small auroral exhibitions were extremely few in number and insignificant in respect of brilliancy. If now we inquire as to the probable connection between these three classes of phenomena, we cannot suppose that a small black spot on the sun exerts any direct influence on the earth's magnetism or electricity; but we must rather conclude that the black spot is a result of a disturbance of the sun's surface, which is accompanied by an emanation of some influence from the sun, which is almost instantly felt upon the earth, in an unusual disturbance of the earth's magnetism, and a flow of electricity, developing the auroral light in the upper regions of the earth's atmosphere. The appearances favour the idea that this emanation consists of a direct flow of electricity from the sun. If we maintain that light and heat are the result of vibrations of a rare ether which fills all space, the analogy between these agents and electricity would lead us to conclude that this agent also is the result of vibrations in the same medium, or at least that it is a force capable of being propagated through the ether with a velocity similar to that of light. While this influence is travelling through the void celestial spaces it develops no light; but as soon as it encounters the earth's atmosphere, which appears to extend to a height of about 500 miles, it develops light, and its movements are controlled by the earth's magnetic force, in a manner analogous to the influence of an artificial magnet upon a current of electricity circulating round it."

Spectroscopic analysis.

Among the most interesting discoveries in solar physics are those which have been effected by means of the spectroscopic analysis, not only as regards the constitution of the sun himself, but as to the nature of the solar spots and faculæ, as well as of the various objects which lie outside the sun's visible surface, and are only rendered discernible during the darkness of total solar eclipses.

The evidence of the spectroscope respecting the sun's constitution is too intimately associated with the history of spectroscopic analysis to be properly discussed at any length in this place. We propose, therefore, to present results, rather than to describe in detail the processes by which these results have been obtained, or the considerations on which must be based the interpretation of such results.

It has been shown, then, that the light of the sun comes from an orb glowing with intense *white* light,—that is, light of all refrangibilities. Hence the sun is either liquid or solid, or if vaporous, then so greatly compressed that, in fact, the condition of its vapours is unlike that of any gases with which we are familiar. But inasmuch as the rainbow-tinted streak constituting the solar spectrum is crossed by a multitude of dark lines, it is seen that the glowing mass of the sun is surrounded by a complex vapourous envelope at a lower temperature. Nevertheless we are not to suppose that the vapours constituting the solar atmosphere are in any sense cool. In fact, we find from the position of the dark lines of the solar spectrum, that the vapours of magnesium and sodium, of iron, copper, and other metals, exist in the true solar atmosphere, which

[1] These lines are from the records of the Kew Observatory.

implies an excessive intensity of heat. We know also, in another manner presently to be described, that the vapours of the solar atmosphere, although less intensely hot than the glowing mass of the sun, are yet so hot as to be brightly luminous.

The evidence respecting the constitution of the sun is based on the following coincidences between dark lines of the solar spectrum and bright lines in the spectra of various elements:—

	Lines coincident.		Lines coincident.
Hydrogen	4	Manganese	57
Sodium	9	Chromium	18
Barium	11	Cobalt	19
Calcium	75	Nickel	33
Magnesium	4 + (3?)	Zinc	2
Aluminium	2 (?)	Copper	7
Iron	450	Titanium	200

It must not be supposed either that no other terrestrial elements exist in the sun, or that no other coincidences are recognisable. The above list simply indicates the results obtained by Angström, and presented in the latest available announcement on the subject. With each improvement in spectroscopic appliances fresh coincidences are determined. Moreover, it is certain that many elements existing in the sun may for ever escape notice, simply because their vapours in the solar atmosphere may be either insufficient in quantity, or too low down to produce any recognisable effect.

Mitscherlich and others have lately shown that where one or two lines of a many-lined spectrum are recognised and others wanting, the evidence for the existence of the corresponding element in the sun may yet be regarded as sufficient, because under certain conditions only one or two lines of a spectrum show themselves.

The evidence given by the spectroscope respecting the solar spots confirms the theory that these are due to the existence of masses of relatively cool vapours at a lower level, and therefore relatively more compressed than the vapours elsewhere existing in the solar atmosphere. For the spectrum of the umbra of a spot differs chiefly from the spectrum of the solar photosphere in the greater strength and breadth of some of the dark lines.

Phenomena of eclipses.

We pass on to the phenomena witnessed during total solar eclipses. These are the red prominences and sierra, the inner corona, and the outer or radiated corona. Some add to these "Baily's beads" and like phenomena, of no real interest or importance whatever.

Prominences.

The red prominences were first seen during the solar eclipse of July 8, 1842. During the eclipse of July 28, 1851, it was shown incontestably that they belong to the sun, since the moon was seen to traverse them, hiding those on the east and revealing those on the west. Some still maintained that the prominences are lunar or terrestrial phenomena, on the ground that observers might have been deceived. But this doubt was finally set at rest by the photographic records which De la Rue and Secchi obtained of the total solar eclipse of June 18, 1860.

It was not, however, until the eclipse of August 1868—sometimes known as the great Indian eclipse—that the real nature of these wonderful objects was ascertained. Spectroscopic analysis was applied successfully to the investigation of the prominences by Colonel Tennant, Captain Herschel, and MM. Janssen and Rayet. The spectrum was found to consist of bright lines, indicating that the coloured prominences are masses of glowing vapour. All the observers agreed that among the bright lines those of hydrogen were present; and one yellow line was mistakenly ascribed to sodium.

But Janssen on the day following the eclipse applied a new method of research, the principle of which had been definitely indicated several months before by Mr Huggins. (See Report of the Council of the Astronomical Society, in the *Monthly Notices* for February 1868.) This method depends on the fact that prismatic dispersion reduces the brilliancy of a continuous spectrum, but only throws apart the lines of a bright-line spectrum. Accordingly, by using a spectroscope of sufficient dispersive power, and directing it (with suitable telescopic adjuncts) towards a part of the solar limb on which a prominence exists, the light of our atmosphere, which under ordinary conditions obliterates the prominences from view, may be sufficiently dispersed to leave the bright lines of the prominence spectrum discernible (*one at a time*). By noting the length of a bright line so seen, the extent of the prominence in the particular section viewed could be determined; and by combining such determinations, the shape of the prominence could be ascertained. Hence it was that Janssen, speaking of his observations on the day following the great eclipse, said, "I have enjoyed to-day a continuous eclipse."

It happened, curiously enough, that Mr Lockyer, in England, had succeeded in applying the method, not indeed so early as Janssen, but before the news of Janssen's success had reached Europe.

Before long, however, Mr Huggins, the first to enunciate the principle of the new method, showed how it could be improved upon in such sort that the whole of a prominence could be seen at once. Since then many observers have studied the prominences without the aid of an eclipse,—the most successful being Zöllner, Secchi, Lockyer, Respighi, and (above all) Professor Young, of Dartmouth College, New Hampshire.

The following remarks respecting the prominences have been derived from a paper by Respighi:—

"In the circumpolar solar regions great prominences are not formed, but only small and short-lived jets. In the spot zone the great prominences are seen, the equatorial, like the polar zones, being regions of relatively small activity. Where faculæ are present prominences are usually seen, but they are not identical with faculæ. Over spots the jets are seen, but they are not high. There is a great difference in the duration of prominences. Some develop and disappear in a few minutes; others remain visible for several days. They originate, generally, in rectilinear jets, either vertical or oblique, very bright and well defined. These rise to a great height, often to a height of at least 80,000 miles, and occasionally to more than twice that; then, bending back, fall again upon the sun like the jets of our fountains. Then they spread into figures resembling gigantic trees, more or less rich in branches. In general, the highest parts are the regions of the most remarkable transformations."

Sierra

Before passing to the more systematic researches made by Secchi, a few words must be said about the sierra.

It had been observed, even before the prominences were noticed, that there exists a border of a red colour around the solar disk, which can be recognised on the eastern side just after totality has commenced, and on the western side just before totality ceases. Late observations abundantly confirmed the discovery, and after the eclipse of 1860 it had been definitely admitted by all who had sufficiently examined the evidence, that a continuous red envelope surrounds the sun to a depth of three or four thousand miles. This envelope was commonly called the sierra; but recently the name chromosphere (which purists correct into chromatosphere) has been given to it.

The new method of observation, as might be expected, shows the sierra spectrum as successfully as that of the prominences, which must be regarded as extensions of the sierra.

Secchi makes the following remarks on the sierra and prominences:—

"The sierra presents four aspects: (1), smooth, with a defined outline; (2), smooth, with no definite outline; (3), fringed with filaments; and (4), irregularly fringed with small flames.

"The prominences may be divided into three orders—heaps, jets, and plumes. The heaped prominences need no special description. The jets are those to which alone Respighi's description is applicable. Their luminosity is intense, insomuch that they can be seen through the light clouds into which the sierra, breaks up. Their spectrum indicates the presence of many elements besides hydrogen. When they have reached a certain height they cease to grow, and become transformed into exceedingly bright masses, which eventually separate into fleecy clouds. The jet prominences last but a short time, rarely an hour, frequently but a few minutes, and they are only to be seen in the neighbourhood of the spots. Wherever the jet prominences are seen, there also are faculæ. The plume prominences are distinguished from the jets in not being characterised by any signs of an eruptive origin. They often extend to an enormous height, they last longer than the jets, though subject to rapid changes of figure, and lastly, they are distributed indifferently over the sun's surface. It would seem that in jets a part of the photosphere is lifted up, whereas in the case of plumes only the sierra is disturbed."

The theoretical inquiries of Zöllner, confirmed by his own and Respighi's observations, show the probability that the jet prominences are true phenomena of eruption. And more recently, Professor Young has witnessed what must be regarded as in all probability a veritable solar eruption, during which matter was propelled to a height of upwards of 200,000 miles above the sun's surface. The matter whose motion was actually observed was glowing hydrogen; but it should be noticed that it does not necessarily follow that the matter erupted was hydrogen. The outrush may have carried along with it portions of hydrogen which had before been quiescent in the solar atmosphere.

Corona. The solar corona comes next to be considered.

It had long been known that around the black disc of the moon in total solar eclipses a halo or glory of light is seen, rather bright close by the sun, and fading away at first somewhat quickly, afterwards gradually, into the darkness of the surrounding sky. The records of some total eclipses described also radiations in this coronal glory, extending in many cases to a great distance from the sun.

Various theories were propounded in explanation of the solar corona. According to one view, it was a mere terrestrial phenomenon, due to the passage of the solar rays through our own atmosphere. Others ascribed it to the effects produced by a lunar atmosphere. The theory that it is due to diffraction was also advanced. But the generality of astronomers, especially in recent times, regarded the corona as a true solar appendage.

Space will not permit us to enter at length on the discussion of the various theories just mentioned, or on the description of the various observations which appeared to give support to one theory or another. Nor can we present in full the interesting history of the observations made since 1869, when first the spectroscope was applied to this interesting phenomenon, and real evidence as to its nature and structure began to be obtained. We must be content with the brief statement of the salient points of the recent observations.

During the solar eclipse of August 1869 the American astronomers, Young and Harkness, discovered that the spectrum of the corona is discontinuous (or that at least a portion of its light gives a discontinuous spectrum). Certainly one, and probably three bright lines appeared in the spectrum as they saw it, though the faintness of two of the three lines raised some doubt on the question whether they belonged to the corona. During the eclipse of December 1870, Young renewed his observations successfully, and other observers succeeded in seeing the bright-line spectrum of the corona. Young thus sums up the results of his own and other observations:—"There is," he said, "surrounding the sun, beyond any further reasonable doubt, a mass of self-luminous gaseous matter, whose spectrum is characterised by the green line 1474 Kirchhoff. The precise extent of this it is hardly possible to consider as determined, but it must be many times the thickness of the red hydrogen portion of the chromatosphere, perhaps on an average 8′ or 10′, with occasional horns of twice that height. It is not at all unlikely that it may even turn out to have no upper limit, but to extend from the sun indefinitely into space."

It was during this eclipse that for the first time photography gave convincing evidence respecting the corona. Mr Brothers at Sicily, and Mr Willard (an American photographer) in Spain, obtained views which, though differing in extent, accorded so well in those parts which were common to both, as to leave no doubt that the corona is a solar and not a terrestrial phenomenon. A singular V-shaped gap, common to both the photographs, and seen also by several telescopists, attracted particular attention, and was regarded by the late Sir John Herschel as in itself demonstrative of the fact that the corona is a solar appendage.

It was not, however, until the solar eclipse of December 1871 that the evidence on this point became so convincing as to satisfy even those who had most strenuously maintained the theory that the corona is merely a phenomenon of our own atmosphere. The spectroscopic and the photographic evidence were alike important. Janssen, with the spectroscope, succeeded in recognising, besides the bright lines already seen, others less bright, but manifestly belonging to the corona. He also perceived a faint continuous spectrum, crossed by dark lines, and therefore presumably due to reflected solar light, which, since our upper air near the sun's place, in total eclipse, is demonstrably not illuminated by sunlight, can have come only from matter in the true corona, such as meteoric flights, vapour clouds, or the like, capable of reflecting the light of the sun. The photographers met with equally decisive success. Lord Lindsay's photographer, Mr Davis, obtained a series of five pictures of the corona at successive stages of the totality, two of which were excellent and the remainder good. All these agreed perfectly in all respects, save only in the extent of the visible corona (depending, of course, on the conditions of illumination). It was demonstrated, therefore, that the features of the corona do not change during the progress of an eclipse at any given station; hence the corona cannot be a phenomenon depending on the passage of light-rays athwart inequalities of the moon's limb. For whether we regard such rays as illuminating our own atmosphere or matter between the earth and the moon, the illumination would necessarily vary markedly, as the motions of the moon shifted the inequalities of her limb progressively athwart the light-rays. Again, Col. Tennant obtained a series of six photographs (five of which were very good), agreeing perfectly (always excepting differences of extent) with those obtained by Lord Lindsay's photographer. Now Col. Tennant's station was at Dodabetta, near the highest peak of the Neilgherries, more than 10,000 feet above the sea level, while Mr Davis was stationed at Baicull, close to the sea-shore, and hundreds of miles from Tennant's station. The agreement of two series taken under such diverse circumstances, proves to demonstration that the photographers were not dealing with the illumination of matter in the upper regions of our atmosphere, no matter under what circumstances illuminated. Later, indeed, it was found that photographs taken at Java gave precisely the same features, so that, as Col. Tennant remarks in the latest communication on the subject (*Monthly Notices of the Astronomical Society* for June 1873), no one now supposes the corona to be other than a solar phenomenon.

The accompanying picture (fig. 32), carefully copied from the first of Col. Tennant's series of photographs, will afford an idea of the nature of the corona's structure, though only an inadequate one, since photography can present only a portion of an object like the corona, whose light is for the most part extremely delicate.

FIG. 32.—Solar Corona.

Another very curious phenomenon connected with the sun is the faint nebulous aurora which accompanies him, known by the name of the *Zodiacal Light.* This phenomenon was first observed by Kepler, who described its appearance with sufficient accuracy, and supposed it to be the atmosphere of the sun. Dominic Cassini, however, to whom its discovery has been generally but erroneously attributed, was the first who observed it attentively, and gave it the name which it now bears. It is visible immediately before sunrise, or after sunset, in the place where the sun is about to appear, or where he has just quitted the horizon. It has a flat lenticular form, and is placed obliquely on the horizon, the apex extending to a great distance in the heavens. Its direction is in general nearly in the plane of the sun's equator, and for this reason it is scarcely visible in our latitudes, excepting at particular seasons, when that plane is nearly perpendicular to the horizon. When its inclination is great, it is either concealed altogether under the horizon, or it rises so little above it that its splendour is effaced by the atmosphere of the earth. The most favourable time for observing it is about the beginning of March, or towards the vernal equinox. The line of the equinoxes is then situated in the horizon, and the arc of the ecliptic is more elevated than the equator by an angle of $23\frac{1}{2}°$; so that the solar equator, which is slightly inclined to the ecliptic, approaches nearer to the perpendicular to the horizon, and the pyramid of the zodiacal light is consequently directed to a point nearer the zenith than at any other season of the year.

Numerous opinions have been entertained respecting the nature and cause of this singular phenomenon. Cassini thought it might be occasioned by the confused light of an innumerable multitude of little planets circulating round the sun, in the same manner as the Milky Way owes its appearance to the light of agglomerated myriads of stars. Its resemblance to the tails of comets has been noticed by Cassini and others. Mairan, following Kepler, ascribed it to the atmosphere of the sun. This hypothesis was generally adopted until Laplace showed it to be untenable, because no atmosphere could rotate with the sun if extending beyond the distance where centrifugal force is balanced by gravity, and this distance lies far within the observed range of the zodiacal light.

The general opinion respecting the zodiacal light at the present day is, that it forms the outer part of the solar corona, so that if the light of the sun could be for a time obliterated without rendering his appendages invisible, we should see the corona as shown in the preceding figure, merging gradually into the faint glow of the zodiacal light. It must not be understood, however, that this theory in any sense implies a continuity of substance between the zodiacal light and the corona, any more than what has been discovered respecting the corona implies that the corona is a true solar atmosphere. All that is to be understood is, that (1) the inner corona, (2) the outer radiated corona, and (3) the zodiacal light, form part of the series of appendages surrounding the orb of the sun.

It is to be noted, indeed, that the true atmosphere of the sun appears to underlie even the sierra. It had been noted by Secchi in 1869, that on the very limb of the sun the solar spectrum becomes continuous; and he inferred that there must exist an atmosphere (relatively very shallow), consisting of the vapours which occasion the dark lines of the solar spectrum, and that the brightness of the lines of these vapours corresponding very nearly to the brightness of the ordinary solar spectrum for the parts of the sun very near to the edge, the dark lines of the latter spectrum are as it were cancelled, and so a continuous spectrum is produced. This view was shown during the eclipse of December 1870 to be perfectly correct; for Prof Young, directing his analysing spectroscope to the part of the sun's limb which was to disappear last, found that at the instant when totality commenced, the solar spectrum was suddenly replaced by a spectrum consisting of thousands of bright lines, that being precisely the kind of spectrum which Secchi's theory required. This observation was successfully renewed during the eclipse of December 1871, and again during the *annular* eclipse of June 1872. On the latter occasion the remarkable circumstance was noted, that while the bright-line spectrum was only visible for a second or two on the eastern limb (just before the formation of the ring), it was visible for six or seven seconds on the western limb (just after the annulus was broken).

Young's atmosphere.

CHAPTER VIII.—*The Inferior Planets Mercury and Venus.*

Mercury is a small body, but emits a very bright white light, though he is seldom to be seen, always keeping near the sun.

Mercury.

Mercury is about 3060 English miles in diameter, and his mean distance from the sun about 35 millions of miles. On account of his smallness and brilliancy, it is extremely difficult to find any spot on his disk so distinctly marked as to afford the means of determining his rotation. An attentive observation of the variations of the phases of Mercury led Schröter to infer that the planet revolves about its axis in a period of 24 hours 5 min. 30 sec. M. Harding discovered in 1801 an obscure streak on the southern hemisphere of the planet, the observations of which, together with those of a spot discovered by Schröter, gave the same period of rotation. Schröter states that Mercury's form is spherical, exhibiting no sensible compression; that his equator is very considerably inclined to his orbit, and the differences of his days and seasons must consequently be very great; and that there are mountains on his surface which cast very long shadows, and of which the height bears a greater proportion to the diameter of the planet than those of the Earth, the Moon, or even of Venus. The height of Chimborazo is $\frac{1}{1017}$ of the radius of the earth; one of the mountains in the moon has been estimated at $\frac{1}{214}$ of her radius; the highest in Venus at $\frac{1}{144}$; and one in Mercury at $\frac{1}{126}$. But recent observations render it exceedingly doubtful how far Schröter's observations can be trusted. There are no observations to prove decisively whether Mercury is surrounded by an atmosphere.

Venus. Venus, the most beautiful object in the heavens, is about 7510 English miles in diameter, and is placed at the distance of 66 millions of miles from the sun. Although the oscillations of this planet are considerably greater than those of Mercury, and she is seldom invisible, yet on account of the uniform brilliancy of her disk, it is extremely difficult to ascertain the period of her rotation. Dominic Cassini, after having long fruitlessly attempted to discover any object on her surface so well defined as to enable him to follow its motions, at length, in 1667, perceived a bright spot, distant from the southern horn a little more than a fourth part of the diameter of the disk, and near the eastern edge. By continuing his observations of this spot, Cassini concluded the rotation of Venus to be performed in about 23 hours; but he does not seem to have considered this conclusion as deserving of much confidence. In the year 1726 Bianchini, an Italian astronomer, made a number of similar observations for the same purpose, from which he inferred that the rotation of the planet is performed in 24 days 8 hours.' The younger Cassini has shown, however, that the observations of Bianchini, as well as those of his father, could be explained by a rotation of 23 hours and 21 or 22 min. whereas the rotation of 24 days 8 hours cannot be reconciled with the appearances observed by the elder Cassini. The determination of Cassini was regarded by astronomers as the more probable of the two, particularly as Bianchini was not able to make his observations in a connected manner, because a neighbouring building intercepted his view of the planet, and obliged him to transport his telescope to a different situation. The question of the rotation of Venus was again attacked by Schröter, who found it to be performed in 23 hours 21 min. 19 sec. Each of the three observers found the inclination of the axis of rotation to the axis of the ecliptic to be about 75°. Much doubt, however, still exists with respect to the value of this element which De Vico sets at little more than 50°.

Schröter's observations of this planet were principally directed to a mountain situated near the southern horn. The line which joins the extremities of the horns is always a diameter; and the horns of the crescent of a perfect sphere ought to be sharp and pointed. Schröter remarked that this was not always the case with regard to the horns of Mercury and Venus. The northern horn of the latter always preserved the pointed form, but the southern occasionally appeared rounded or obtuse,—a circumstance which indicated that the shadow of a mountain covered the part; but beyond the horn he remarked a luminous point, which he supposed to be the summit of another mountain, illuminated by the sun after he had ceased to be visible to the rest of that hemisphere. Now, in order that the horn of the crescent may appear obtuse in consequence of the shadow of a mountain falling upon it, and another mountain may present a luminous point, the two mountains must be at the same time both at the edge of the disk and on the line separating the dark from the enlightened part of the planet. But this position cannot be of long continuance. Rotation will cause the bright point to rise into the enlightened part, or sink into the dark hemisphere, and in either case the mountain will cease to be visible. If, however, the rotation is completed in 23 hours 21 min., the mountain will appear 39 min. sooner than it did on the previous day. Hence it is possible to obtain several consecutive observations, from which an approximate value of the period may be found; and this being once obtained, it may be rendered still more exact by observations separated from each other by a longer interval. Thus Schröter found that an interval of 20 days 11 hours 15 min. between two appearances of the mountain being divided by 23 hours 21 min. gave 21·04 revolutions; and that intervals of 121 days 14 hours 25 min., 142 days 1 hour 40 min., 155 days 18 hours 11 min., divided each by 23 hours 21 min., gave 125·01, 146·02, 160·09 revolutions respectively. All these comparisons prove that the revolution of 23 hours 21 min. is somewhat too short. They ought to have given 21, 125, 146, and 160 revolutions exactly, supposing the observations to have been perfectly accurate. On dividing the intervals by 21, 125, 146, and 160 respectively, the quotients will be each the time of a revolution very nearly; and by taking a mean of the whole, the most probable result at least will be obtained. In this manner Schröter found the period of rotation already stated, namely, 23 hours 21 min. 19 sec.

Since the time of rotation of Mercury and Venus is nearly equal to that of the earth, the compression of these planets at the poles, which results from the centrifugal force, ought also to be nearly in the same proportion. But at the distance of the earth the compression must be imperceptible even in the case of Venus; for, supposing it to amount to $\frac{1}{300}$, the difference between the radius of her poles and that of her equator would only amount to a tenth of a second as seen from the earth.

Phenomena of transits. During the transits of Venus over the sun's disk in 1761 and 1769 a sort of penumbral light was observed round the planet by several astronomers, which was occasioned, without doubt, by the refractive powers of her atmosphere. Wargentin remarked that the limb of Venus which had gone off the sun showed itself with a faint light during almost the whole time of emersion. Bergman, who observed the transit of 1761 at Upsal, says that at the ingress the part which had not come upon the sun was visible, though dark, and was surrounded by a crescent of faint light; but this appearance was much more remarkable at the egress: for as soon as any part of the planet had disengaged itself from the sun's disk, that part was visible with a like crescent, but brighter. As more of the planet's disk disengaged itself from that of the sun, the part of the crescent farthest from the sun grew fainter, and vanished, until at last only the horns could be seen. The total immersion and emersion were not instantaneous; but as two drops of water, when about to separate, form a ligament between them, so there was a dark shade stretched out between Venus and the sun; and when this ligament broke, the planet seemed to have got about an eighth part of her diameter from the limb of the sun. The numerous accounts of the two transits which have been published abound with analogous observations, indicating the existence of an atmosphere of considerable height and density. During the transit of 1874 these appearances were so satisfactorily seen, that no doubt can remain as to their reality. Schröter calculated that the horizontal refraction of the atmosphere of Venus must amount to 30′ 34″, differing little from that of the terrestrial atmosphere. A twilight which he perceived on the cusps afforded him the data from which he deduced this conclusion, on which, however, very little reliance can be placed.

The atmosphere of Venus has been analysed with the spectroscope by Vogel, and the existence of aqueous vapour is regarded as demonstrated. On the occasion of the late transit (1874) Tacchini made spectroscopic observations, which seem more satisfactorily to establish the fact that there is water on Venus, than Vogel's observations.

Cassini and Montaigne imagined that they had observed a satellite accompanying Venus; but this appears to have been an optical illusion arising from the strong light of the planet reflected back from the convex surface of the eye upon the eye-glass of the telescope, and thence reflected a second time back to the eye. During the transits of Venus in 1761 and 1769, and in the late transit of 1874, no trace of a satellite was seen; and there can be now no doubt whatever that Venus is without a satellite.

CHAPTER IX.—*The Earth regarded as a Planet—Figure and Mass of the Earth—Precession of the Equinoxes—The Shape and Position of the Earth's Orbit—Distance from the Sun—Transit Observations.*

The earth is the third member of the solar system in order of distance from the sun. From what has been already shown, in determining the relative position of the earth and the celestial bodies seen in our skies, we know that the earth is a globe, rotating on her axis once in a day, and circling around the sun in an orbit of great extent once in a year. In the present chapter we propose to present the results of more exact inquiries into the figure and motions of the earth.

Figure of the earth. It has been found by numerous and accurate experiments, that the lengths of arcs of 1° on the same meridian are greater in proportion as we advance nearer the pole. Hence, on account of the similarity of the isosceles triangles of which these arcs form the bases, their sides, or the terrestrial radii, must also be longer, and consequently the convexity of the earth is less towards the poles than at the equator. The surface of the earth is extremely irregular, even independently of the inequalities occasioned by mountains and cavities; yet it has been discovered that the meridional curves differ almost insensibly from ellipses; whence it is concluded that the figure of the earth is an ellipsoid of revolution about its shortest axis. In comparing the results of the various measurements which have been made with the formulæ belonging to the dimensions of such a body, this conclusion has been fully verified; and the lengths of the arcs, the ellipticity, the distance of the pole from the equator, and, in short, all the elements of the spheroid, have been determined.

An arc of the meridian in India was measured by Colonel Lambton in the early part of this century. But its value has been much increased by Colonel Everest's extension of the arc. The arc of Lambton, extending from Punnæ (lat. 8° 9′ 35″) to Damargida (lat. 18° 3′ 15″), was measured after the model of the English trigonometrical survey. From Damargida, where Lambton's arc terminated, another was measured by Colonel Everest to Kaliana (lat. 29° 30′ 48″), a space of 797 miles, covering an arc of 11° 27′ 33″, the latest geodetical improvements being introduced. The whole extent of Lambton's and Colonel Everest's operations includes a continuous arc of 21° 21′ (1477 miles). The work was rivalled in extent by a vast operation executed in Russia and other northern countries of Europe, by which an arc of 25° 20′, extending from the banks of the Danube to the shores of the Arctic Sea, near the North Cape, was measured under the general superintendence and direction of W. Struve.

The arcs of India and of Russia include a space from lat. 8° to lat. 71°, with the exception of only about sixteen degrees, and are unquestionably the most important which exist for the determination of the earth's figure. When to them we add the French arc of 12° 22′ in a medium latitude, it will scarcely be necessary to take into account any other, at least for the northern hemisphere.

The following brief details of the Russian arc are taken from M. Struve's report of 1852:—

The southern extremity of the Russo-Scandinavian arc is Ismail on the Danube (lat. 45° 20′), the northern extremity is Fuglenaes, on the island of Qualoe, in Finnmarken (lat. 70° 40′). The interval from Tornea to Fuglenaes (4° 49′) was measured by Swedish and Norwegian engineers; all the remainder by those of Russia, and, in particular, by M. Von Tenner, who, with M. Struve, from 1816 directed the whole operation.

The calculation of the figure of the earth from the completed Russian arc indicates an ellipticity somewhat greater than that generally received. The results obtained by Colonel Everest, on the other hand, by comparing his arc with those of Europe, give generally small ellipticities, that is, under $\frac{1}{300}$. The French and Indian arcs, for instance, give $\frac{1}{316}$. The determinations by means of the pendulum are somewhat larger. The extensive observations of Colonel Sabine and Captain Foster concur in giving an ellipticity of $\frac{1}{289}$, but the French experiments by Duperrey and Freycinet lead to a result considerably greater. The discrepancy between the geodetical and pendulum results may, of course, be a real one depending on local variations of density. The astronomical determination from the lunar inequalities, which might be expected to concur with the results of the pendulum, gives $\frac{1}{306}$ as a mean. Captain A. R. Clark, R.E., combining all the results obtained up to the year 1860, arrived at conclusions thus stated by Sir J. Herschel:—"The earth is not exactly an ellipsoid of revolution. The equator itself is slightly elliptic, the longer and shorter diameters being respectively 41,852,864, and 41,843,096 feet. The ellipticity of the equatorial circumference is therefore $\frac{1}{4283}$, and the excess of its longer over its shorter diameter about two miles. The vertices of the longer diameter are situated in longitude 14° 23′ E and 194° 23′ E. of Greenwich, and of its shorter in 104° 23′ E. and 284° 23′ E. The polar axis of the earth is 41,707,796 feet in length, and consequently the most elliptic meridian (that of longitude 14° 23′ and 194° 23′) has for its ellipticity $\frac{1}{287 \cdot 5}$, and the least (that of longitude 104° 23′ and 284° 23′) an ellipticity of $\frac{1}{308 \cdot 5}$."

General Schubert, using a method which Sir J. Herschel justly regards as less trustworthy, "makes the ellipticity of the equator $\frac{1}{8885}$, and places the vertices of the longer axis 26° 41′ to the eastward of Captain Clark's. His polar axis, as deduced from each of the three great meridian arcs, the Russian, Indian, and French respectively, is 41,711,000 feet, 41,712,534 feet, and 41,697,496 feet, the mean of which, giving to each a weight proportional to the length of the arc from which it is deduced, is 41,708,710 feet."

Earth's mass and density. The figure and volume of the earth being thus determined, we require only to ascertain its mean density in order to know its mass. But this problem has not been solved, probably cannot be solved, with any very near approach to exactness. Various methods have been employed, the mere description of which suffices to show the difficulty and uncertainty of the subject.

Mountain experiments. The deviation of the plumb line from the vertical in the neighbourhood of a mountain had been pointed out by Newton[1] as a direct method of dealing with the problem of

[1] *De Mundi Systemate*, § 22. Newton, in a very remarkable passage of the Third Book of the *Principia* (Prop. X.), conjectures that "the quantity of matter in the earth may be five or six times greater than if the whole were composed of water."

determining the earth's density. Bouguer had the merit of pointing out the form in which the experiment might be made, and of making the trial, though in a rude and insufficient manner, in the Peruvian Andes in 1738. Maskelyne proposed to the Royal Society in 1772 to repeat the observation on some British mountain. Skiddaw and the Yorkshire Hills were first thought of, but finally Schihallion in Perthshire was preferred. The distance between the two stations, obtained with Ramsden's 9-inch theodolite, was 4364·4 feet, which in the latitude of Schihallion corresponds to 42″·94 of latitude. The observed difference of latitude by 337 observations with Sisson's 10-feet zenith sector was 54″·6. The excess, or 11″·6, is the double attraction of the hill drawing the plumb-line towards itself at the two stations. The sine of this angle, or $\frac{1}{17804}$, represents the *actual* ratio between the double attraction of the hill and the attraction of the earth. But by the computation of the attraction which the hill ought to exert, from its figure, as determined by Maskelyne's gauges, were its density the same as that of the globe generally, this ratio should amount to $\frac{1}{9933}$, which can only be accounted for by assuming the earth to be denser on the average than the hill of Schihallion in the proportion of 17,804 to 9933. A careful lithological survey of the hill enabled Professor Playfair to deduce the probable mean specific gravity of the globe to be between 4·56 and 4·87.

Cavendish experiment.

A second method was devised by the Rev. Mr Michell, but first put in practice by Mr Cavendish in 1797–8. It consisted in measuring the force of gravitation between two spheres of such small size that they could be moved by the hand nearer to or farther from one another. To provide a balance so delicate as to measure the almost inappreciable attraction of such small bodies, Michell imagined the *balance of torsion.* His apparatus came into the hands, first of Wollaston, then of Cavendish, who made the experiment. He used a very light rod of deal, six feet long, suspended by a fine silver or copper wire, forty inches long, within a wooden case to defend it from currents of air. At each end of the lever was hung a ball of lead, two inches in diameter, and by a simple contrivance a pair of leaden spheres, weighing together 348 pounds, could be brought simultaneously into the neighbourhood of the balls (but outside the case), on opposite sides, so that their attractions might concur to swing the suspended lever out of the position of repose which it had previously taken up, under the action of the slight twisting force of the silver wire. A new position of rest was thus established, the small balls being pulled as much one way by the attraction of the spheres as they were urged in the opposite direction by the torsion of the wire. The position of repose being observed from a distance by a telescope (to avoid disturbance from the heat of the observer's body), the great spheres were then changed in position so as to act upon the opposite sides of the small balls, from what they formerly did. The deflection and new stable position would be as much on the other side of the zero, and the arc described would be an accurate measure of the double deflection. The force of torsion for one degree of deflection is known by the time of oscillation of the lever and balls when free, and as the forces are exactly as the angles, the force corresponding to any displacement becomes known. Cavendish found the joint attraction of the small balls and large spheres to be about $\frac{1}{4300}$ of a grain, their centres being 8·85 inches apart, and he thence computed the density of the earth to be 5·48 times that of water. The experiment has been repeated since by Reich of Freiberg and Baily of London. The former obtained 5·44, the latter 5·66 for the earth's specific gravity,—this last result being worthy of much confidence, from the extraordinary care taken to avoid errors and to obtain independent values of the quantities sought.

Pendulum experiments.

A third method of determining the earth's density depends on the fact that a pendulum suspended at a considerable height above the earth would swing more slowly than at the surface, while if it be at the summit of a mountain, though it will still swing more slowly, the attraction of the mountain will slightly accelerate the rate of swing. Carlini and Plana, by observations made on this plan, have deduced 4·950 for the mean density of the earth. The objection to this method, as well as to the Schihallion experiment, resides in our uncertainty as to the actual mean density of any given mountain mass. If the experiment could be carried out by pendulum observations made at the base and on the summit of a conical or conoidal mass, of some known material and of great height, the true density of the earth could thence be very accurately determined.

A similar objection applies to the converse of the third method described above. If a pendulum be suspended at the bottom of a deep mine, of known figure, and existing in a region whose geological structure is well known, the change of rate gives a means of calculating the density of the earth, since it obviously depends on the calculable difference of attraction due to increased proximity to the earth's centre (reducing the attraction), and to the absence of counter-attracting matter where the mine is dug out (which in effect increases the attraction). In the Harton colliery, experiments were carried out by Mr Dunkin on this plan in accordance with arrangements devised by the astronomer royal. It was found that gravity was increased by $\frac{1}{19190}$th part at the lower station, 1260 feet below the mouth of the mine, where the upper station was placed. Hence Airy found that, on taking into account the configuration of the mine and the structure of the surrounding region, a density of 6·565 resulted. Very little reliance can be placed, however, on results obtained by this method.

It may be fairly assumed that the earth's mean density amounts to about 5·6 times the density of water, combining which with the known dimensions of the earth, we find that the earth's weight in tons may be roundly expressed by the number 6,000,000,000,000,000,000,000.

Position of earth's axis.

We have next to inquire into the rotation of the earth about its axis, and especially into the position of that axis. In Chapter I. we considered the axis as fixed in position; or, seeing that the earth circles around the sun, we regarded the axis as moving always parallel to itself, while the earth traversed her path in the plane of the ecliptic. But we must now take into account variations in its position with reference to the ecliptic. In this inquiry we should naturally take the ecliptic as our plane of reference, if we were assured that the position of the plane of the ecliptic is constant,—in other words, that the sun's path in the heavens undergoes no change. This is, in fact, so nearly the case that the ecliptic forms a suitable reference circle for the fixed stars—far more suitable for example than the equator itself. The star's *latitude*, that is, its distance from the ecliptic measured on the arc of a great circle through the poles of the ecliptic, is very nearly constant, while the *longitude*, or the distance between the point ♈ and the point where the great circle through the star cuts the ecliptic, undergoes, as will presently appear, a variation nearly uniform, and nearly the same for every star; whereas the declination and right ascension of stars are undergoing variations which are neither alike for different stars nor uniform for any star. Yet the place of the ecliptic on the heavens is not absolutely constant. The ecliptic, in fact, is inclined about 1½° to the invariable plane mentioned at the end of Chapter VI., and this inclination is undergoing a slow process of change, while the nodes of the ecliptic on it are slowly shifting. A result of this is that the obliquity of the ecliptic is changing, for the mean inclination of the earth's axis to the invariable plane does not change, so that the mean inclination of this axis to the ecliptic must necessarily change. At present the obliquity of the ecliptic—that is, the inclination of the equator to the ecliptic—is diminishing; and this process, which has been going on for many centuries, will continue for a long time yet to come, after which the obliquity will increase, the total range on either side of the mean value amounting to about 3°. The various observations and traditions by which the progressive diminution of the obliquity is confirmed have been collected by Bailly. The following table contains those which appear to be the best authenticated, as well as the results of some more recent observations, from which the present value of the obliquity and the rate of its diminution may be deduced:—

Change of obliquity of ecliptic.

Year.	Name of Observer	Obliquity.		
Before Christ.		°	′	″
1100	Tcheou-Kong	23	54	3
200	Eratosthenes, confirmed by Hipparchus and Ptolemy	23	51	15
160	The Chinese	23	45	52
After Christ.				
827	Arabians at Baghdad	23	33	52
880	Albategni	23	35	40
1150	Almansor	23	33	30
1278	The Chinese	23	32	12
1437	Ulugh Begh	23	31	58
1490	Walther	23	29	47
1590	Tycho	23	29	52
1646	Riccioli	23	30	20
1660	Hevelius	23	29	10
1672	Cassini	23	29	00
1690	Flamsteed	23	28	48
1703	Bianchini	22	28	35
1736	Condamine	23	28	24
1743	Cassini de Thury	23	28	26
1750	Lacaille	23	28	19
1755	Bradley	23	28	15
1756	T. Mayer	23	28	16
1769	Maskelyne	23	28	10
1780	Cassini	23	27	54
1800	Maskelyne	23	27	56·6
	Piazzi	23	27	56·3
	Delambre	23	27	57
1813	Pond	23	27	48·66
1815	Bessel	23	27	47·46
1816	Brinkley	23	27	49 21
1825	Pearson	23	27	44 01

Although the comparison of these observations with one another gives very discordant results relatively to the law according to which the obliquity varies, their totality places the fact of its progressive diminution beyond all manner of doubt. It amounts to about $45\frac{1}{2}''$ per century at present, and may be regarded as uniform for many centuries to come.

Precession of the equinoxes.

The longitudes of the stars, as has already been mentioned, are measured on the ecliptic from the vernal equinox; and therefore, if the line of the equinoxes, which is the same as the line of the nodes, is invariable, the longitude of any star will always be the same, whatever interval of time may elapse between two observations of that longitude. But on comparing the actual state of the heavens with the observations recorded by ancient astronomers, it is perceived that the longitudes of all the stars are considerably increased. The phenomenon is to be explained by attributing to the equinoctial points a retrograde motion from east to west, in consequence of which the sun, whose motion is direct, arrives at them sooner than if they remained at rest; and therefore the equinoxes, and spring, autumn, and the other seasons, happen before the sun has completed an entire circuit. On this account the motion has been denominated the *Precession of the Equinoxes.* As this motion is extremely slow, its exact amount can be discovered only by a comparison of observations separated from each other by long intervals of time. The comparison of modern observations with those of Hipparchus gives as its annual amount $50\frac{2}{3}''$. The mean result of the observations of Tycho, compared with those of Lacaille, gives $50\frac{1}{3}''$. On comparing modern observations with one another, we find 50″·06. Delambre, in his solar tables, supposes the annual precession to be equal to 50″·1. According to this estimate the equinoctial points go backwards at the rate of 1° in 71·6 years nearly, and therefore will make a complete revolution of the heavens in about 25,868 years.

The diminution of the obliquity of the ecliptic arises from the displacement of the ecliptic itself; the precession of the equinoxes is, on the contrary, occasioned by the continual displacement of the plane of the terrestrial equator. This displacement results from the combined action of the sun and moon (for the influence of the planets amounts only to a fraction of a second, and is consequently scarcely sensible) on the mass of protuberant matter accumulated about the earth's equator, or the matter which forms the excess of the terrestrial spheroid above its inscribed sphere. The attracting force of the sun and moon on this shell of matter may be resolved into two; one parallel to the plane of the equator, the other perpendicular to it. The tendency of this last force is to diminish the angle which the plane of the equator makes with that of the ecliptic; and if the earth had no motion of rotation, it would soon cause the two planes to coincide. In consequence, however, of the rotatory motion of the earth, the inclination of the two planes remains constant; but the effect produced by the action of the force in question is, that the plane of the equator is constantly shifting its place, in such a manner that the line of the equinoxes advances in the direction of the diurnal motion, or contrary to the order of the signs, its pole having a slow angular motion about the pole of the ecliptic.

If the sun and moon moved in the plane of the equator, there would evidently be no precession; and the effect of their action in producing it varies with their distance from that plane. Twice a year, therefore, the effect of the sun in causing precession is nothing; and twice a year, namely, at the solstices, it is a maximum. On this account the obliquity of the ecliptic is subject to a semi-annual variation; for the sun's force, which tends to produce a change in the obliquity, is variable, while the diurnal motion of the earth, which prevents the change from taking place, is constant. Hence the plane of the equator is subject to an irregular motion, which is technically called the *Solar Nutation.* The existence of the solar nutation is, however, only a deduction from theory, for its amount is too small to be perceptible by observation; but a similar effect of the moon's action is sufficiently appreciable, and was, in fact, discovered by Bradley before theory had indicated its existence. Its period, however, is different, and depends on the time of the revolution of the moon's nodes, which is performed in 18 years and about 7 months. During this time the intersection of the lunar orbit with the ecliptic has receded through a complete circumference, and the inequality of the moon's action will consequently, in the same time, have passed through all its different degrees. Bradley observed that the declinations of the stars continued to augment during nine years, that they diminished during the nine years following, and that the greatest change of declination amounted to 18″. He remarked further, that this motion was connected with an

Nutation.

irregularity of the precession of the equinoxes, which followed exactly the same period; whence he concluded that the motion of the poles of the equator, occasioned by this vibration of its plane, was not confined to the solstitial colure. A series of observations on stars differently situated proved that all the phenomena could be explained on the hypothesis that the pole of the equator describes in 18 years a small circle of 18″ diameter, contrary to the order of the signs; or that the axis of the earth, following the circumference of this circle, describes the surface of a cone, the axis of which forms with its side an angle of 9″. This apparent vibratory motion is denominated the *Nutation of the Earth's Axis.*

Bradley remarked that the effects of the nutation would be represented still more accurately by supposing the curve described by the pole of the equator about its mean place to be, not a circle, but an ellipse, the transverse and conjugate axes being 18″ and 16″ respectively. This is also confirmed by theory, from which Laplace calculated the semi-axes of the ellipse at 9″·63 and 7″·17. The semi-transverse axis of the ellipse described by the pole in virtue of the sun's action alone does not exceed half a second, and is therefore scarcely appreciable. The sensible part of the nutation follows exactly the period of the revolution of the nodes of the moon. By 603 observations of Polaris, made at Dorpat between 1822 and 1838, M. Peters has determined the semi-axis major of the ellipse to be 9″·2361, and gives, for his definitive result, 9″ 2231.

We must draw a distinction then, between the *mean* and the *true* or *apparent* obliquity of the ecliptic. The mean obliquity is the obliquity calculated for any particular date on the supposition that there is no nutation, while the true obliquity is that quantity increased or diminished by the nutation. The progressive diminution of the mean obliquity and the nutation of the earth's axis are inequalities distinguished from each other, not only by their being derived from different and distinct causes, but still more by the very great difference of time required for their full development.

Change of eccentricity and perihelion of earth's orbit.

The path in which the earth at present travels around the sun is indicated in the elements (p. 782). Plate XXVII. also shows the varying rate at which the earth moves owing to the eccentricity of her orbit. It will be seen also from that plate, and more precisely from the table of elements, that the perihelion of the orbit lies near the place of the winter solstice, so that, in fact, about ten days after midwinter of the northern hemisphere the earth is at her nearest to the sun. An important difference thus exists between the seasons of the two hemispheres. In the northern we have the sun farthest from us a few days after midsummer, while at the corresponding season in winter the sun is at his nearest. So far, then, as the sun's distance is concerned, the seasons are rendered more moderate for the northern hemisphere by the effects of the earth's eccentricity. Nor is the difference on this account by any means inconsiderable. The sun in aphelion is farther from us than in perihelion in the proportion of about 61 to 59, and the earth receives more heat in the proportion of about 31 to 29, or roughly, about $\frac{1}{15}$th more heat in aphelion than in perihelion. There is also a difference due to the varying rate of the earth's real (that is, of the sun's apparent) motion. In winter the earth moves more rapidly than in summer, really as 61 to 59, but the apparent change of the sun's rate of motion along the ecliptic is as 31 to 29, because the increased rate is magnified by the earth's greater proximity. Hence the interval from the autumnal to the vernal equinox is shorter than the interval from the vernal to the autumnal equinox. This also is shown by Plate XXVII., where the number of divisions marking the earth's daily journey is seen to be greater in the summer half than in the winter half of the orbit. Thus the winter cold is less enduring than the summer heat. In the southern hemisphere all these relations are reversed. The summer heat is rendered more intense by the greater proximity of the sun, the winter cold is intensified by his increased distance. The summer heat is less enduring than the winter cold. We have in the north a relatively short but moderate winter (so far as the sun's proximity can moderate winter cold); and a long but also moderate summer; in the southern hemisphere they have a short and intensely hot summer, a long but also intense winter. The presence of a great expanse of sea in the southern hemisphere partially tends to moderate the seasonal changes; but we see in the wider extension of the antarctic snows the effect of the long and cold winter and the short summer. We have, however, referred to these considerations less on account of their intrinsic importance, than to show how the eccentricity of the earth when near its maximum value, and when the perihelion was differently situated from its present position, may have caused the condition of the two terrestrial hemispheres to differ from that now existing. The present value of the eccentricity is nearer the minimum than the maximum value, though the perihelion is at present so placed as to produce almost the maximum possible difference between the two hemispheres, with the present degree of eccentricity. It must not be supposed that the eccentricity, in obedience to the law relating to planetary eccentricities (Chapter VI.), oscillates between the absolute maximum and the absolute minimum, the perihelion shifting continuously forwards. On the contrary, the successive maxima and minima are very unequal, and are attained after very unequal intervals; while the perihelion, apart from short periods of regression, and though always progressing on the whole in any considerable period, yet progresses at very unequal rates in different periods. This will be seen from the following table, presenting the eccentricity as calculated for different epochs from 1,100,000 years before our present era till now, chiefly by Mr James Croll, but partly from Leverrier and Stone:—

Years B C	Eccentricity of Earth's Orbit.	Longitude of Perihelion.
1,100,000	0·0303	54° 12′
1,050,000	0 0326	4 8
1,000,000	0 0151	248 22
990,000	0·0224	313 50
980,000	0·0329	358 2
970,000	0·0441	32 40
960,000	0·0491	66 49
950,000	0·0517	97 51
940,000	0·0495	127 42
930,000	0 0423	156 11
920,000	0·0305	181 40
910,000	0·0156	194 15
900,000	0·0102	135 2
890,000	0·0285	127 1
880,000	0·0456	152 33
870,000	0·0607	180 23
860,000	0·0708	209 41
850,000	0·0747	239 28
840,000	0·0698	269 14
830,000	0 0623	298 28
820,000	0·0476	326 4
810,000	0·0296	348 30
800,000	0·0132	343 49
790,000	0·0171	293 19
780,000	0·0325	303 37
770,000	0·0455	328 38
760,000	0·0540	357 12
750,000	0·0575	27 18
740,000	0·0561	58 30
730,000	0·0507	90 55

Years B C.	Eccentricity of Earth's Orbit.	Longitude of Perihelion.
720,000	0·0422	125° 14′
710,000	0 0307	177 26
700,000	0·0220	208 13
650,000	0·0226	141 29
600,000	0·0417	32 34
550,000	0·0166	251 60
500,000	0·0388	192 56
450,000	0·0308	356 52
400,000	0 0170	290 7
350,000	0·0195	182 50
300,000	0·0424	23 29
250,000	0 0258	59 39
240,000	0·0374	74 58
230,000	0·0477	102 49
220,000	0 0497	124 38
210,000	0·0575	144 65
200,000	0·0569	168 18
190,000	0 0532	190 4
180,000	0 0476	209 22
170,000	0 0437	228 7
160,000	0·0364	236 38
150,000	0·0332	242 56
140,000	0·0346	246 29
130,000	0·0384	259 54
120,000	0·0431	274 47
110,000	0·0460	293 48

Years B C.	Eccentricity of Earth's Orbit.	Longitude of Perihelion.	Year A.D	Eccentricity of Earth's Orbit.	Longitude of Perihelion.
100,000	0·0473	316 18	1850	0·0168	100° 22′
90,000	0·0452	340 2	· To these add Croll's special calculation for the maximum eccentricity between 851,000 B C. and 849,000 B C.		
89,000	0·0398	4 13			
70,000	0·0316	27 22			
60,000	0·0218	48 8			
50,000	0·0131	50 3			
40,000	0·0109	28 36			
30,000	0 0151	5 50	851,000	0 07454	...
20,000	0·0188	44 0	850,000	0·074664	...
10,000	0 0187	78 28	849.500	0·07466	...
			849,000	0·07456	...
0	0·0168	99 30			

While the shape of the earth's orbit and the position of its centre (whose longitude = long. of perih. + 180°) thus undergo continual alteration, her mean distance from the sun remains appreciably constant. This we know from the length of the year, which certainly has not changed ten seconds in length since the time of the Chaldean determination of that element.

Determination of sun's distance. There are various ways of determining the sun's distance from the earth in terms of the earth's semidiameter. The distance of a planet from the sun may likewise be obtained if we can find the means of measuring its distance from the earth at any epoch, for the geocentric positions of the sun and the planet being known from the theory of their motions, the radius vector of the orbit, or planet's distance from the sun at that epoch, may be found by a simple trigonometrical computation. To determine the distance of a planet from the earth, it might seem only necessary to determine its horizontal parallax; but in general the parallaxes of the planets are quantities by far too small to be directly observed. That of Mars, however, becomes very appreciable in particular circumstances, that is to say, when Mars is in opposition with the sun, and at the same time near the perihelion of his orbit. Thus, in the year 1751, on the 6th of October, that planet, being near his opposition, was observed at the same instant of time by Lacaille at the Cape of Good Hope, and by Wargentin at Stockholm; and the horizontal parallax deduced from the two observations, was found to amount to 24″·6, corresponding to a solar parallax of 9″·4.

Parallax of Mars. This method requires that observations should be made from opposite sides of the earth; but Flamsteed long ago pointed out that the distance of Mars might be determined by observing how much the planet's place is shifted by the diurnal rotation of the earth. Both methods have been employed very successfully in modern times. Stone, of Greenwich, by combining the two methods, discussing observations of Mars at the opposition of 1862,—made (1), at Greenwich, (2), at Greenwich and Cape Town, and (3), at Greenwich and Williamstown,—deduced a solar parallax of 8″·943. Winnecke, from the discussion of the same opposition as observed at Poulkowa and Cape Town, deduced the solar parallax 8″·964. Professor Newcomb of Washington, U.S., deduced the value 8″·855.

Transits of Venus. A more accurate method of determining the sun's distance, and thence the dimensions of the planetary orbits, is afforded, though rarely, by the transits of Venus over the sun's disk. When Venus is at her inferior conjunction, and at the same time very near either node, her body will be projected on the disk of the sun; and through the effect of her proper motion, combined with that of the earth, she will appear as a dark spot passing over the disk, and describing a chord which will be seen under different aspects by spectators placed at different points on the earth, because, by reason of the parallax, they refer the planet to different points on the solar disk. The position of the spectator not only occasions a difference in the apparent path described by the planet, but has also a very sensible influence on the duration of the transit, in consequence of which the parallaxes both of Venus and the sun can be determined with great exactness. In order to illustrate this, let E (fig. 33) represent the earth, V Venus, and S the sun. An observer placed at E, near the north pole of

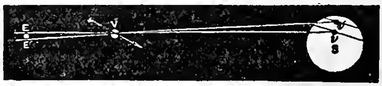


FIG. 33.—Diagram illustrating Transit of Venus.

the earth, would see Venus projected on the sun's disk at v, and she would appear to describe the line lvm. An observer placed at E′, near the south pole, would see the planet at v', and she would appear to describe the chord $l'v'm'$. This is a necessary result of the difference of the parallaxes of Venus and the sun; and as the chords lv, $l'v'$ differ in length according as they are more or less remote from the centre of the disk, the duration of the transit will be longer or shorter according to the situation of the observer and the geocentric latitude of the planet. If by reason of the relative parallax the time of a transit is longer than the true time in one hemisphere, it will be shorter in the other; and hence the difference of the times (which may be observed with great accuracy) at places having very different latitudes may serve to determine the relative parallax, or the difference between the parallax of Venus and that of the sun. But the parallaxes are reciprocally proportional to the distances; and the ratio of the distances being known, therefore the ratio of the parallaxes is also known; and having thus the ratio and the difference of the two parallaxes, it is easy to compute the separate amount of each.

This particular application of the transits of Venus to the determination of the sun's distance was first pointed out by Dr Halley, when he announced the transit of 1761. The transit of Venus in 1769 was observed in many different parts of the world. The result of the whole of the observations led to the conclusion, that the parallax of the sun is included within the limits 8″·5 and 8″·7. The mean 8″·6 was adopted by Delambre and Lalande; and later the value 8″·5776 was deduced by Encke from a careful re-examination of all the observations made in 1761 and 1769. But several methods have been since applied to the determination of the solar parallax, with results which appear to agree in indicating a larger value for the parallax, or in other words, a smaller value for the sun's distance, than had been deduced from the transits of 1761 and 1769.

Parallactic inequality. One of these depends on the moon's motions, and was first indicated by Laplace towards the close of the last century. Since the moon's distance from the earth, though small compared with the sun's, bears yet a measurable ratio thereto, it follows that there is not a perfect symmetry between the perturbations produced by the sun when the moon is passing from third to first quarter, and from first to third. The effect of this circumstance is recognisable in the lunar motions, which are affected by a minute variation arising from this cause, and called the *Parallactic Inequality*. It amounts at the maximum to about 2′; and as it depends on the proportion of the sun's distance to the moon's known distance, its amount supplies a means of determining the solar parallax. In 1854 Hansen announced, in a letter addressed to the astronomer royal, that this method, applied to his new tables of the lunar motions, gives a parallax of 8″·9159.

A second method depends on the fact, that the earth in reality revolves, in the course of a lunar month, around the common centre of gravity of her own globe and the moon's. The diameter of the orbit thus circuited by the earth (in the same sense, at least, as the moon may be said to circuit in her monthly orbit) amounts to about 6000 miles, and by the radius of this small orbit the earth is sometimes in advance of and sometimes behind her mean position in heliocentric longitude. The sun's geocentric longitude is affected to precisely the same degree as the earth's heliocentric longitude; and by determining the actual amount of the sun's displacement, we can ascertain what angle the mean diameter of the earth's monthly orbit subtends at the sun. Leverrier, by the careful study of a great number of observations of the sun made at the principal observatories in Europe, came to the conclusion that the solar parallax is 8″·95. But recently Mr Stone of Greenwich detected a numerical error in Leverrier's computations, and when this is corrected, the value 8″·91 results. Prof. Newcomb of Washington has by the same method deduced the value 8″·84.

Velocity of light.

Another method, depending on terrestrial measurements of the velocity of light, need not be here described, as the principles involved are mainly optical, and belong to the subject of LIGHT. Of course the comparison between the velocity of light measured without reference to extra-terrestrial bodies, and the velocity inferred from the time of the passage of light over given celestial distances, supplies at once the means of testing the accepted measures of these distances. Fizeau, by a measurement of the velocity of light depending on the rapid rotation of toothed wheels, has deduced a solar parallax falling even somewhat short of that obtained by Delambre from the transit of 1769. But Fizeau's method is not susceptible of great exactness. Foucault, by a much more effective method (the principle of which is due to Wheatstone), depending on the use of revolving mirrors, deduced the value 8″·942.

Deduced solar parallax.

We have seen that observations of Mars have given the values 8″·943 in Stone's hands, 8″·964 in Winnecke's, and 8″·855 in Newcomb's. By combining, according to their various importance, the values indicated above, the astronomer royal and Leverrier deduced the probable mean value 8″·94. Unfortunately, Leverrier's own estimate had not been corrected when this value was adopted, and 8″·92 may be considered as in all probability nearer the truth. But for the present 8″·94 may be adopted for convenience, as it has been used in the recalculation of the dimensions of the solar system by nearly all writers on astronomy in Europe and America. It is the value which has been used in the table of Elements at p. 782. Mr Stone, after discussing the observations made in 1769, with special reference to the effects of the peculiarity at the internal contacts of Venus, described in Chapter VIII., *supra*, has arrived at the conclusion, that the value 8″·9 more correctly represents the observations of 1769 than Delambre's 8″·6, or Encke's 8″·5776. But little value can be attached to this result, seeing that the correction for the interval of time between real contact and apparent contact comes out from the equations themselves which are made use of to determine the parallax, and this correction 17ˢ is constant, whereas the observed time difference in 1769 was not only far from constant, but in every instance far exceeded 17ˢ. One or two English astronomers still attach weight to Mr Stone's investigation, but Continental and American astronomers are unanimous in discarding it.

Much interest attaches to the late transit of 1874, now known to have been successfully observed at a sufficient number of stations to ensure success. At most of the stations the whole transit was observed by Halley's method. At the English stations in the northern hemisphere another method called Delisle's was employed. This method depends on the observation and eventual comparison of the absolute times of ingress or egress, where these phenomena are considerably accelerated or retarded by the effects of parallax. Photography has also been applied, as well as direct micrometrical measurement, to determine the planet's distance from the sun's centre at different epochs.

Owing to certain mistakes made with reference to the relative values of the two methods of observation, for the transits of 1874 and 1882, it was long thought that Delisle's only could be applied; and it was stated positively that Halley's method fails totally in 1874. But fortunately the mistake was discovered in good time, and in the summer of 1873, the leading astronomers of England urged the desirability of applying Halley's method. At the time of writing (April, 1875), the reports from the principal stations, though promising excellent results, afford no means of determining what changes will have to be made in our estimate of the sun's distance. The first rough analysis of some of the observations gives 8″·88 for the solar parallax. Another transit of Venus will occur on December 6, 1882; after which Venus will not again transit the sun until June 8, 2004, and June 6, 2012. The beginning of the transit of 1882, the whole transit of 2004, and the end of the transit of 2012, will be visible in England.

CHAPTER X.—*The Moon—Her Phases, Parallax, Magnitude, Motions, and Probable Physical Conditions.*

The different appearances or phases of the moon were probably the first celestial phenomena observed with any degree of attention. They have been described in general terms in Chapter IV., but must now be more particularly considered. The following definitions may conveniently be given in this place. When the moon passes the meridian at the same time with the sun, she is said to be in *Conjunction*. The two points of her orbit in which she is situated when in opposition and conjunction are called the *Syzygies;* those which are 90° distant from the sun are called the *Quadratures;* and the intermediate points between the syzygies and quadratures are called the *Octants.*

A slight attention to the lunar phases during a single revolution will be sufficient to prove that they are occasioned by the reflection of the sun's light from the opaque spherical surface of the moon. This fact, which was recognised in the earliest ages, will be made obvious by the help of a diagram. If the moon is an opaque body, we can only see that portion of her enlightened side which is towards the earth. Therefore, when she arrives at that point of her orbit M_1 (fig. 34) where she is in conjunction with the sun S, her dark half is towards the earth, and she disappears, as at 1, fig. 35, there being no light on that half to render it visible. When she comes to her first octant, at M_2, or has gone an eighth part of her orbit from her conjunction, a quarter of her enlightened side is towards the earth, and she appears horned, as at 2. When she has gone a quarter of her orbit from her conjunction, to M_3, she shows us one-half of her enlightened side, as at 3, and we say she is a quarter old. At M_4, she is in her second octant, and by showing us more of her enlightened side she appears gibbous, as at 4. At M_5, her whole enlightened side is towards the earth, and therefore she appears round, as at 5, when we say it is full moon. In her third octant, at M_6, part of her dark side being towards the earth, she again appears gibbous, and is on the decrease, as at 6. At M_7, we just see one-half of her enlightened side, and she appears as a semicircle, as at 7. At M_8, when she is in her fourth octant, we only see a quarter of her enlightened side, and she appears horned, as at 8. And as

Lunar phases explained.

M_1, having completed her course from the sun to the sun again, she disappears, and we say it is new moon.

The moon's absolute distance from the earth is obtained by means of her parallax, which on account of her proximity

FIG. 34.—Diagram illustrating the Phases of the Moon.

is very considerable. On comparing her parallaxes observed at different times, they are found to differ considerably in value. These differences in the value of the parallax arise from the variations of the moon's distance from the earth. But it is also observed to differ sensibly at different points of the earth's surface, even at

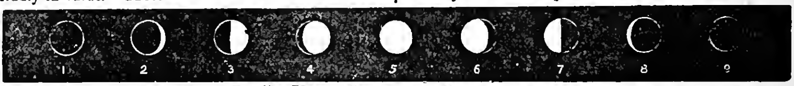


FIG. 35.—Diagram illustrating the Phaser of the Moon.

the same instant of time, on account of the spheroidal figure of the earth. Hence it is necessary, in speaking of the horizontal parallax, to specify the place of the observation.

Constant of parallax. Since the parallax of the moon is subject to incessant variation, it is necessary to assume a certain mean value, about which the true and apparent values may be conceived to oscillate. This is called the constant of parallax. If we abstract all the inequalities of the lunar orbit, and suppose the moon to be at her mean distance and mean place, the constant of parallax will be the angle under which a given semidiameter of the earth is seen by a spectator at the moon in such circumstances. But, for convenience, the constant of parallax is understood to be $= \frac{\text{earth's equat. rad.}}{\text{moon's mean dist.}}$, which, see Chapter IV, is in reality = sine of the mean horizontal parallax.

The best modern observations assign 57′ 2″·7 as the value of the lunar mean equatorial horizontal parallax, corresponding to a distance of 238,818 miles. The mean equatorial parallax being 57′ 2″·7, its double is 1° 54′ 5″·4, which expresses the angle subtended by the diameter of the earth at the distance of the moon. The angle subtended by the moon at the same distance is 31′ 5″·1; whence the diameter of the moon is to that of the earth as 31′ 5″·1 is to 1° 54′ 5″·4, or as 3 to 11 nearly. The accurate expression of the above ratio is 1 : 0·27251; hence the true diameter of the moon is 0·2725 diameters of the terrestrial equator. The surface of the moon is consequently $(0{\cdot}02725)^2 = 0{\cdot}0742 = \frac{1}{13\frac{1}{471}}$ of that of the earth, and its volume $(0{\cdot}2725)^3 = 0{\cdot}0202 = \frac{1}{49\frac{1}{441}}$ or, in round numbers, $\frac{2}{99}$ths of the volume of the earth. For other elements, see table of Lunar Elements, p. 782.

The *Ascending Node* of the lunar orbit is that point of the ecliptic through which the moon passes when she rises above the ecliptic towards the north pole; it is distinguished by the character ☊. The *Descending Node*, ☋, is the opposite point of the ecliptic, through which she passes when she descends below that plane towards the south. The position of the nodes is not fixed in the heavens. They move in a retrograde direction, or contrary to the order of the signs; and their motion is so rapid that its effects become very apparent after one or two revolutions.

The mean retrograde motion of the nodes is found, by the comparison of observations made at distant epochs, to amounts to 19° 21′ 18″·3 in a mean solar year, and the time in which they make a tropical revolution is consequently 6793·391 mean solar days. The inclination of the lunar orbit is observed to vary between 5° 3′ and 5° 13′. The mean inclination may be taken at 5° 8′.

The inclination of the lunar orbit to the plane of the terrestrial equator occasions considerable differences in the intervals between the moon's rising or setting on successive days, and gives rise to the phenomenon of the *Harvest Moon*. Harvest moon. As the daily motion of the moon is about 13° from west to east, it follows that if she moved in a plane parallel to the equator, she would rise 50 minutes later every successive evening. For the sake of explanation, we may here suppose the moon to move in the plane of the ecliptic. Now, the time in which a given arc of the ecliptic rises above the horizon depends on its inclination to the horizon. In our latitudes the inclination of the ecliptic at different points to the horizon varies so much, that at the first point of Aries an arc of 13° becomes visible in the short space of 17 minutes, while at the 23d of Leo the same arc will only rise above the horizon in 1 hour and 17 minutes. Hence, when the moon is near the first point of Aries, the difference of the times of her rising on two successive evenings will be only about 17 minutes; and as this happens in the course of every revolution, she will rise for two or three nights every month at nearly the same hour. But the rising of the moon is a phenomenon which attracts no attention, excepting about the time when she is full, that is, when she rises at sunset. In this case she is in opposition to the sun, and consequently, if she is in Aries, the sun must be in Libra, which happens during the autumnal months. At this season of the year, therefore, the moon, when near the full, rises for some evenings at nearly the same hour. This circumstance affords important advantages to the husbandman, on which account the phenomenon attracts particular attention.

It is obvious that, as this phenomenon is occasioned by the oblique position of the lunar orbit with regard to the equator, the effect will be greater than what has just been described if the plane of that orbit makes a greater angle with the equator than the plane of the ecliptic does. But we have seen that the plane of the moon's orbit is inclined to the ecliptic in an angle exceeding 5°; consequently, when her ascending node is in Aries, the angle which her orbit makes with the horizon will be 5° less than that which the ecliptic makes with the horizon, and the difference of time between her risings on two successive evenings will be less than 17 minutes, which would have been the time had her orbit coincided with the ecliptic. On the contrary, when the descending node comes to Aries, the angle which her orbit makes with the horizon will be greater by 5°, and consequently the difference of the times of her successive risings will be greater than if she moved in the plane of the ecliptic. If when the full moon is in Pisces or Aries the ascending node of her orbit is also in one of those signs, the difference of the times of her rising will not exceed 1 hour and 40 minutes during a whole week; but when her nodes are differently situated, the difference in the time of her rising in the same signs may amount to 3½ hours in the space of a week. In the former case the harvest moons are the most beneficial, in the latter the least beneficial to the husbandman. All the variations in the intervals between the consecutive risings or settings take place within the period in which the line of the nodes makes a complete revolution.

Lunar theory

The moon's orbit at any moment is an ellipse, having the earth at one of the foci; but this orbit is continually changing in form and position, the eccentricity alternately increasing and decreasing between the limits 0·066 and 0·044, and the perihelion sometimes advancing and sometimes retrograding, but on the whole advancing at an average rate of 40⅔° per annum, so as to complete a sidereal revolution in 3232·575 mean solar days. See also table of Lunar Elements. These changes, like those which affect the inclination of the orbit and the position of the nodes, are due to the perturbing influence of the sun on the moon's motions relatively to the earth. The consideration of these perturbations, whether as affecting the figure and position of the moon's orbit, or her motions in that orbit, constitutes what is called the *Lunar Theory*. The following are the chief peculiarities of the lunar movements :—

Equation of moon's centre.

In the first place, the moon's motion differs from uniform motion around the earth as centre, because the moon's orbit is elliptic, so that an equation of the centre corresponding to that already described in dealing with the sun's motion, but greater in amount, has to be applied to the mean motion.

Annual equation.

Secondly, the sun lying constantly far outside the moon's orbit relatively to the earth, his influence on the whole must tend to diminish the earth's influence. It is true that when the moon is in quadrature the sun's attraction tends to draw her towards the earth; but it is manifest that this influence is small compared with the action of the sun in drawing the moon from the earth when she is in conjunction with him, and in drawing the earth from the moon when she is in opposition. The balance of effects during a single lunation must correspond to a diminution of the earth's influence, or in other words, to an increase in the moon's period. Now, if the earth and moon, or their common centre of gravity, were always at the same distance from the sun, this action of his would be uniform all the year round. But as he is nearer in perihelion than in aphelion, he exerts a greater influence in the former than in the latter position; in other words, the lunar month in winter (when the sun is near perihelion) is lengthened to a greater degree by the sun's perturbing action than in summer (when the sun is in aphelion). Accordingly, on the whole, the moon's motion in longitude is less in winter than in summer. She lags behind her mean place more and more throughout the whole time that the sun is at a distance exceeding his mean distance; she is therefore at her maximum displacement, behind her mean place, near the time that the sun is at his mean distance after perihelion passage; while she is at her maximum displacement, in advance of her mean place, when the sun is at his mean distance after aphelion passage. The greatest amount by which, so far as this cause is considered, she gets in advance of or behind her mean place, is about 11′ 12″; and this displacement, because of its period, is called the *Annual Equation*.

The variation.

Since the sun acts to diminish the earth's influence when the moon is in syzygies, and to increase that influence when the moon is in quadratures, the motion of the moon is retarded in the former case and accelerated in the latter; and at the octants there is neither acceleration nor retardation. Hence arises an inequality called the *Variation*. It was discovered by Tycho Brahe, who found that the moon's place, calculated from her mean motion, the equation of the centre, and the evection, does not always agree with her true place, and that the variations are greatest in the octants, or when the line of the apsides makes an angle of 45° with that of the syzygies and quadratures. Having observed the moon at different points of her orbit, he found that this correction has no dependence on the position of the apsides, but only on the moon's elongation from the sun. Its maximum value is additive in the octants which come immediately *after* the syzygies, and subtractive in the octants which precede the syzygies. It vanishes altogether in the syzygies and quadratures, and on this account was not perceived by the ancient astronomers, who only observed the sun in those positions. Its maximum value is 35′ 42″.

The evection.

The next inequality to be mentioned is the largest of all, except, of course, the equation of the centre. It is called the *evection*, and was discovered by Hipparchus, but Ptolemy first recognised the law of its effects. These are to diminish the equation of the centre when the line of the apsides lies in syzygy, and to augment it when the same line lies in quadratures. Thus, supposing the apsides to lie in syzygy, and that it is sought to compute the moon's true longitude about seven days after she has left the perigee, by adding the equation of the centre to the mean anomaly, the resulting longitude will be found to be above 80′ less than that which is given by observation. But if the line of the apsides lies in quadratures, the place of the moon at about the same distance, that is, 90° from the perigee, computed in the same manner, will be found to be before the observed place by above 80′; that is, the computed will be *greater* than the observed longitude by more than 80′. The maximum value of the evection is 1° 20′ 29″·9. It is occasioned by the sun's action in modifying the form of the lunar orbit, and so causing the equation of the centre to vary in amount.

Secular inequalities.

The lunar inequalities which we have as yet considered are all of a periodic nature. But there are others of a different kind, the periods of which are so long that, with reference to the duration of human life, they may be considered as permanently affecting the elements of the lunar orbit. These are the *Secular Inequalities*, the most remarkable of which is the *acceleration of the moon's mean motion*.

Lunar acceleration.

On comparing the lunar observations made within the last two centuries with one another, there results a mean secular motion greater than that which is given by comparing them with those made by Ibn-Junis, near Cairo, towards the end of the 10th century, and greater still than that which is given by comparing them with observations of eclipses made at Babylon in the years 719, 720, and 721 before our era, and preserved by Ptolemy in the *Almagest*. This acceleration of the moon's mean motion was first remarked by Dr Halley, and was fully confirmed by Dunthorne, who was led, by the discussion of a great number of ancient observations of eclipses, to suppose that it proceeded uniformly at the rate of 10″ in 100 years. This was the first attempt to estimate the value of the secular equation, which had hitherto been confounded with the mean secular motion. Mayer was led to the value 7″, which he advanced to 9″ in his last tables published in 1770. Lalande found it to amount to 9″·886. In 1786 Laplace demonstrated that the acceleration is one of the effects of the attraction of the sun, and connected with the variations of the eccentricity of the earth's orbit, in such a manner that the moon will continue to be accelerated while the eccentricity diminishes, but cease to be accelerated when the eccentricity has reached its maximum value; and when that element begins to increase, the mean motion of the moon will be retarded. Professor Adams, however, has recently shown that though a portion of the acceleration is undoubtedly due to the cause assigned by Laplace, in reality one-half or thereabouts remains unexplained by that cause. The researches of Delaunay confirm this view. The theory is entertained that the unexplained part of the acceleration is only apparent, the real cause in operation being a retardation of the earth's motion of rotation.

The same cause which gives rise to the acceleration of the mean motion, namely, the diminution of the eccentricity of the earth's orbit, also occasions secular inequalities in the motion of the perigee and nodes of the orbit of the moon. These two inequalities are, however, affected with opposite signs to that of the former, that is, while the mean motion of the moon is accelerated, the motion of her perigee and that of her nodes are retarded. By pushing the approximations to a great length MM. Plana and Carlini, and M. Damoiseau, in *Memoirs* which obtained the prize of the Academy of Sciences for 1820, found different numbers; those of Damoiseau are 1, 4·702, and 0·612.

The three secular inequalities which have been pointed out will obviously occasion others, for all quantities depending on the mean motion, the motion of the perigee, or of the nodes, must be in some degree modified by them. They can only be developed by the complete integration of the differential equations of motion. What is most essential is to select, among the multitude of terms, such as may possibly acquire considerable co-efficients by integration.

Various lunar months.

Understanding by the term *month* the time which the moon employs to make an entire revolution relatively to any given point, movable or fixed, we have as many different species of months as there are different motions with which that of the moon can be compared. For example, if we estimate her revolution relatively to the sun, the month will be the time which elapses between two consecutive conjunctions or oppositions. This is called the *synodic month*, *lunar month*, or *lunation*. If we consider her revolution as completed when she has gone through 360° of longitude counted from the movable equinox, we shall have the *tropical* or *periodic month*. The interval between two successive conjunctions with the same fixed star is the *sidereal month*. A revolution with regard to the apsides of her orbit, that is to say, the time in which she returns to her perigee or apogee, gives the *anomalistic month*. And, finally, the revolution with regard to the nodes is the *nodical month*.

It is clear that, taking the sidereal lunar month as a standard of reference, any other month will be greater or less according as the point which defines it moves in the same direction around the star-sphere as the moon or in the reverse direction, and that the excess or defect will be greater or less as such motion is more or less rapid. Thus, as the sun advances with considerable rapidity, the synodical month will much exceed the sidereal month; as the point ♈ retrogrades very slowly, the tropical month is very slightly less than the sidereal month; as the apsides advance, on the whole completing a revolution in 8·85 years, the anomalistic month will exceed the sidereal, but only by about $\frac{100}{885}$ths the excess of the synodical month; while, as the nodes retrograde, on the whole, completing a revolution in about 18·6 years, the nodical month will fall short of the sidereal by a defect equal to about $\frac{10}{186}$ths of the excess of the synodical month. This is illustrated in the following table presenting the values of the different lunar months. (See further the table of Lunar Elements, p. 782):—

		Differs from Sidereal Month.
Synodical month	29·53059 days.	+ 2·20893 days
Sidereal ,, ...	27·32166 ,,	0·00000 ,,
Tropical ,, ...	27·32156 ,,	− 0·00010 ,,
Anomalistic ,, ...	27·55460 ,,	+ 0·23294 ,,
Nodical ,, ...	27·21222 ,,	− 0·10944 ,,

The moon at all times presents very nearly the same face to the earth. If this were rigorously the case, it would follow that the moon revolves about an axis perpendicular to the plane of her orbit in the same time in which she completes a sidereal revolution about the earth, and that the angular velocities of the two motions are exactly equal. It is, however, proved by observation, that there are some variations in the apparent position of the spots on the lunar disk. Those which are situated very near the border of the disk alternately disappear and become visible, making stated periodical oscillations, which indicate a sort of vibratory motion of the lunar globe (apparent only), which is known by the appellation of the *Libration*.

Libration.

The rotation of the moon is sensibly uniform, while the motion of revolution is variable. The apparent rotation occasioned by the revolution of the moon round the earth is, consequently, not exactly counterbalanced by the real rotation, which remains constantly the same. Hence the different points of the lunar globe must appear to turn about her centre, sometimes in one direction, and sometimes in the contrary, and the same appearances be produced as would result from a small oscillation of the moon, in the plane of her orbit, about the radius vector drawn from her centre to the earth. The spots near the eastern or western edge of her disk disappear according as her motion in her orbit is more or less rapid than her mean motion. This is called the *Libration in Longitude*. Its maximum value corresponds to a rotation through 7° 45′

Further, the axis of rotation of the moon is not exactly perpendicular to the plane of her orbit; hence the two poles of rotation, and those parts of her surface which are near these poles, are alternately visible from the earth. This is the *Libration in Latitude*. Its maximum value amounts to 6° 44′.

Again, the observer is not placed at the centre of the earth, but at its surface. Thus in the course of a day the moon appears to oscillate about her radius vector because of the earth's rotation. This phenomenon constitutes what is called the *Diurnal Libration*, and is evidently the effect of the lunar parallax, and corresponds to it in amount, measured in minutes of arc. It therefore never exceeds 1° 1′ 28″·8.

The libration in latitude and the diurnal libration were discovered by Galileo soon after the invention of the telescope. It was Hevelius who discovered and first explained the libration in longitude. Regarding libration in general, it remains to be stated that, instead of one-half of the moon remaining invisible, about 4111 parts out of 10,000 are absolutely and at all times unseen. If diurnal libration be neglected, about 4198 parts out of 10,000 may be regarded as altogether unseen.

The nodes of the lunar equator coincide with those of the moon's orbit. The mean inclination of the lunar

Moon's inclination. equator to the ecliptic is 1° 28′ 42″. Mr Baily makes it 1° 30′ 11″·3. Since the descending node of the equator coincides with the ascending node of the orbit, it is evident that its plane lies on one side of a plane parallel to the plane of the ecliptic, while the plane of the orbit lies on the other. Thus the plane of the equator makes an angle of about 1° 30′ with the first, and of 6° 39′ with the second, on the average. But these angles are slightly variable.

The coincidence of the nodes of the lunar equator and orbit ranks among the most curious discoveries of modern astronomy. It was shown by Lagrange to be a necessary consequence of the attraction which the earth exercises on the lunar spheroid.

Spots on the moon. The various features of the moon's surface have been observed with great interest since the discovery of the telescope, and astronomers have been at much pains to determine their selenographic positions. On account of their number, it has been found necessary to distinguish them by particular names. Riccioli designated the most conspicuous of them by the names of astronomers and other eminent men. Hevelius gave them the names belonging to countries, islands, seas, and regions on the earth, without reference to situation or figure. The nomenclature of Riccioli is now universally followed. Delineations of the lunar disk have been given by Hevelius, in his *Selenographia*, by Cassini, Russell, Schröter, Lohrmann, and others. The subjoined engraving (fig. 36) gives a pretty accurate view of the appearance of the moon in her mean libration.

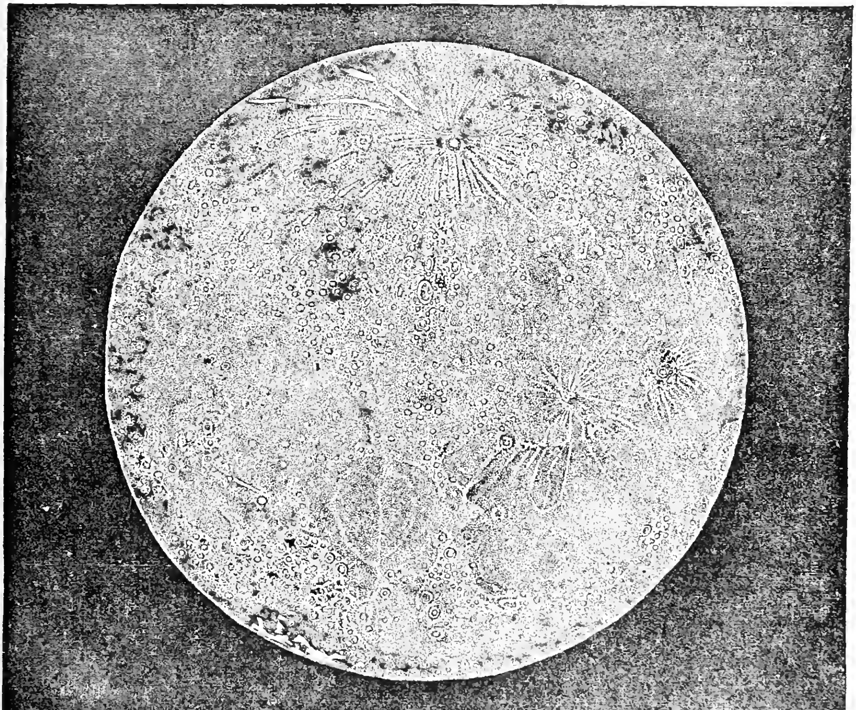


FIG. 36.—The Moon in her mean Libration (telescopic or inverted view).

That there are great inequalities on the surface of the moon is proved by looking at her through a telescope at any other time than when she is full; for then there is no regular line bounding the dark and illuminated parts, but the confines of these parts appear as it were toothed and cut with innumerable notches and breaks; and even in the dark part, near the borders of the enlightened surface, there are seen some small spaces illuminated by the sun's beams. It is impossible that this should be the case, unless these shining points were higher than the rest of the surface, so that the rays of the sun may illumine their summits before they reach their basis. Portions of considerable extent are also perceived on the lunar surface, which are never brilliant like the other parts, but remain constantly obscure. These are thought by some to be old sea-bottoms; they were formerly supposed to be seas, but this idea has been abandoned. Some of these cavities are upwards of four English miles in depth, and forty in circumference at the orifice. An insulated mountain is frequently observed to rise in the centre of these enormous pits or caverns, and they are surrounded by high annular ridges, the masses of which would fill the enclosed cavities.

Herschel imagined that he even observed volcanoes in activity; but it is now known that he mistook for volcanic light the effects of earth-light reflected from those parts of the moon's surface which have the highest reflective capacity. It has been urged that, as the brightness of the moon is sensibly equal at all times, she cannot be surrounded by an atmosphere similar to that of our earth. Moreover, if a lunar atmosphere existed, its influence would be perceptible in the occultations of the planets, or fixed stars, by the moon. The effects of refraction as exerted by an atmosphere resembling the earth's would cause a star to remain visible for a considerable time after it had really passed behind the moon's globe. In fact, it is easily shown that an atmosphere like our earth's would prevent any star from being concealed at all. It would render visible a star really placed directly behind the moon's centre; for the actual refractive effect required for this purpose would correspond to a deviation of the rays of light by about 16′, or 8′ in entering, and 8′ in passing out of the lunar atmosphere. Now the earth's atmosphere produces a refractive effect of 34′ on an orb in the horizon, or more than four times as much as would be required in a lunar atmosphere in order to render visible a star directly beyond the moon's centre. In point of fact, stars are occulted by the moon the instant they reach her edge; or if at any time there is apparent delay, this is such only as may be fairly attributed to the effect of irradiation.

In recent years the surface of the moon has been studied with increased care.

Lohrmann, a land surveyor of Dresden, planned the construction of a lunar chart on a large scale in twenty-five sections, and in 1824 the first four sections were published. He was unable, however, to complete this arduous task, as failing sight compelled him to desist. He published in 1838 a good general chart of the moon, 15¼ inches in diameter.

Amongst contributions to this department of astronomical research must be mentioned the well-executed map by Messrs Beer & Mädler (see their work *Der Mond*). It is the result of several years' careful study and micrometrical measurement of the surface of the moon, and every point discovered by the telescope has been laid down with great precision. In *Der Mond* these astronomers give the measurements of 919 spots, and 1095 determinations of the height of lunar mountains.

Schmidt of Athens has completed the most important contribution yet made to selenographic research. Passing over his earlier and, in his own estimation, unsatisfactory processes of charting, commenced in 1839, we may note that, according to his present plan, the complete chart has a diameter of 6 feet. It is constructed, however, in 25 sections (after Lohrmann's plan), and these are now completed. But the work still awaits publication, as the expenses of engraving must be very great, and are beyond Schmidt's means.

Lunar photography. Photography has been applied successfully to the work of picturing our satellite, though it will probably be long before photographic charts can be produced comparable with the work of Schmidt, or even of Beer and Mädler, so far as details are concerned.

The moon was first photographed by Dr J. W. Draper of New York, in 1840. Bond photographed the moon successfully in 1850, using the telescope of the Cambridge (U.S.) Observatory. Between the years 1850 and 1857, the moon was photographed by Secchi in Rome, Bertch and Arnauld in France, Phillips, Crookes, Hartnup, De la Rue, Fry, Huggins, Dancer, Baxendell, and others in England. Later, De la Rue produced lunar photographs of remarkable accuracy and beauty. But the very best pictures of the moon yet obtained are by Rutherfurd of New York, using a refractor of 11¼ inches aperture, and 13 feet focal length, corrected for the chemical rays.

Moon's brightness. A series of interesting researches has been made into the light-reflecting capacity, or, in point of fact, the *whiteness* of our satellite, by Zöllner of Leipsic. Bouguer had assigned to the moon a brightness equal to $\frac{1}{300000}$th part of the sun's. Wollaston made the proportion much smaller, determining it at $\frac{1}{801070}$th only. Zöllner employed two different methods of research. In one he determined the moon's illumination by tests of her surface brightness; in the other he obtained point-like images of the sun and moon for comparison with corresponding images of candle-flames. The results, lying between those obtained by Bouguer and Wollaston, are also in close agreement *inter se*. According to the former method, the light of the full moon is $\frac{1}{618000}$th part of the sun's light; according to the other, the proportion is as one to 619,000.

But the most interesting results obtained by Zöllner are those relating to the varying brightness of the moon at her different phases. He found that the defect of light when the moon is not full is much greater than it would be if the moon were a smooth but unpolished globe. From the agreement between the observed results and an empiric formula, intended to correspond for phases within 70° of the full moon with the case of an orb grooved meridionally so that the slopes of the grooves' sides are inclined 52° to the surface, Zöllner infers that the average slope of the lunar elevations amounts to about 52°. The following table indicates the degree of approximation :—

Arc from Moon's place to point opposite the Sun.	Theoretical Brightness. Full Moon's as 100.		Observed Brightness.
	Moon regarded as smooth.	By Zöllner's formula.	Zöllner
+ 1°	99·98	98·60	98·60
5	99·63	92·79	87·20
8	99·06	88·41	92·19
11	98·24	84 04	88·76
- 13	97·57	81·21	82·60
+ 19	94·93	72·29	68·41
24	92·13	65·15	71·38
27	90·18	61·00	57·90
– 27	90·18	61·00	63·47
+ 28	89·50	59·60	56·15
– 28	89·50	59·60	57·00
+ 23	85·82	52·90	48·60
– 39	80·87	45·00	41·70
+ 40	80·04	43·70	47·10
41	77·78	42·50	43·95
– 42	76·27	41·40	38:00
+ 46	74·61	36·70	36·10
– 52	68·87	27·63	29:11
+ 58	62·91	24·30	27:10
– 62	58·89	20·60	20·40
– 69	51 82	15·20	14·60

Chapter XI.—*Eclipses of the Sun and Moon.*

Eclipses. Strictly speaking, the term eclipse extends to all cases in which one celestial body is wholly or partially obscured by another, either by direct intervention or by the interception of light illuminating the former, so that the term includes transits of inferior planets, the concealment of stars by the moon or by a planet, or the concealment of a satellite by its primary. But the term eclipse is for convenience limited to the three following orders of phenomena :—(1.) The total or partial concealment of the sun by the moon, called a *solar eclipse*. (2.) The obscuration of the moon by the shadow of the earth, called a *lunar eclipse*. (3.) The concealment of a satellite of a planet by the shadow of the primary, called *eclipses of satellites*, and distinguished from *occultations* in which the *disk* of the primary hides the satellite from view.

Solar and lunar eclipses can be considered together, so far as the general law of their sequence is concerned. From what has been already shown, it follows that, if the motions of the sun and moon could be watched continuously from the centre of the earth, the moon would be seen to pass round the star-sphere once in each sidereal month on a path inclined about 5° 8′ to the ecliptic, while the sun would complete the circuit of the ecliptic once in a sidereal year; and the moon would pass the sun's place once

Seasons. in each synodical month. The place of conjunction of the sun and moon would clearly pass round the star-sphere, advancingly, making the complete circuit of the heavens once in each year on the average; and the same would happen with the place of conjunction of the moon and the point directly opposite the sun. Moreover, as the moon at these conjunctions would, of course, be on her own apparent orbit, and that orbit is inclined to the sun's, it is clear that, supposing the moon's orbit fixed, the conjunctions of sun and moon during one-half of the year would occur with the moon in the northern half of her apparent orbit, and those in the other half would occur with the moon in the southern half of her orbit. The same would be true of the conjunctions of the moon with the point opposite the sun, only, of course, the halves of the lunar orbit would be interchanged. At or near the time when the place of either conjunction was crossing from the northern to the southern side of the moon's orbit, or *vice versa*, the conjunction would occur with the moon so near to the ecliptic, that if the conjunction was one of sun and moon, she would hide the sun's disk wholly or partially, while, if the conjunction was one of the moon with that point opposite the sun towards which the earth's shadow is thrown, she would enter that shadow wholly or partially. In other words, at two seasons separated by six months there would be eclipses of the sun or moon, or both, whereas during the intervening months no eclipses would occur.

The number of eclipses which could occur in either eclipse-season would depend on the rate at which the points of successive conjunction approached and left the ecliptic, on the proximity necessary for the occurrence of an eclipse of either sort, and also on the manner in which the lunar node happened to be passed. For example, suppose that a conjunction of the sun and moon occurred when the moon was exactly at a node, so that a central eclipse of the sun occurred; then, half a synodical month before and half a synodical month after that conjunction, there would be a conjunction of the moon with the point opposite the sun, and the moon being only half a month's journey from her node, would be at a point of her orbit not far from the ecliptic. But the extent of the earth's shadow is such, that the moon would only be partially in the penumbra, and penumbral lunar eclipses are not considered by astronomers. There would therefore be only one eclipse in such an eclipse-season, viz., a central solar eclipse. Next, suppose that when the moon was at her node, she was exactly opposite the sun, then there would be a total lunar eclipse. Half a lunation later and earlier she would be in conjunction with the sun, and she would be at a point of her orbit not far from the ecliptic. In this case, although during half a month from nodal passage the moon supposed to be viewed from the earth's centre gets to a distance from the ecliptic exceeding the sum of her own and the sun's semidiameters, and therefore *so viewed* would pass clear of the sun, yet for the earth, regarded as a whole, she would not pass quite clear of the sun. In other words, for those parts of the earth where the effect of parallax would shift the moon most towards the sun, there would be a slight partial solar eclipse at the conjunction following or preceding the total lunar eclipse. In this case, then, there would be three eclipses, one lunar and total, the other two solar and partial. These results would be approximated to if the conjunction of sun and moon in the first case, or of moon and sun-shadow in the second case, occurred with the moon very near a node. But otherwise there would be an eclipse either solar or lunar a few days before her nodal passage, and another either lunar or solar a few days after her nodal passage, and no other eclipse of either sort in that eclipse-season.

All this corresponds to the actual conditions except in one respect. The lunar nodes retrograde, so as to meet the advancing conjunction-points of either kind, and thus, instead of a year being occupied in the complete circuit of the conjunctions, the actual interval has for its mean value the mean interval between the successive conjunctions of the sun with the rising node of the moon's orbit, or 346·607 days. Accordingly, the average interval between successive eclipse-seasons is 173·3 days instead of half a sidereal year.

Eclipses of both sorts are illustrated in fig. 37. Here E Theory of
is the earth, and the moon is shown in two places—at M, eclipses.
directly between the earth and sun, and at the point opposite M, in the heart of the earth's shadow-cone. The true geometrical shadows of the earth and moon are shown black, the true geometrical penumbræ are shaded (of course the vertical dimensions in the figure have been enormously exaggerated). The distance EC is variable, being as great

Fig. 37.

as 870,300 miles when the earth is in aphelion, and as small as 843,300 miles when the earth is in perihelion. The earth's shadow thus extends about $3\frac{1}{4}$ times as far from the earth as the moon's orbit. In figs. 38 and 39 the extremity of the moon's shadow is shown on a larger scale, in one case falling short of the earth, in the other extending beyond the earth. For the moon's conical shadow has a length which varies in the same proportion as the earth's shadow, that is, as 8703 to 8433; and the absolute length thus varies from 229,780 miles (fig. 38) to 237,140 miles (fig. 39). Since the moon's greatest mean and least distances are respectively 252,984 miles, 238,818 miles, and 221,593 miles, it follows that for solar eclipses we have—

Fig 38

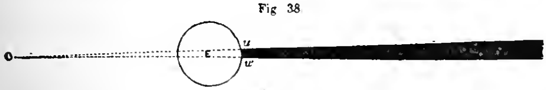


Fig 39.

Sun in perigee	☽ in apogee	Point C is 23,204 miles from earth (fig. 38).
	at mean distance	Point C is 9038 miles from earth (fig. 38)
	in perigee	Point C is 8187 miles beyond earth (fig. 39).
Sun in apogee	☽ in apogee	Point C is 15,844 miles from earth (fig. 38).
	at mean distance	Point C is 1678 miles from earth (fig. 38).
	in perigee	Point C is 15,547 miles beyond earth (fig. 39).

These numbers correspond to the fact that the limits between which the apparent diameter of the sun varies are 32′ 36″·4 and 31′ 31″·8, while the lunar disk varies in diameter from 33′ 31″·1 to 29′ 21″·9, so that in a central solar eclipse, where the sun is in perigee and the moon in apogee, the sun's disk extends beyond the moon's by

$$\tfrac{1}{2}\,(32'\,36''\cdot4 - 29'\,21''\cdot9),\ \text{or by } 1'\,37''\cdot2\,;$$

while the sun is in apogee and the moon in perigee, the moon's disk extends beyond the sun's by

$$\tfrac{1}{2}\,(33'\,31''\cdot1 - 31'\,31''\cdot8)\ \text{or by } 59''\cdot6.$$

In the former case, or any case in which the sun's disk exceeds the moon's so that in central eclipse a ring of sunlight is seen, the eclipse is called an *annular solar eclipse;* while, if the moon's disk exceeds the sun's, and the whole of the sun is thus eclipsed, when the centres of the disks coincide, the eclipse is called a *total* solar eclipse. When only a part of the sun is hidden, and no annulus is formed, the eclipse is called a *partial* solar eclipse. It is clear that an eclipse which is total or annular for certain parts of the earth will be partial elsewhere; and in cases (which occur very seldom, however) where the point C falls between E and *a*, fig. 38, the eclipse will be total along a certain part of the central track, and annular along the rest of that track. In a total eclipse the greatest possible breadth of the total shadow *uu′* (fig. 39) is about 173 miles. This is the *minor* axis of the shadow-ellipse.

The following table, combined with the fact that the moon's greatest apparent diameter is 33′ 31″·8, will be sufficient to illustrate the general conditions of lunar eclipses and the limits for totality:—

		Apparent diameters of earth's shadow. °	′	″
Sun in perigee.	☽ in apogee	1	15	24·30
	at mean distance	1	23	2·31
	in perigee	1	30	40·31
Sun at mean distance,	☽ in apogee	1	15	56·86
	at mean distance	1	23	34·87
	in perigee	1	31	12·87
Sun in apogee,	☽ in apogee	1	16	28·29
	at mean distance	1	24	6·30
	in perigee	1	31	44·80

Eclipse limits. It may be added that an eclipse of the sun can only occur when the moon at the time of mean conjunction with the sun is within $19\frac{2}{3}$° of her node, and will certainly occur if she is within $13\frac{1}{2}$°. A lunar eclipse can only happen when she is within $13\frac{1}{3}$° of her node, at the time of mean opposition to the sun, and will certainly occur if she is within 7°; but the limits are somewhat wider than those for solar eclipses, if penumbral lunar eclipses be counted. It is convenient to notice that in every period of 21,600 lunations there are, on the average, 4072 solar eclipses and 2614 lunar eclipses, besides 1617 penumbral lunar eclipses—that is, 4231 lunar eclipses including penumbral ones.

Number of eclipses annually. Noting that eclipse-seasons last on the average about 33 days, and that three eclipse-seasons each having three eclipses cannot occur in succession, it is easy to determine the greatest and least number of eclipses which may occur in any single year. The average interval between successive eclipse-seasons is 173·3 days. Two such intervals amount together to 346·6 days, or fall short of a year by about 19 days. Hence there cannot be three eclipse-seasons in a year; for each eclipse-season lasts on the average 33 days. Suppose an eclipse-season to begin with the beginning of a year of 366 days. The middle of the season occurs at about midday on January 17; the middle of the next eclipse-season 173·3 days later, or on the evening of July 8; and the middle of the third occurs yet 173·3 days later, or on December 29, early in the forenoon; so that nearly the whole of the remaining half belongs to the following year. This is clearly a favourable case for the occurrence of as many eclipses as possible during the year. If all three seasons could be of the class containing three eclipses, there would be eight eclipses in the year, because the second eclipse of the third season would occur in the middle of that season. This, however, can never happen. But there may be two seasons, each containing three eclipses, followed by a season containing two eclipses, only one of which can occur in the portion of the eclipse-season falling within the same year. In this case there would be seven eclipses in the year. So also there would be seven if in the first season there were three, in the second two, and in the third three, for then the portion of the third falling within the year, being rather more than one-half, would comprise two eclipses. So also if the three successive seasons comprise severally two, three, and three eclipses. The same would clearly happen if the year closed with the close of an eclipse-season.

There may then be as many as seven eclipses in a year, in which case at least four eclipses will be solar, and at least three of these partial, while of the lunar eclipses two at least will be total.

As regards the least possible number of eclipses, it is obvious that, as there must be two eclipse-seasons in the year, and at least one eclipse in each, we cannot have less than two eclipses in the course of a year. When there are only two, each eclipse is solar and central.

As regards intermediate cases, we need make no special inquiry. Many combinations are possible. The most common case is that in which there are four eclipses—two solar and two lunar. Further, it may be noticed that, whatever the number of eclipses, from two to seven inclusive, there must always be two solar eclipses at least in each year.

Chapter XII.—*The Planet Mars.*

After Venus, Mars is the planet whose orbit is nearest Mars. to the earth. His diameter is about 4400 miles, and his volume about one-sixth of the earth's; his mass, however, is little more than one-ninth of hers, his density being estimated at only $\frac{7}{10}$ths of the earth's. His mean distance from the sun is about 139 millions of miles; but the eccentricity of his orbit amounting to 0·093262, his greatest and least distances differ considerably from this mean value, amounting to 152,304,000 and 126,318,000 miles respectively. It follows that his distance from the earth when in opposition varies largely—in opposition near his perihelion his distance is about 33,800,000 miles, whereas, when he is near aphelion, his opposition-distance amounts to 61,800,000 miles. As he is also more brightly illuminated by the sun when in perihelion, it follows that he appears much brighter when in opposition at that part of his orbit. In fact, the brightness of Mars at opposition near perihelion bears to his brightness at opposition near aphelion, the ratio

$$(61{,}800{,}000)^2 \times (152{,}304{,}000)^2 : (33{,}800{,}000) \times (126{,}318{,}000)^2,\ \text{or about } 34 : 7.$$

In other words, the planet is nearly five-times as bright at one of the favourable oppositions as at one of the unfavourable. The planet's synodical period being 779·936 days, or two years and about 49½ days, it follows that the place of opposition performs a complete circuit of the ecliptic in an average period of rather more than 7 times the synodical period (for 7 × 49½ days = 346½ days, so that the change in the place of opposition nearly corresponds to the earth's yearly motion). The correspondence is nearer if two circuits of the ecliptic be taken; for 15 synodical revolutions are equal to 11,699·040 days, and 32 sidereal years are equal to 11,688·2048 days, or not quite 11 days less. But a much nearer agreement still is effected in 79 years, which differ by little more than two days from 42 sidereal revolutions of Mars. So that if at any time Mars in opposition has been very favourably placed for observation, the same condition of things, or very nearly so, will be brought about after 79 years. For instance, in the opposition of 1719, Mars was within $2\frac{1}{2}°$ of perihelion, and shone so brightly as to be mistaken for a new star. He was similarly situated at the opposition of 1798, and will again be so situated when in opposition in 1877.

Spots on Mars.

It is said that Fontana first noted the spots of Mars, and suspected the planet's rotation. But Fontana's credit is shaken by his alleged discovery of *seven* Jovian satellites. Cassini observed the spots at Bologna in 1666, and having continued his observations for a month, determined the planet's rotation-period as 24 h. 40 m. Observers at Rome, mistaking two opposite faces of the planet for the same face, deduced the period 13 h. Cassini in 1670 again observed the planet, obtaining the same rotation-period as before. Maraldi in 1704 noted changes in the shape of the spots; but from some which underwent little change, he deduced the rotation-period 24 h. 39 m. In 1719, when (as already mentioned) Mars was exceedingly well placed for observation, Maraldi again carefully observed the planet, deducing from the observations of 37 days a rotation-period identical with Cassini's.

Polar snows.

Besides the dark spots, which have a somewhat greenish colour, the rest of the disk being mostly ruddy, astronomers had noticed a portion of the disk around the south pole which was brightly white. Maraldi states that this spot had been observed for 60 years before his later observations were made. One part seemed fainter than the rest, and this portion was subject to considerable changes, occasionally disappearing, while the brighter part was constantly seen.

Sir W. Herschel examined a similar bright region around the north pole, which had not before his time been well seen, because the northern regions of the planet are only bowed towards us when the planet is traversing the parts of its orbit near aphelion. Herschel's powerful telescopes, however, enabled him to examine the planet during oppositions occurring in any part of the ecliptic. The magnifying powers he used were sometimes as high as 932, and with this the south polar spot was found to be 41″ in diameter. From these observations Herschel concluded that the diurnal rotation of Mars is accomplished in 24 h. 39 m. $21\frac{2}{3}$ s., that his equator is inclined to his orbit at an angle of 28° 42′, and his axis of rotation to the axis of the ecliptic at an angle of 30° 18′.

The bright appearance so remarkable about the poles of Mars was ascribed by Herschel to the reflection of light from mountains of ice and snow accumulated in those regions.

"The analogy between Mars and the earth," he says, "is perhaps by far the greatest in the whole solar system. Their diurnal motion is nearly the same, the obliquity of their respective ecliptics not very different; of all the superior planets, the distance of Mars from the sun is by far the nearest alike to that of the earth; nor will the length of the Martial year appear very different from what we enjoy, when compared to the surprising duration of the years of Jupiter, Saturn, and the Georgium Sidus. If we then find that the globe we inhabit has its polar regions frozen and covered with mountains of ice and snow, that only partly melt when alternately exposed to the sun, I may well be permitted to surmise that the same causes may probably have the same effect on the globe of Mars; that the bright polar spots are owing to the vivid reflection of light from frozen regions; and that the reduction of those spots is to be ascribed to their being exposed to the sun."

According to Herschel, the ratio of his equatorial and polar axes is 103 to 98. Schröter estimates the same ratio to be that of 81 to 80, but later observers have found no perceptible compression.

Charts of Mars.

Observations of Mars in recent times have added largely to our knowledge of the planet.

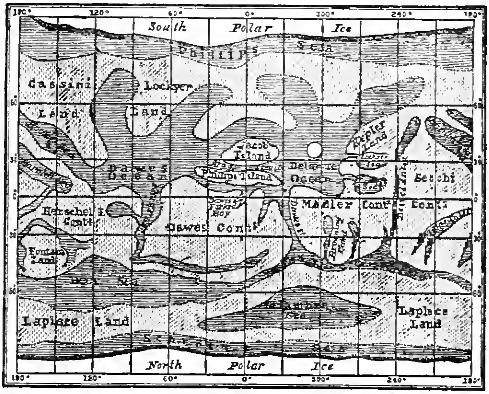


FIG. 40.—Chart of Mars on Mercator's Projection.

From drawings by Beer and Mädler (1830–1857), Dawes (1856–1866), De la Rue, Secchi, and others, Proctor has constructed the above chart of the planet (fig. 40).

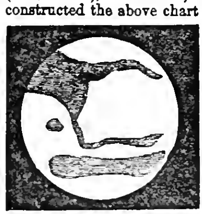


FIG. 41.—Mars, May 23, 1873, 9 G. M. T.

FIG. 42.—Mars, May 22, 1873, 11.30 G. M. T.

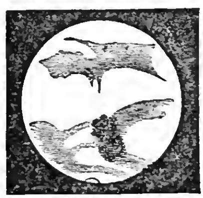


FIG. 43.—Mars, May 19, 1873, 12.30 G. M. T.

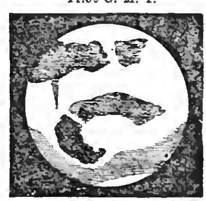


FIG. 44.—Mars, May 13, 1873, 12.30 G. M. T.

But the latest drawings, taken during the opposition of

1873, while showing excellent agreement with the chart as respects the southern parts of Mars, present some features in the northern hemisphere (more favourably seen in 1871 and 1873 than for many previous years) which are wanting in the above chart. This will be manifest from the views here given (figs. 41, 42, 43, and 44), obtained by Mr Knobel, F.R.A.S., with an 8-inch reflector of the Browning-With construction.

Compression. The shape of the planet has been repeatedly measured, but the results are not accordant. A set of measures made at Greenwich with a double-image micrometer in 1845 gave $\frac{1}{62}$ for the ellipticity, and another set in 1852 gave $\frac{1}{50}$. Arago contends for an ellipticity of $\frac{1}{30}$, the result of the Paris measures. But some observers can detect no difference between the polar and equatorial diameters, some even find the polar diameter longer than the equatorial. *Adhuc sub judice lis est.*

Rotation of Mars. The planet's rotation has been determined more accurately than was possible in Herschel's time. Beer and Mädler, from their observations in 1830–1837, deduced the rotation-period 24 h. 37 m. 23·8 s., and showed how Herschel had omitted to count one complete rotation when he deduced the period above mentioned. Kaiser of Leyden, by comparing his own observations in 1862 with those of Beer and Mädler, Sir W. Herschel, and finally (carrying back the research) with an observation made by Huyghens in 1672, deduced the period 24 h. 37 m. 22·62 s.

Proctor, by a similar process, extending from observations made in 1869 backwards to an observation by Hooke in 1666 (N.S.), deduced the period 24 h. 37 m. 22·735 s. Kaiser contended for the accuracy of his result, asserting that Hooke's pictures were less trustworthy than Huyghens's. But recently, in 1873, Proctor has detected three errors in Kaiser's computation, who has reckoned the years 1700 and 1800 as leap years instead of common years, and made a further error of a day in correcting Hooke's date from old style into new. When account is taken of these corrections, Hooke's observations and Huyghens's are easily reconciled. Due weight being given to each, the period 24 h. 37 m. 22·72 s. results, a value probably lying within 0·01 s. of the true sidereal rotation-period of the planet.

Atmosphere of Mars. It remains only to be added, that the spectroscopic observations of Mr Huggins show that the vapour of water is present in the atmosphere of Mars, a discovery of great interest and importance. A volume, however, instead of the limited space which is here available, would be required to discuss fully all that has been discovered respecting the planet Mars.

CHAPTER XIII.—*Asteroids, or Minor Planets.*

Discovery of Ceres. On the first day of the present century a new planet was discovered, which, although in one sense seeming to fill up a gap in the solar system, was yet unlike any hitherto known member of the planetary family. Kepler and Titius, followed in later times by Bode, had adopted the view that a planet was wanting to complete the symmetry of the solar system, as indicated by a certain law of progression in the planetary distances. This law is presented in the following table, which includes Uranus (known to Bode, but not to his predecessors in the recognition of this law):—

Mercury	Venus.	Earth.	Mars.	Missing Planet.	Jupiter.	Saturn.	Uranus.
4 0	4 3	4 6	4 12	4 24	4 48	4 96	4 192
4	7	10	16	28	52	100	196
3·9	7·2	10	15	...	52	95	192

Here the series 7, 10, 16, &c., is obtained by adding to 4 successively the numbers 3, 6, 12, 24, &c., forming a geometrical series; and the distances of Venus, the earth, Mars, Jupiter, &c., which are indicated in the lowest row, are found to correspond with the members thus obtained very closely indeed. Mercury is included in the above table, though the proper number to add to the constant 4 would be $1\frac{1}{2}$, not zero, and thus the distance of Mercury is really less than $\frac{8}{11}$ths of the proper distance according to the law of progression. And in passing it may be noticed that the distance of Neptune on the outside of the system differs as markedly from that indicated by the above law as the distance of the innermost known planet; for the law gives the distance of the next planet beyond Uranus as 388 on the scale above used, whereas the real distance of Neptune is 300 on that scale. However, towards the close of the last century, when Uranus had but lately been discovered and found to obey the law of distances, it was natural that the attention of astronomers should be directed to the strange gap in the series between Mars and Jupiter. So great was the confidence with which many now regarded the law, that the theory was advanced that a planet invisible to the naked eye was travelling within the seemingly vacant space; and through the exertions of Baron de Zach, an association of 24 astronomers was formed to search the zodiac for the unseen planet. Yet the discovery was not made by any member of this society. Wollaston had laid down a star in his catalogue where no star could be seen. Piazzi carefully examined the neighbourhood, to determine whether some star really existing there had been misplaced by Wollaston. On January 1, 1801, he noted a small star in Taurus, which on January 3 had changed its place. He wrote to Oriani and Bode; but the planet, which was at its stationary point, following opposition, on January 12, had become invisible owing to its approach to the sun, before the letter reached them, and Piazzi himself fell ill soon after. But Gauss the eminent mathematician undertook to compute the new planet's orbit and motions from the observations made by Piazzi, and at length, after long searching, De Zach rediscovered the planet on December 3, 1801, Olbers independently discovering it on the following evening. The planet was found to correspond well with the theory which had suggested the search for it, since its distance is 2·767 where the earth's distance is represented by unity, or 27·67 on the scale used in the above table. Piazzi gave to the new planet the name Ceres. Besides differing from the other known planets in being so small as apparently to belong to a different order, Ceres was found to have an inclination (of more than $10\frac{1}{2}°$) exceeding largely even that of Mercury. But these anomalous relations were soon found to be but the first indications of a discovery altogether more remarkable.

Pallas. During his long and arduous search for Ceres, Dr Olbers of Bremen had had occasion to examine with peculiar care the stars near her path. On March 28, 1802, he observed a star near Bode's stars 20 and 191 Virginis, where he felt sure that no star had existed during his former observations. After two hours it had moved very much as Ceres had done when he had first seen her almost in the same spot. Subsequent observations showed that this was a small planet (to which the name Pallas was given) travelling in an orbit having a mean distance of about 2·770 (earth's as 1), slightly exceeding, therefore, that of Ceres, but with an eccentricity of ·248, considerably exceeding that of any known planet, and an inclination of 34° 39′, exceeding the sum of the inclinations of all the other planets together. The effect of this great inclination on the geocentric position of the planet is even more remarkable than the heliocentric range of more than 69° in latitude. For when Pallas is at her greatest heliocentric latitude, and near opposition, her geocentric latitude exceeds 42°. This is very different from Venus's range of less than 9° in geocentric latitude, which had been regarded as the maximum, and had led astronomers to assign to the zodiac a breadth of 18°. A zodiac to include the asteroids should be 90° in breadth, and would cover $\frac{7}{10}$ths of the whole heavens.

Even more remarkable, however, was the discovery of two planets having nearly the same mean distance from the sun. The supposition that yet others might be found was naturally suggested; indeed, Olbers was led to conjecture that Ceres and Pallas are but fragments of a larger planet formerly circulating at the same distance, and shattered by some tremendous internal convulsion; and he proposed that search should be made where the paths of these planets nearly intersect. For if his theory were true, this must be the region where the explosion took place, and the fragments must continue to pass through that region.

Juno. While Harding of Lilienthal was charting the stars near the paths of Ceres and Pallas in the region thus indicated, he determined, on September 2, 1804, the position of a small star in Pisces, near 93 and 98 of Bode's catalogue. On September 4 the star was no longer in the same position. It was found to be a planet (to which the name Juno was given) travelling at a mean distance of 2·67 (considerably less than that deduced for Ceres and Pallas), in an orbit having eccentricity 0·257, and inclination 13° 1′. The effect of this great eccentricity is remarkable, as may be thus indicated:—supposing the apsides of the orbit to correspond to the planet's solstices, then the summer of one hemisphere is only half as long as the winter of that hemisphere, or as the summer of the other.

Vesta. Next Olbers, pursuing the same method, discovered Vesta, moving in an orbit having mean distance 2·373 (far less even than Juno's), eccentricity 0·0898, and inclination 7° 71′.

Later discoveries. A long interval then elapsed without the discovery of any new members of this remarkable family. It was not until December 8, 1845, that the fifth was recognised. On that night M. Hencke, an amateur astronomer of Driessen, discovered the body since named Astræa. He communicated his discovery to Encke and Schumacher, who confirmed it by observations made with more powerful telescopes. M. Hencke also discovered the sixth planet, on July 1, 1847. Since that time not a year has passed without the discovery of one or more minor planets; and in some years as many as ten or twelve have been added. At present (April 1875), the total number known amounts to 143, as shown in the following table, which gives also the names of the discoverers, as well as the date and place of discovery. It is to be observed that Melete, numbered 56, was mistaken for 41 till January 1859.

No.	Name.	Date of Discovery.	Discoverer.	Place of Discovery.
1	Ceres	1801, January 1	Piazzi	Palermo
2	Pallas	1802, March 28	Olbers	Bremen
3	Juno	1804, September 1	Harding	Lilienthal
4	Vesta	1807, March 29	Olbers	Bremen
5	Astræa	1845, December 8	Hencke	Driessen
6	Hebe	1847, July 1	Hencke	Driessen
7	Iris	August 13	Hind	London
8	Flora	October 18	Hind	London
9	Metis	1848, April 25	Graham	Markree
10	Hygeia	1849, April 12	De Gasparis	Naples
11	Parthenope	1850, May 11	De Gasparis	Naples
12	Victoria	September 13	Hind	London
13	Egeria	November 2	De Gasparis	Naples
14	Irene	1851, May 19	Hind	London
15	Eunomia	July 29	De Gasparis	Naples
16	Psyche	1852, March 17	De Gasparis	Naples
17	Thetis	April 17	Luther	Bilk
18	Melpomene	June 24	Hind	London
19	Fortuna	August 22	Hind	London
20	Massilia	September 19	De Gasparis	Naples
21	Lutetia	November 15	Goldschmidt	Paris
22	Calliope	1852, November 16	Hind	London
23	Thalia	December 15	Hind	London
24	Themis	1853, April 6	De Gasparis	Naples
25	Phocea	April 6	Chacornac	Marseilles
26	Proserpina	May 5	Luther	Bilk
27	Euterpe	November 8	Hind	London
28	Bellona	1854, March 1	Luther	Bilk
29	Amphitrite	March 1	Marth	London
30	Urania	July 22	Hind	London
31	Euphrosyne	September 1	Ferguson	Washington
32	Pomona	October 26	Goldschmidt	Paris
33	Polyhymnia	October 28	Chacornac	Paris
34	Circe	1855, April 6	Chacornac	Paris
35	Leucothea	April 19	Luther	Bilk
36	Atalanta	October 5	Goldschmidt	Paris
37	Fides	October 5	Luther	Bilk
38	Leda	1856, January 12	Chacornac	Paris
39	Lætitia	February 8	Chacornac	Paris
40	Harmonia	March 31	Goldschmidt	Paris
41	Daphne	May 22	Goldschmidt	Paris
42	Isis	May 23	Pogson	Oxford
43	Ariadne	1857, April 15	Pogson	Oxford
44	Nysa	May 27	Goldschmidt	Paris
45	Eugenia	June 28	Goldschmidt	Paris.
46	Hestia	August 16	Pogson	Oxford
47	Aglaia	September 15	Luther	Bilk
48	Doris	September 19	Goldschmidt	Paris
49	Pales	September 19	Goldschmidt	Paris
50	Virginia	October 4	Ferguson	Washington
51	Nemausa	1858, January 22	Laurent	Nismes
52	Europa	February 6	Goldschmidt	Paris
53	Calypso	April 4	Luther	Bilk
54	Alexandra	September 10	Goldschmidt	Paris
55	Pandora	September 10	Searle	Albany, U.S.
56	Melete	1857, September 9	Goldschmidt	Paris
57	Mnemosyne	1859, September 22	Luther	Bilk
58	Concordia	1860, March 24	Luther	Bilk
59	Olympia	September 12	Chacornac	Paris
60	Echo	September 15	Ferguson	Washington
61	Danaë	September 19	Goldschmidt	Chatillon-sous-Bagneux
62	Erato	October 10	Forster	Berlin
63	Ausonia	1861, February 10	De Gasparis	Naples
64	Angelina	March 4	Tempel	Marseilles
65	Cybele	March 8	Tempel	Marseilles
66	Maia	April 9	Tuttle	Cambridge, U.S.
67	Asia	April 17	Pogson	Madras
68	Leto	April 29	Luther	Bilk
69	Hesperia	April 29	Schiaparelli	Milan
70	Panopea	May 5	Goldschmidt	Fontenay-aux-Roses
71	Niobe	August 13	Luther	Bilk
72	Feronia	May 29	Peters	Clinton, U.S.
73	Clytie	1862, April 7	Tuttle	Cambridge, U.S.
74	Galatea	August 29	Tempel	Marseilles
75	Eurydice	September 22	Peters	Clinton, U.S.
76	Freia	October 21	d'Arrest	Copenhagen
77	Frigga	November 12	Peters	Clinton, U.S.
78	Diana	1863, March 15	Luther	Bilk
79	Eurynome	September 14	Watson	Ann Arbor, U.S.
80	Sappho	1864, May 3	Pogson	Madras
81	Terpsichore	September 30	Tempel	Marseilles
82	Alcmene	November 27	Luther	Bilk
83	Beatrix	1865, April 26	De Gasparis	Naples
84	Clio	August 25	Luther	Bilk
85	Io	September 19	Peters	Clinton, U.S.
86	Semele	1866, January 6	Tietjen	Berlin
87	Sylvia	May 16	Pogson	Madras
88	Thisbe	June 15	Peters	Clinton, U.S.
89	Julia	August 6	Stéphan	Marseilles
90	Antiope	October 1	Luther	Bilk
91	Ægina	November 4	Stéphan	Marseilles
92	Undina	1867, July 7	Peters	Clinton, U.S.
93	Minerva	August 24	Watson	Ann Arbor, U.S.
94	Aurora	September 26	Watson	Ann Arbor, U.S.
95	Arethusa	November 23	Luther	Bilk
96	Ægle	1868, February 17	Coggia	Marseilles
97	Clotho	February 17	Tempel	Marseilles
98	Ianthe	April 18	Peters	Clinton, U.S.
99	Dike	May 29	Borelly	Marseilles
100	Hecate	July 11	Watson	Ann Arbor, U.S.
101	Helena	August 16	Watson	Ann Arbor, U.S.
102	Miriam	August 22	Peters	Clinton, U.S.
103	Hera	September 7	Watson	Ann Arbor, U.S.
104	Clymene	September 13	Watson	Ann Arbor, U.S.
105	Artemis	September 16	Watson	Ann Arbor, U.S.
106	Dione	October 10	Watson	Ann Arbor, U.S.
107	Camilla	November 17	Pogson	Madras
108	Hecuba	1869, April 2	Luther	Bilk
109	Felicitas	October 9	Peters	Clinton, U.S.
110	Lydia	1870, April 19	Borelly	Marseilles
111	Ate	August 14	Peters	Clinton, U.S.
112	Iphigenia	September 19	Peters	Clinton, U.S.
113	Amalthea	1871, March 12	Luther	Bilk
114	Cassandra	July 24	Peters	Clinton, U.S.
115	Thyra	August 6	Watson	Ann Arbor, U.S.
116	Sirona	September 8	Peters	Clinton, U.S.
117	Lomia	September 12	Borelly	Marseilles
118	Peitho	1872, March 15	Luther	Bilk
119	Althæa	April 3	Watson	Ann Arbor, U.S.
120	Lachesis	April 10	Borelly	Marseilles
121	Hermione	May 12	Watson	Ann Arbor, U.S.
122	Gerda	July 31	Peters	Clinton, U.S.
123	Brunhilda	July 31	Peters	Clinton, U.S.
124	Alcestis	August 23	Peters	Clinton, U.S.
125	Liberatrix	September 11	Prosper Henry	Paris
126	Velleda	November 5	Paul Henry	Paris
127	Johanna	November 5	Prosper Henry	Paris
128	Nemesis	November 25	Watson	Ann Arbor,

No.	Name.	Date of Discovery.	Discoverer.	Place of Discovery.
129	Antigone	1873, February 5	Peters	Clinton, U.S.
130	Electra	February 17	Peters	Clinton, U.S.
131	Vala	May 26	Peters	Clinton, U.S.
132	Æthra	June 13	Watson	Ann Arbor, U.S.
133	Cyrena	August 16	Watson	Ann Arbor, U.S.
134	Sophrosyne	September 27	Luther	Bilk
135	Hertha	1874, February 18	Peters	Clinton, U.S.
136	Austria	March 18	Palisa	Pola
137	Melibœa	April 21	Palisa	Pola
138	Tolosa	May 19	Perrotin	Toulouse
139	...	October 10	Watson	Peking (Transit Exped.)
140	Siwa	October 13	Palisa	Pola
141	...	1875, January 13	Paul Henry	Paris
142	...	January 28	Palisa	Pola
143	...	February 23	Palisa	Pola

...s of Asteroids.

It has been shown by Leverrier, from the observed secular motion of the perihelion of Mars, that the combined mass of all the asteroids cannot exceed one-fourth of the earth's mass, even if the whole perturbation were ascribed to asteroids, and no account taken of the error in the estimated mass of the earth compared with the sun's. But as the recent new estimate of the sun's distance assigns a relatively increased mass to the earth, almost sufficient of itself to account for the observed motion of the perihelion of Mars, it appears to follow that the combined mass of the asteroids must be exceedingly small. Prof. Newcomb, of Washington, after carefully analysing the motions of the asteroids, comes to the conclusion, that, "though there are some peculiarities in the mutual relations between the orbits of these bodies which might favour Olbers's hypothesis, a much greater number of peculiarities negative the assumption."

Prof. Kirkwood, of Bloomington, Indiana, has shown that, when the mean distances of the minor planets are arranged in order of magnitude, certain gaps are recognised, that is, there are no asteroids having mean distances nearly equal to certain definite values. These values correspond to distances at which asteroids would revolve in periods associated with Jupiter's period by certain simple laws of commensurability. He infers, therefore, that the asteroids had an origin resembling that assigned to them by the nebular hypothesis. He compares the observed peculiarity to the existence of at least one great gap in the Saturnian ring system, showing that "a satellite revolving within that gap would have a period associated with the periods of Saturn's inner satellites, by similar simple laws of commensurability."

Chapter XIV.—*The Planet Jupiter.*

Jupiter is the largest planet of the solar system. Indeed he surpasses the rest so greatly, that the combined mass of all of them together would barely exceed two-fifths of his. This superiority is deserving of more consideration than it has commonly received. If we are justified in regarding our moon or the asteroids as belonging to a different order of bodies from the earth, Venus, Mars, and Mercury, because so much less than them in mass, we may not unreasonably regard Jupiter as belonging to a different order, because so much exceeding in mass the planets which travel within the zone of asteroids. The earth exceeds the moon only 81 times in mass, but Jupiter exceeds the earth in mass more than 300 times.

Jupiter travels at a distance from the sun exceeding the earth's $5\frac{1}{5}$ times, or at a mean distance of 475,692,000 miles. The eccentricity of his orbit is considerable, amounting to 0·048239, so that his greatest and least distances amount respectively to 498,639,000 miles and 452,745,000 miles. When in opposition, and at his mean distance, his distance from the earth amounts to about 361,000,000 miles. His orbit is inclined about 1° 18′ 40″·3 to the ecliptic. His sidereal revolution is completed in 4332·5848 days, or 11 years 314·92 days; whence it is easily calculated that his synodical period, or the interval separating his mean returns to opposition, has a mean value of 398·867 days. His mean diameter is nearly 85,000 miles in length, according to the best modern measurements, though strict accuracy cannot be claimed for this estimate, as the various determinations, even by the most skilful observers, differ considerably *inter se.* Until recently, the compression of his globe had been estimated at $\frac{1}{14}$, from the observations of W. Struve; but later measurements give $\frac{1}{17}$ as the compression. His volume exceeds the earth's 1233·205 times, but his density is only about one-fourth of hers, and his mass does not exceed hers more than 301 times.

Although the actual order of discovery would lead us to speak of the satellites of Jupiter before considering the features of his globe, it will be for several reasons more convenient to describe these features first. Cassini was the first to discover that Jupiter's globe is surrounded by belts apparently belonging to his surface. The features of these belts as described by Cassini are those which still continue to be recognised. Their number is variable; sometimes only one can be readily discerned, while at others the whole surface is covered by them. They are generally parallel to one another, as in fig. 45, but not always so. Their breadth is likewise variable, one belt having been Jupiter's belts.

Fig. 45.—Jupiter as seen Nov. 27, 1857, by Dawes.

Fig. 46.—Jupiter as seen Nov. 18, 1858, by Lassell.

observed to grow narrow, while another in its neighbourhood has increased in breadth, as if one had partially flowed into the other; and in this case a part of an oblique belt is commonly recognised between them, as if forming the channel of communication. Some of these peculiarities are illustrated in figs. 46, 47, and 48. Sometimes the belts

Fig. 47.—Jupiter as seen March 12, 1860, by Jacob.

Fig. 48.—Jupiter as seen April 9, 1860, by Baxendell.

remain unchanged for months; at others, new belts have formed in an hour or two. Although his surface appears Rotation.
thus variable, yet at times spots have been visible for several weeks, whose motions have served to indicate the law of the planet's rotation.

In 1665 Cassini observed a spot near the large central belt of Jupiter. It moved more quickly when near the middle of the disk than when near the edge, and also appeared narrower when at the edge, showing that it belonged to the surface (that is, to what appears as the surface) of the planet. This principal or ancient spot, as

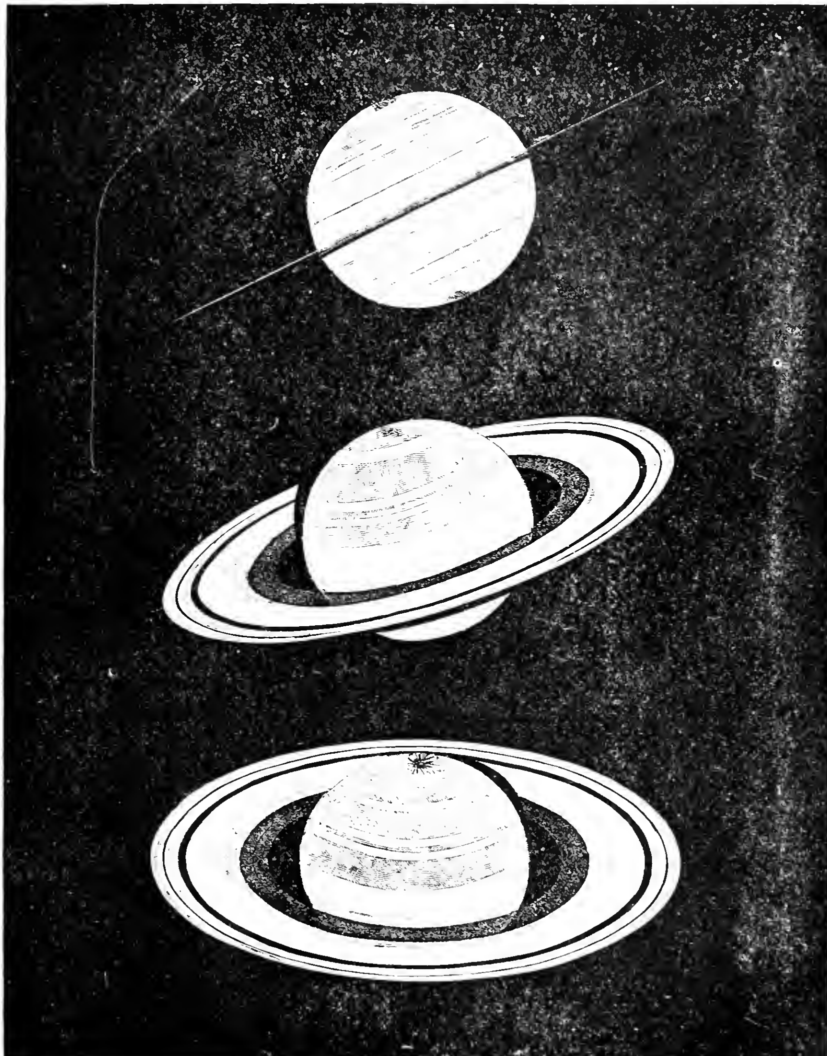


Fig. 1. SATURN AND HIS RINGS FEBRUARY 2nd, 1862.
Fig. 2. SATURN AND HIS RINGS NOVEMBER 9th, 1856.
Fig. 3. SATURN AND HIS RINGS MARCH 23rd, 1856.
(AS SEEN IN AN INVERTING TELESCOPE)

it is called, is the largest and most permanent of any yet discovered. It appeared and vanished eight times between the years 1665 and 1708, then continuing invisible till 1713. The spot has been frequently observed since, sometimes remaining visible for two or three years in succession, at others being unseen for as long or longer. It would be rash, however, to assume that the same spot has been seen, especially as there is reason to believe that a dark spot on Jupiter, instead of being a permanent feature of his surface (and only concealed from time to time by clouds), resembles rather a large spot upon the sun, an opening formed either by cyclonic disturbance in a deep atmosphere, or by some process of disturbance acting from beneath such an atmosphere. From various sets of observations made upon spots seen for long periods, the following rotation-periods have been deduced :—

	Jupiter's Rotation-Period h.	m.	s.
Cassini (1665)	9	56	0
Silvabelle	9	56	0
Schroter (1786)	9	55	33
Airy	9	55	25
Madler (1855)	9	55	26·6

Mädler's rotation-period is commonly regarded as the most reliable. It was based on observations commenced on November 3, 1834, and continued on every clear night until April 1835, a period including 400 revolutions. Two dark spots were visible when these observations were made. It need hardly be said, however, that very little reliance can be placed on the *seconds* in Mädler's, Airy's, or Schröter's determinations. In fact, there is clear evidence that spots on Jupiter are subject to a proper motion, like that which affects the spots on the sun. Schmidt, in No. 1973 of the *Astronomische Nachrichten*, gives a number of cases of such proper movements of spots, ranging in velocity from about 7 miles to about 200 miles an hour. It may be noted, also, that from a series of observations of one spot made between March 13 and April 14, 1873, with the great Rosse reflector, a period of 9 h. 55 m. 4 s. was deduced, while observations of another spot in the same interval gave a rotation-period of 9 h. 54 m. 55·4 s.

Physical condition of Jupiter.

The equator of Jupiter is inclined only 3° 5′ 30″ to the planet's orbit, so that there can be no appreciable seasonal changes. We should expect, therefore, a great calm to reign in the atmosphere of this planet, the more so that the sun's heat poured upon each square mile of it is (on the average) less than the 27th part of that received by each square mile of the earth's surface. Moreover, the seasons of Jupiter last nearly twelve times as long as ours, so that we should expect all changes in his atmosphere produced by solar action to take place with exceeding slowness. When, instead, we find signs of very rapid changes in the aspect of the belts, implying remarkable changes in the condition of the Jovian atmosphere, we seem compelled to recognise the operation of causes much more active than the heat poured by the sun on the distant orb of Jupiter. It seems natural to suppose that Jupiter's mass is itself intensely heated, and that such inherent heat produces these changes in the condition of his atmosphere. We find also in this theory an explanation of several remarkable circumstances, the significance of which has been somewhat strangely overlooked.

So soon as we institute a comparison between Jupiter and the earth, on the supposition that Jupiter is surrounded by an atmosphere bearing the same relation to his mass that the atmosphere of the earth bears to her mass, we find that a state of things would prevail in no sort resembling what we are acquainted with on earth. For the mass of Jupiter exceeds the earth's more than three hundredfold, while his surface exceeds hers little more than a hundredfold, so that the quantity of atmosphere above each square mile of surface would be three times greater on Jupiter than on the earth, and, owing to the greater force of gravity, the atmospheric pressure would still more largely exceed that on the earth. In fact, the density of the Jovian atmosphere at the surface would be more than six times as great as the density of our air at the sea level. Yet the extension of the atmosphere would be very much less in the case of Jupiter; for in our air the density is halved for each vertical ascent of $3\frac{1}{2}$ miles, whereas in the case of a Jovian atmosphere similarly constituted, the density would be halved for each vertical ascent of $1\frac{1}{2}$ miles. At a height, therefore, of $10\frac{1}{2}$ (7 times $1\frac{1}{2}$) miles from the surface of Jupiter the pressure would only exceed $\frac{1}{2^7}$ ($= \frac{1}{128}$th) that at his surface, or say $\frac{1}{20}$th that at the surface of our earth; whereas, at a height of $10\frac{1}{2}$ (3 times $3\frac{1}{2}$) miles from our sea level the atmospheric pressure is still equal to $\frac{1}{2^3}$ ($= \frac{1}{8}$th) that at the sea level, or $2\frac{1}{3}$ times as dense as the Jovian atmosphere at the same height under the supposed conditions.

We see that, in the case of Jupiter, under any assumption of resemblance in atmospheric constitution and condition, we should infer great density at the surface of the planet, but an exceedingly shallow atmosphere, the density diminishing much more rapidly with vertical height than in the case of our atmosphere; and if aqueous clouds formed in such an atmosphere, as in ours, they would occupy much shallower layers. Yet everything in the telescopic aspect of Jupiter implies that the cloud-layers are of great depth. In fact, their appearance shows that they are far deeper than the terrestrial cloud-layers. The disappearance of dark spots at a considerable distance from the limb of the planet, as observed by Mädler (who found that the two great spots by which he timed the planet's rotation became invisible at from 56° to 57° from the centre of the disk), would indeed imply that the darker inner region lay at an enormous distance below the upper light-reflecting layer. Yet even a depth of thirty or forty miles below the upper cloud-layer would not be consistent with any hypothesis of resemblance between the condition of Jupiter and the earth. Assuming a depth of only thirty miles, the atmospheric pressure would be increased 2^{20} times, or more than a millionfold, and the density in the same degree, if the atmosphere could retain the properties of a perfect gas at that enormous pressure. But such a density would exceed some fiftyfold the density of platinum, and of course no gas could exist as such at a thousandth part of this pressure.

Even when we place on one side the difficulty of reconciling observed appearances with the behaviour of gases under conditions with which we are familiar, a difficulty remains which cannot be removed without regarding Jupiter as utterly unlike our earth. If Jupiter had a shallow atmosphere, so that his solid globe were apparently of the same dimensions as the orb we measure, the mean density of such a globe would far surpass the earth's mean density, if the materials of the two globes were similar; for the pressure within the globe of Jupiter would be enormously greater. Yet we know that, instead of the density of Jupiter being greater than that of the earth, it is not one-fourth of hers. The theory that Jupiter's globe is hollow is inadmissible, because no shell of Jupiter's mass could resist the pressure generated by its own gravity. The alternative theory suggested by Brewster, that the substance of Jupiter and his fellow-giants of the outer planetary family may be porous, like pumice stone, is equally untenable for a like reason.

We seem forced, then, to the conclusion, that no resemblance exists between the condition of Jupiter and that of our earth. This being so, the theory to which we have been already led, that the condition and rapid changes of condition of the deep Jovian atmosphere are due to the planet's intense heat, suggests at once a solution of the difficulties just mentioned. These difficulties arose while we were dealing with Jupiter as a planet like our earth. But at the outset we noted, in his great volume and mass, the suggestion of a wide difference between his condition and that of our earth. Regarding him as belonging to a different class on account of his enormous size, and being led also to consider him as intensely heated, we may fairly compare him with a body known to be intensely heated, and of size enormously surpassing the earth, viz., with the sun. And though our difficulties are not in this way removed, yet we find that a much more complete analogy can be established between Jupiter and the sun than between the earth and Jupiter. Thus the density of the sun, like that of Jupiter, is small compared with the earth's; in fact, the mean density of the sun is almost exactly the same as that of Jupiter. The belts of Jupiter may be much more aptly compared with the spot-zones of the sun than with the trade-zones of the earth, which would certainly not present, as viewed from Mercury or Venus, any resemblance to the belts of Jupiter. The spots on Jupiter are not constant, and in this respect resemble the sun spots. They are like these also in having a proper motion. They change less rapidly, but this is intelligible when we consider how much less intensely heated Jupiter is than the sun.

Brightness of Jupiter, Saturn, &c.

It remains to be mentioned, in support of this theory of the inherent heat of Jupiter, that the light received from him is far greater than he would reflect if his surface were like that of the moon or of Mars. As the reasoning we have given has not been intended to relate solely to Jupiter, but to Saturn certainly, and probably to Uranus and Neptune, we may suitably present here a table which exhibits the relation between the light received from the various members of the solar system, and appears as markedly to distinguish the giant planets from the inner family, as the relations of size, mass, orbital scale, rapid rotation, and complexity of system, which have been longer known. From the observations of Zöllner, *Grundzüge einer allgemeinen Photometrie des Himmels*, Berlin, 1861, it appears that the light of the five planets at their mean opposition bears the following proportion to the light of the sun:—

			Probable Error. Per cent.
Sun =	6,994,000,000 times	Mars	5·8
Sun =	5,472,000,000 ,,	Jupiter	5·7
Sun =	130,980,000,000 ,,	Saturn (without the ring)	5·0
Sun =	8,486,000,000,000 ,,	Uranus	6·0
Sun =	79,620,000,000,000 ,,	Neptune	5·5

To which add two estimates of the moon's light, by comparing surfaces, and by comparing point-like images, of the sun and moon:—

		Probable Error.
Sun = 618,000 times	Moon	2·7 per cent.
Sun = 619,600 ,,	,,	1·6 ,,

Whence the average reflecting powers of the surfaces of the six orbs compared would be (on the assumption that the outer planets have no inherent light),—

Moon	0·1736	Saturn	0·4981
Mars	0·2672	Uranus	0·6400
Jupiter	0·6238	Neptune	0·4848

These results seem strongly to suggest that the four members of the outer family of planets shine partly by inherent lustre. The spectroscopic analysis of the light of Jupiter and Saturn, though not altogether satisfactory, indicates clearly the existence of a very deep vapour-laden atmosphere around each planet.

Satelites of Jupiter.

Soon after the invention of the telescope, Galileo discovered that four small orbs or satellites circle around Jupiter. Galileo soon found that their orbits are nearly circular, and their motions nearly uniform. They revolve in planes inclined little to the plane of the ecliptic, so that as viewed from the earth they appear to traverse very narrow ellipses. Even when these ellipses are most open, they all, save the outermost, have minor axes less than Jupiter's apparent diameter, so that any one of the three interior satellites is necessarily occulted when in superior conjunction with Jupiter as viewed from the earth, and eclipsed in his shadow when in superior heliocentric conjunction, while when in inferior geocentric conjunction, it is in transit across the planet's disk; and when in inferior heliocentric conjunction, its shadow is in transit. The same is true of the fourth satellite during about two-thirds of Jupiter's year, viz., for about one-sixth of his year before and after the two equinoxes (four sixths in all), the plane of the satellite's orbit being nearly coincident with the planet's equator. The elements of the satellites are given in the tables on p. 783, and the orbits are pictured to scale in Plate XXVIII. To the elements tabulated may be added these (the densities usually given in the books being altogether incorrect):—

	Density (earth's as 1).	Density (water as 1).
Sat. I.	0·198	1·148
,, II.	0·374	2·167
,, III.	0·325	1·883
,, IV	0·258	1·463

Thus all the satellites (except the first) have a density exceeding Jupiter's. Probably their real densities are greater, as irradiation increases their apparent size.

The motions of Jupiter's satellites have been very carefully studied. They had not been long observed before a peculiarity was recognised, which Roemer was the first to interpret. Their various phenomena were found to occur earlier when Jupiter was in opposition, and later when he was near conjunction, than the predicted time. (In conjunction, of course, he cannot be seen.) Roemer suggested that the time-difference is due to Jupiter's variations of distance from the earth,—light, which brings to our earth information of the phenomena, taking a longer time in reaching us when Jupiter is farther away. Ridiculed at first, this theory was before long established by repeated observation, and eventually placed beyond all question by Bradley's discovery of aberration. (See ABERRATION, vol. i. p. 48.)

A singular relation exists between the motions of Jupiter's three inner satellites. It will be observed from the table of elements that the period of the second is almost exactly double the period of the first, that of the third almost exactly double that of the second; in other words, the sidereal motions of I. II. and III. are almost exactly as the numbers 4, 2, and 1. This will be more clearly shown by the following table:—

	Sidereal Revolution in Seconds.	Sidereal Revolution per Second.
Sat. I.	152853·505	8·478706
,, II.	306822·040	4·223947
,, III.	618153·360	2·096567
,, IV.	1441931·271	0·898795

The coincidence is not exact; but the following relation holds *exactly*:—The sidereal motion of I. added to twice the sidereal motion of III. is equal to three times the sidereal motion of II. Thus—

$$(8''\cdot478706) + 2(2''\cdot096,567) = 12''\cdot671840$$
$$= 3(4''\cdot223947).$$

A result of this relation, combined with the fact that when

I. and III. are in conjunction II. is in opposition to both, is that the three satellites are never in conjunction together. Thus, starting from a conjunction of I. and III., with II. in opposition, we have, after almost exactly one revolution of I., II. and I. in conjunction, and III. in quadrature to both, after another, II. and III. are in conjunction, and I. in opposition to both; after another, II. and I. are in conjunction, and III. in quadrature to both; and after a fourth, the same arrangement is resumed as at first, I. and III. being in conjunction, and II. in opposition to both, but the line on which all four satellites now lie holding a slightly different position from that occupied when these circuits began. Thus the satellites can never be all occulted together, or all in transit together.

Chapter XV.—*The Planet Saturn.*

Saturn is the largest planet but one of the solar system, being surpassed in mass by Jupiter alone. His mass exceeds the combined mass of all the other planets (Jupiter excepted) nearly threefold. He is the sixth planet in order of distance from the sun, and was the remotest planet known to the ancients. He travels at a mean distance of 872,137,000 miles from the sun, his greatest distance being 920,973,000 miles, his least distance 823,301,000 miles. The eccentricity of his orbit is 0·055996, and the inclination 2° 29′ 28″ to the plane of the ecliptic. Saturn's mean sidereal period of revolution in his orbit is 29 years 167 days (see the *Elements*, p. 782); his mean synodical revolution, or the mean interval between his successive returns to opposition, is 378·090 days. The planet's mean diameter is about 70,000 miles, his polar diameter about 3500 miles less, his equatorial diameter about 3500 miles greater. In volume he exceeds the earth nearly 700 times, but in mass only about 90 times, his density being less than the earth's in the proportion of about 13 to 100. He rotates on his axis in about 10¼ hours, the plane of his equator being inclined nearly 27° to the plane of his orbit.

Saturnis rings. This planet, in consequence of a luminous ring with which he is surrounded, is one of the most interesting objects in the heavens. This singular appendage was first noticed by Galileo, to whom the planet presented a *triple* appearance, as if a large orb were situated between two small bodies or *ansæ*. He observed that sometimes the ansæ were so enlarged as to present the appearance of a continuous ring; at other times they entirely disappeared, and Saturn appeared round like the rest of the planets. After a certain time they again became visible, and gradually increased in magnitude. These curious appearances were shown by Huyghens to be occasioned by an opaque, thin, circular ring surrounding the equator of Saturn, and at a considerable distance from the planet. Saturn moving in the plane of his orbit, carries the ring along with him, which, presenting itself to the earth under different inclinations, occasions all the phenomena which have been described.

Disappearance of the rings. The ring being only luminous in consequence of its reflecting the solar light, it is evident that it can be visible only when the sun and the earth are both on the same side of it; if they are on opposite sides, it will be invisible. It will likewise be invisible in two other cases, namely, 1*st*, when its plane produced passes through the centre of the earth, for then none of the light reflected from it can reach us; and 2*d*, when its plane passes through the sun, because only its edge is then enlightened, and being very thin, the whole quantity of reflected light will scarcely be sufficient to render it visible. It is, however, evident that in these two cases the effect will be modified in some degree by the power of the telescope. In ordinary telescopes the ring disappears sometimes before its plane comes into either of the situations mentioned; but Herschel never lost sight of it, either when its plane passed through the earth or the sun. In the last case the edge of the ring appeared as a luminous line on the round disk of the planet, measuring scarcely a second in breadth, but at the distance of Saturn a second corresponds to 4000 miles, which is equal to the semidiameter of the terrestrial globe. The reason of the ring's disappearance will be easily understood by referring to fig. 49, where the circle *a b c d* represents the orbit of

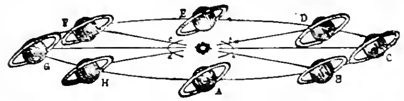


Fig. 49.—Diagram illustrating Different Appearances of Saturn's Rings.

the earth, A B C D that of Saturn 9½ times more distant from the sun. When Saturn is at A, the earth and sun are both in the plane of the ring; its edge is consequently turned towards us, and it will be invisible unless telescopes of very high power are used. See Plate XXIX. fig. 1. As Saturn advances from A to B, the ring gradually opens, see Plate XXIX. fig. 2, and it attains its greatest breadth at C, where a straight line perpendicular to its plane makes a more acute angle with the visual ray than in any other situation, see Plate XXIX. fig. 3. As the planet advances towards D, the plane of the ring becomes more oblique to the visual ray; the breadth of the ring consequently contracts, and it again disappears at E. From E to F, G, and A, the same phenomena will be repeated, only in this case it is the southern side of the ring which is visible to the earth, whereas, while Saturn was in the other half of his orbit, it was the northern side. These changes take place in a period whose full length is Saturn's year, or about 29½ of our years. Thus the interval between successive disappearances is about 15 years.

The brothers W. and J. Ball discovered a division separating the ring into two concentric rings, the inner being the wider. Cassini confirmed this discovery. Sir W. Herschel concluded that the matter of the ring is no less solid than that of Saturn, as it casts a strong shadow upon the planet. The light of the ring is generally brighter than that of the planet; for it appears sufficiently luminous when the telescope affords scarcely light enough for Saturn. The outer ring is much less brilliant than the inner. Division in the rings.

In observing the ring with very powerful telescopes, some astronomers have remarked, not one only, but several

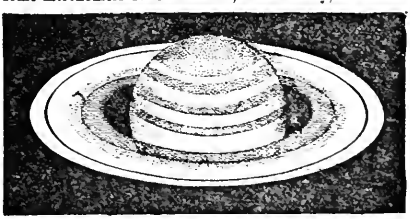


Fig. 50.—Saturn, as seen at Malta by Mr Lassell with a 20 feet Reflector on 9th October 1852.

dark concentric lines on its surface, which divide it into as many distinct circumferences. In common telescopes these are not perceptible; for the irradiation, by enlarging the space occupied by each ring, causes the intervals between them to disappear, and the whole seems blended together in one belt of uniform appearance. (See fig. 50.)

By means of some spots observed on the surface of the

Rotation of the rings. ring, Herschel found that it revolves in its own plane in 10 hours 32 min. 15·4 sec.; and Laplace arrived at the same result from theory. It is worthy of remark, that this is the period in which a satellite, having for its orbit the mean circumference of the ring, would complete its revolution according to the third law of Kepler.

The dark ring. Amongst the most remarkable discoveries of recent times with regard to the rings of Saturn is that of the *inner dusky or semi-transparent ring*, sufficiently obvious to any observer capable of using well a moderately good telescope, but which, previously to the year 1850, was only once mentioned by any astronomer. Dr Galle of Berlin saw this ring with the Berlin refractor in 1838, but the attention of the scientific world was not generally drawn to it. The account of Galle's observations is accompanied by drawings exhibiting the trace of the dusky ring where it crosses the body of the planet. In the year 1850 the ring was recognised almost simultaneously by two observers, namely, by Prof. Bond of the Cambridge Observatory, U.S., and by Mr Dawes. Since that time there has been no difficulty in seeing this appendage, though it requires a practised eye and a good telescope.

At the time of the discovery of the dusky ring, Mr Dawes also satisfactorily established the fact of the division of the exterior ring near its outer extremity; and subsequently he observed a series of discontinuous gradations of colour or intensity of brightness in a portion of the inner bright ring. He observes that "the exterior portion of the inner bright ring to about one-fourth of its whole breadth was very bright, but, interior to this, the shading-off did not appear, as under ordinary circumstances, to become deeper towards the inner edge without any distinct or sudden gradations of shade; on the contrary, it was clearly seen to be arranged in a series of narrow concentric bands, each of which was darker than the next exterior one. Four such were distinctly made out: they looked like steps leading down to the black chasm between the ring and the ball. The impression I received was, that they were *separate rings*, but too close together for the divisions to be seen in black lines." This curious phenomenon was confirmed afterwards by Professor Bond.

Captain Jacobs, at the Madras Observatory, discovered that the dusky ring is semi-transparent, the body of the planet being visible through it. M. Otto Struve shows with tolerable certainty that the inner or dusky ring is not a modern appendage to the planet, but that, at the beginning of the 18th century, the dark line thrown by it across the planet was known by the name of the *equatorial belt*. He also finds reason to believe, from a comparison of the measures of Huyghens, Cassini, Bradley, Herschel, W. Struve, Encke, Galle, and himself, that the *inner edge of the interior bright ring is gradually approaching the body of the planet, while at the same time the total breadth of the two bright rings is constantly increasing.*

Nature of the rings. The opinion now generally entertained respecting the Saturnian ring-system is, that it is composed of multitudes of minute satellites, probably intermixed with vapour, travelling independently around the planet. On no other supposition, indeed, can the permanence of the ring-system be explained.

Rotation and figure of Saturn. From observations of some obscure belts, and a very conspicuous spot on the surface of Saturn, Sir W. Herschel concluded that his rotation is performed in 10 hours 16 min., on an axis perpendicular to the belts and to the plane of the ring; so that the planes of the planet's equator and ring coincide. According to the same astronomer, the ratio of the equatorial and polar diameters of Saturn is 2281 to 2061, or nearly 11 to 10. He also observed that the globe of Saturn appeared to be flattened at the equator as well as at the poles. The compression he thought to extend to a great distance over the surface of the planet, and the greatest diameter to be that of the parallel of 43° of latitude, where, consequently, the curvature of the meridians is also the greatest. The disk of Saturn, therefore, resembled a square of which the four corners have been rounded off. According to recent measures the shape of the planet has been found to be that of an exact spheroid of revolution; but it does not follow that this is always the case. Applying to Saturn reasoning similar to that already employed in the case of Jupiter, we see that the atmospheric envelope may be so deep that the cloud-layers which the astronomer really measures may lie at different levels, under the varying conditions to which the planet is subject.

Saturn is surrounded by a system of eight satellites— the most extended as well as most numerous subordinate system within the sun's domain. The span of the orbit of the outermost satellite amounts to nearly 4 millions of miles. This satellite is probably larger than our moon, while Titan, the 6th satellite, is nearly as large as the planet Mercury. The elements of the satellites and the names of their discoverers are indicated in the table at p. 783. Their motions are less interesting to observers than those of Jupiter's satellites, because, owing to their considerable inclination to the plane of Saturn's orbit, they are seldom occulted by the planet, or transit across his disk. Saturnian satellites

CHAPTER XVI.—*The Planets Uranus and Neptune.*

Uranus is the seventh primary planet in order of distance from the sun, and, with the exception of Neptune, the remotest. His mean distance from the sun exceeds the earth's more than 19 times, and amounts to 1,753,869,000 miles. But the eccentricity of the orbit is considerable, amounting to 0·0466; consequently, the variation of the planet's distance is also great, his greatest distance amounting to 1,835,561,000 miles, his least to 1,672,177,000 miles. Subtracting roughly from his greatest, mean, and least distance the earth's distance, we obtain the opposition distances 1,744,000,000 miles, 1,662,500,000 miles, and 1,581,000,000 miles respectively; and, therefore, it is manifest that the planet is seen under much more favourable conditions in some oppositions than in others, especially if it is remembered that when at one of his nearer oppositions, Uranus, being also nearer to the sun, is more strongly illuminated, a point of great importance in the case of a planet so far from the sun. The sidereal revolution of Uranus is performed in 30,686·8208 days, or 84 years $6\frac{1}{2}$ days. His mean diameter is about 33,000 miles, and, as seen from the earth, Uranus in opposition subtends an angle of less than 4″. The apparent diameter of the sun seen from Uranus is less than $\frac{1}{19}$th of the diameter of the sun as we see him, or is but about $1\frac{2}{3}'$; and the apparent surface of the sun is but about the 367th part of the apparent surface of the sun we see. Accordingly, the light and heat received by Uranus are less in the same proportion. This refers, of course, only to the light and heat received per unit of surface. The whole globe of Uranus receives about $\frac{1}{24}$th part of the heat which is received by the whole globe of the earth. It has been asserted that Uranus turns upon an axis in about $9\frac{1}{2}$ hours, but the evidence on which this statement rests is slight and insufficient. Uranus.

Uranus was discovered by Sir W. Herschel on March 13, 1781, while he was examining the small stars in the neighbourhood of η Geminorum. Being struck with the enormous magnitude of a star in this region, he suspected it to be a comet. He examined it with higher power, and found the disk enlarged, which would not be the case with a star. He therefore announced the discovery of a comet. Discovery of Uranus

But it was found to be moving in a nearly circular path, and was presently recognised as one of the principal planets of the solar system. Herschel gave it the name of Georgium Sidus, and foreign astronomers called it Herschel; but the name Uranus, suggested by Bode, of Berlin, is now universally adopted. In 1787 Herschel discovered that it was attended by two satellites, and he subsequently supposed that he had discovered four others; but there is great reason to believe that he had mistaken small stars near the planet for satellites. Two other satellites inferior to the rest have been discovered by Mr W. Lassell, completing the series of four satellites whose elements are given at p. 783. Recently Prof. Holden of Washington, U.S., after careful study of the motions of all four satellites, has found reason for believing that one of those discovered by Sir W. Herschel (subsequently to satellites 3 and 4) is identical with satellite 2, while another seems not improbably identical with the innermost satellite. The satellites of Uranus are distinguished from all others in the solar system by the great inclination of their orbits to the ecliptic, amounting to nearly 80°, and by their retrograde motion. Hind gives 79° 26′ as the inclination of the orbits of Titania and Oberon (3 and 4), and for the longitudes of their rising nodes 165° 25′ and 165° 28′ respectively.

ranian tellites.

Little of interest has rewarded the telescopic study of Uranus; nor has the spectroscope given any trustworthy evidence, though Secchi, Huggins, and Vogel recognise peculiarities distinguishing the spectrum of Uranus from that due to reflected sun-light.

scovery Neptune.

The discovery of the planet Neptune ranks amongst the most brilliant of the scientific feats of the present century.

For many years the orbit of Uranus had been the occasion of great embarrassment to astronomers, from the impossibility of adequately reconciling the ancient and modern observations by any one set of elements, and from the rapid increase of the error from year to year. Bouvard early suggested that some planet exterior to Uranus caused these apparent irregularities. Amongst the astronomers who entered seriously upon the task of determining the position of such a disturbing planet two arrived at a successful solution of the problem, namely, Mr Adams and M. Leverrier.

Adams had, ever since the year 1841, determined on attempting the solution of the problem relating to the unknown disturbances of Uranus, and in 1843 he began his investigations. In September 1845 he communicated to Professor Challis the values of the elements of the orbit of the supposed disturbing planet, and in the following month he communicated to the astronomer royal the same results slightly corrected. These communications did not lead, however, to any steps being taken to secure by observation the discovery of the planet till the summer of 1846, after the publication of Leverrier's second memoir, in which the same position, within one degree, was assigned to the disturbing planet as that given in Adams' paper.

Leverrier undertook the task of revising the theory of Uranus at the instance of M. Arago. His first memoir on the subject was read before the French Academy in November 1845, and his second memoir in June 1846. A third memoir, entitled "*Sur la planète qui produit les anomalies observées dans le mouvement d'Uranus—Determination de sa masse, de son orbite, et de sa position actuelle,*" was read on August 31, 1846. A fourth memoir, containing the remaining part of M. Leverrier's investigations, was read after the discovery of Neptune on October 5, 1846.

The discovery of the disturbing planet followed almost immediately after the publication of the third memoir of Leverrier. He wrote to his friend Dr Galle, of Berlin, requesting him to search for the planet with the large refracting telescope of the Berlin Observatory, at the position which he indicated to him. This letter reached Berlin on September 23, and on the same evening Galle observed all the stars in the neighbourhood of the place indicated, and compared their places with those given in Bremiker's *Berlin Star-Map*. This map had not yet reached England, and on this circumstance probably depended the priority of discovery at Berlin. Galle very quickly found a star of about the eighth magnitude, nearly in the place pointed out, which did not exist in the map. Little doubt was entertained at the time that this was the planet, and the observations of the next two days confirmed the discovery.

After Leverrier had announced the results of his labours, agreeing, as we have seen, with Adams's results, the resources of the Cambridge Observatory were brought into use for the discovery of the planet, and a systematic search was begun by Professor Challis with the great Northumberland telescope. The sweeps of the portion of the heavens in which it was supposed the planet would be found were begun on July 29, and the planet was actually observed on August 4, but without recognition. After the discovery of the planet at Berlin, it was found that the planet had also been observed on August 12. If, therefore, Bremiker's map had been in the hands of Professor Challis, or if he had found leisure for the mapping of his observations from night to night, Neptune would have been infallibly detected within a very few days of the commencement of the search, and the whole glory of the discovery would have belonged to the English geometer.

An ancient observation in Lalande's catalogue was discovered almost simultaneously by Mr Walker, of the Washington Observatory, and by Dr Peters at Altona. Two observations, the one in October 1845, and another in September 1846, were also detected by Mr Hind in Lamont's *Zones*; and these (especially the former) contributed greatly to the construction of an accurate orbit. An excellent orbit was computed by the joint labours of the American astronomers Peirce and Walker.

Almost immediately after the discovery of Neptune, it was found to be attended by one satellite. This discovery was made by Mr Lassell in October 1846. The orbit of the satellite is inclined to the ecliptic at an angle of about 29°. By observations of this satellite at Cambridge (in America), and at Poulkowa, two separate values of the mass, namely, $\frac{1}{19840}$ and $\frac{1}{14496}$ have been deduced; but the object is so difficult to observe, that a considerable time must elapse before any very accurate determination can be obtained. The satellite is supposed to travel in a retrograde direction, like the satellites of Uranus; but this has not yet been demonstrated.

Neptune's satellite.

Chapter XVII.—*Comets.*

Comets.

The comets form a class of bodies belonging to the solar system, distinguished from the planets by their physical appearance and the great eccentricities of their orbits.

Orbits of comets.

While the orbits of all the planets are confined within a narrow zone, or to planes not greatly inclined to the ecliptic, those of the comets are inclined in all possible angles. The figures of the orbits, instead of being nearly circular, like those of the planets, often have the appearance of being almost rectilinear. Hevelius seems to have been the first who discovered, by means of a geometrical construction, that the orbits might be represented by parabolas; and Halley first calculated their elements on this hypothesis. After it was known, however, that certain comets return to the sun in the same orbits, it became necessary to adopt the opinion that, in conformity with the laws of Kepler, the cometary orbits are ellipses having the sun in one of the foci. As the ellipses are in general extremely elongated, and the comets are only visible while they describe a small portion of their orbits on either side of their perihelia, their paths during the time of their appearance differ very little from parabolas; whence it is usual, on account of the facility of computation, to assume that they really move in parabolic curves. Newton employed the hypothesis of an elliptic motion to compute the orbit of the famous comet of 1680. They have received the name of comets (*coma*, hair) from the *bearded* appearance which they frequently exhibit.

Halley's comet. One of the most remarkable periodic comets with which we are acquainted is that known to astronomers as Halley's. Having perceived that the elements of the comet of 1682 were nearly the same as those of two comets which had respectively appeared in 1531 and 1607, he concluded that all the three orbits belonged to the same comet, of which the periodic time was about 76 years. After a rough estimate of the perturbations it must sustain from the attraction of the planets, Halley predicted its return for 1757,—a bold prediction at that time, but justified by the event, for the comet again made its appearance as was expected, though it did not pass through its perihelion till the month of March 1759, the attraction of Jupiter and Saturn having caused, as was computed by Clairaut previously to its return, a retardation of 618 days. This comet had been observed in 1066, and the accounts which have been preserved represent it as having then appeared to be four times the size of Venus, and to have shone with a light equal to a fourth of that of the moon. History is silent respecting it from that time till the year 1456, when it passed very near to the earth: its tail then extended over 60° of the heavens, and had the form of a sabre. It returned to its perihelion in 1835, and the splendour of its appearance rendered it once more an object of universal interest; it was well observed in almost every observatory.

Lexell's comet. The orbit of the comet of 1770 was calculated by Lexell, and subsequently by Burckhardt, and both these astronomers found that the observations could only be represented by an ellipse in which the time of revolution was five years and a half; yet the comet has never been seen since, or at least has not been seen moving in the same orbit. Hence it is concluded with certainty that the attraction of Jupiter, near which planet it had passed, was so great as to compel it to move in a totally different ellipse.

Another famous comet, whose periodic returns have been verified by observation, received the name of Encke the astronomer, who first recognised it as having been observed in previous revolutions. It returns to its perihelion in 1208 days. Encke's comet, although its identity was not discovered till 1818, had been frequently observed, as in 1789, 1795, and 1805; and on these occasions it exhibited very different appearances, having been seen with and without a nucleus, and with and without a tail,—circumstances which account for its having so long escaped being recognised as a regular attendant on the sun. In its returns to its perihelion in 1808, 1812, and 1815, it escaped detection; but it reappeared in 1818, and it was from the observations of that year that Encke computed the elliptic elements of its orbit. On its next return, in 1822, it was invisible in Europe; but it was observed at Paramatta, in New South Wales, during the whole month of June, and the time of its perihelion passage was found to differ only by about three hours from that previously computed by Encke. During most of its returns since then it has been well observed.

Other periodical comets will be mentioned further on.

Phenomena of comets. The appearances exhibited by comets are diversified, and sometimes remarkable. That which appeared in the year 134 B.C., at the birth of Mithridates, is said to have had a disk equal in magnitude to that of the sun. Ten years before this, one was seen which, according to Justin, occupied a fourth part of the sky (that is, extended over 45°), and surpassed the sun in splendour. Another, equally remarkable, appeared in the year 117 of our era; and in 479 there was one, of which the disk, according to Freret, was of such magnitude, that it might have occasioned the extraordinary eclipse of the sun which took place about that time. In 400 one was observed, which is said to have resembled a sword, and to have extended from the zenith to the horizon. That of 531 was of greater magnitude still, and its appearance more terrific. Those which appeared in 1066 and 1505 exhibited disks larger than that of the moon. It is, however, probable that these accounts were exaggerated; for since comets have been observed by astronomers, no instances have occurred in which their magnitudes and appearances have been so extraordinary. The most remarkable among those of which we possess accurate accounts appeared in the years 1456, 1618, 1680, 1744, 1759, 1769, 1807, 1811, 1841, 1858, 1861, and 1874.

The nucleus, which is the densest and most luminous part, may be said to form the true body of the comet. It is far, however, from having the dense and solid appearance of the planets, and astronomers consider it to be diaphanous, and believe that they have observed stars through it. But it is extremely difficult to distinguish the nucleus from the surrounding nebulosity. If the nucleus were an opaque globular body, it would exhibit phases like Venus or Mars, according to its different positions with relation to the sun and the earth; and such were supposed to have been observed in the case of the comet of 1682, by Hevelius, Picard, and Lahire. But the nebulosity renders the phases obscure, and prevents the true body of the comet from being seen. The real nucleus has probably never been observed by any astronomer.

It is known certainly that comets are of small density, from the circumstance that they produce no appreciable effect on the motions of the planets. The comet of 1770 traversed the system of Jupiter's satellites without causing any sensible perturbation of these small bodies. This comet also passed very near the earth; and Laplace calculated that, if its mass had been equal in density to that of the earth, the effect of its attraction would have increased the length of the sidereal year by 2 hours 28 min. But since its influence was altogether insensible, it is certain that its mass was not equal to the five-thousandth part of that of the earth, and was probably much less than even this quantity.

If the real nuclei of comets were solid, the matter of which they are composed must be extremely fixed, in order to enable them to resist the intense heat they necessarily experience in their approaches to the sun. According to the computation of Newton, the great comet of 1680, at its perihelion, was only distant from the sun by the 163d part of the semidiameter of the earth's orbit, where it would be exposed to a heat above 2000 times greater than that of red-hot iron,—a temperature of which we can form no conception, and which would instantly dissipate any substance with which we are acquainted.

The most interesting features of recent research into the subject of comets are (1) the spectroscopic examination of those comets which have appeared since the importance of spectroscopic analysis has been recognised, and (2) the association which has been recognised between meteor-systems and comets.

Periodic comets. Before proceeding, however, to discuss these matters, we give the following tables indicating the progress which has been made in the determination of the orbits of periodic comets:—

Table of Comets having a Mean Distance less than that of Saturn.

Name.	Mean distance from Sun.	Eccentricity.	Inclination.	Period in years.
Encke's..........	2·2181	0·8464	13° 4′ 15″	3·303
Blainpain's......	2·8490	0·6867	9 11 6	4·809
Burckhardt's....	2·9337	0·8640	8 1 45	5·025
Clausen's.........	3·0913	0·7213	1 53 43	5·435
De Vico's........	3·1028	0·6173	2 54 45	5·469
Winnecke's......	3·1343	0·7547	10 48 4	5·549
Brorsen's.........	3·1463	0·7945	30 57 51	5·581
Lexell's..........	3·1560	0·7861	1 34 28	5·607
Pons's............	3·1602	0·7552	10 42 48	5·618
D'Arrest's	3·1618	0·6609	13 56 6	6·380
Biela's	3·5306	0·7563	12 33 17	6·635
Faye's	3·8118	0·5576	11 22 7	7·414
Pigott's	4·6496	0·6787	47 43 0	10·025
Peters's..........	6·3206	0·7567	13 2 14	15·990

Motion in all cases direct.

Table of Comets having a Mean Distance exceeding Saturn's, and less than that of Uranus.

Name.	Mean distance.	Eccentricity.	Inclination.	Period in years.
Westphal's......	16·6200	0·9248	40° 53′ 32″	67·770
Pons's	17·0955	0·9545	73 57 3	70·068
De Vico's........	17·5836	0·9544	84 57 13	73·250
Olbers's..........	17·6338	0·9312	44 29 55	74·050
Brorsen's.........	17·7795	0·9726	19 8 25	74·970
Halley's..........	17·9875	0·9674	17 45 5	76·680

Motion of the first five direct, of Halley's retrograde.

Analysis of cometic spectra.

The fine comet of 1858-59, called Donati's, was subjected to a rough spectroscopic analysis by Donati, and the spectrum shown to be discontinuous, consisting of a few broad bands. Comet I., 1866 (called Tempel's), examined by Huggins in 1866, showed three bands in the spectrum of the nucleus. Brorsen's comet, examined in 1868, showed similar appearances. But it was not until the examination of Winnecke's comet in 1868 that any successful attempt was made to compare the band spectrum of a comet's nucleus with the spectrum of a known terrestrial element. The result was somewhat remarkable. It was found that the spectrum is that obtained from carbon when the electric spark is taken through olefiant gas. The same result has been obtained, both by Huggins and by Professors Harkness and Young of America, from the spectroscopic analysis of Encke's comet in 1872. Professor Harkness sums up the result of his own series of researches into the condition of this comet as follows :—(1.) Encke's comet gives a carbon spectrum. (2.) From November 18 to December 2, the wave length of the brightest part of the comet's spectrum was continually increasing. (3.) No polarisation was detected in the light of the comet. (4.) The mass of Encke's comet is certainly not less than that of an asteroid. (5.) There is some probability that the electric currents which give rise to auroras are propagated in a medium which pervades all space, and that the aurora is in reality the spectrum of the medium. 6. It is not improbable that the tails of all large comets will be found to give spectra similar to that of the aurora, though additional lines may be present.

Connection of comets and meteors.

It is only of late years that the study of meteors or falling stars has come to be regarded as belonging to astronomy. Even now the discovery of the connection of meteors and comets is so recent, and the aspect under which the new department of astronomy presents itself varies so continually as fresh relations are recognised, that it seems desirable to limit our remarks to the statement of a few broad facts.

It has been shown, then, that meteors travel in systems round the sun, and that displays of falling stars occur when the earth passes through a meteor-system.

There are already recognised more than one hundred meteor-systems, known by the direction in which the corresponding falling stars encounter the earth.

The best-known meteor-systems are those which produce a shower on November 13–14 in certain years, and those which usually produce a display on August 10–11. The former have been called the Leonides, because the part of the stellar sphere whence the meteors appear to radiate is in the constellation Leo. The latter, for a like reason, appearing to radiate from Perseus, have been called the Perseides.

It has been found that these two meteor-systems accord, so far as their orbital motions are concerned, with two comets, viz., respectively Tempel's comet, I., 1866, and the comet known as III., 1862. The association is indicated in the following table :—

Known Elements.	Orbit of November Meteors.	Comet I. 1866.	Orbit of August Meteors.	Comet III. 1862.
Perihelion passage..........	Nov. 13, 1866	Jan. 11, 1866	July 23·62	Aug. 22·9
Perihelion distance.........	0·9893	0·9765	0·9643	0·9626
Longitude of Perihelion..	...	...	343° 38′	344° 41′
Longitude of Node:........	☋ 51° 28′	51° 26′·1	☊ 138° 16′	137° 27′
Eccentricity ..	0·9033	0·9054	...	...
Semi - axis major........	10·340	10·324	...	...
Inclination....	18° 8′	17° 18′ 1	64° 3′	66° 25′
Period (in years)........	33·25	33·176	...	123·74
Motion	Retrograde	Retrograde	Retrograde	Retrograde

Other comets have been associated, though not quite so distinctly, with meteoric systems. But perhaps the most remarkable evidence in this matter is that afforded by Biela's comet. At the return in 1866, and again in 1872, this comet was not seen; and as it had become divided into two distinct comets in 1846, the inference was, that it had further subdivided since it was last seen in 1852. Now the orbit of this comet nearly intersects that of the earth, at about the place occupied by the earth on November 27. Accordingly, after the fruitless telescopic search for the comet in 1872, Professor Alexander Herschel pointed out that, during the last week in November, meteors following in the train of this comet might be expected to make their appearance. On the night of November 27, 1872, a remarkable shower of meteors was observed, the meteors radiating from a region of the heavens indicating that they were travelling in the track of Biela's comet.

Telescopic observation of comets.

The telescopic study of some of the remarkable comets of the last quarter of a century has been rewarded by results of interest. This has been the case in particular with Donati's comet of the year 1858. During the comet's passage past its perihelion, several envelopes formed around the head, continually passing outwards, and disappearing after a certain distance from the nucleus had been reached, while new envelopes appeared within. Besides the principal tail, which was curved like an aigrette plume, another thin straight tail was visible for a while; and for a short time yet another was seen. A striation of the chief tail could also be recognised, which, according to the researches of Bond and Norton in America, corresponded to the action of a repulsive force exerted by the sun, and sweeping matter away from the main tail with a velocity exceeding that with which this tail itself was formed, but not exceeding the velocity indicated by the straightness of the subsidiary tails.

Coggia's comet.

The great comet of 1874 is shown in fig. 51, as pictured by Mr Huggins. It exhibits well a peculiarity which has characterised many comets, the well-defined dark streak behind the nucleus (which, however, is in this case somewhat eccentrically situated). This phenomenon is not

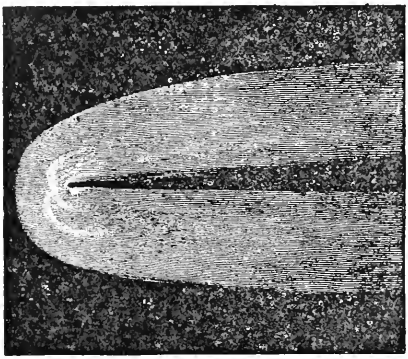


FIG. 51.—Coggia's Comet

easily explained. It is common, indeed, to find it accounted for as due to the absence of illuminated matter behind the nucleus. But as a comet's tail is not a flat object, spread out on the dome of the heavens, but a conical, or rather conoidal, appendage, which viewed from all sides would present, no doubt, much the same appearance, the line of sight directed towards the axis must pass through the illuminated envelope Huggins's spectroscopic examination of this comet yielded results resembling those he had already obtained from small comets. But this was the first comet whose tail he had analysed The spectroscopic analysis of the various parts of the comet gave the following results —

"When the slit of the spectroscope was placed across the nucleus and coma, there was seen in the instrument a broad spectrum, consisting of the same three bright bands exhibited by Comet II., 1868, crossed by a linear continuous spectrum from the light of the nucleus. On the continuous spectrum of the nucleus," he proceeds, "I was not able to distinguish with certainty any dark lines of absorption, or any bright lines, other than the three bright bands. Besides these spectra, there was also present a faint broad continuous spectrum between and beyond the bright bands. When the slit was moved on to different parts of the coma, the bright bands and the faint continuous spectrum were found to vary in relative intensity. When the slit was brought past the nucleus on to the commencement of the tail, the gaseous spectrum became rapidly fainter, until, at a short distance from the nucleus, the continuous spectrum predominated so strongly that the middle band only, which is the brightest, could be detected on it. We have presented to us, therefore, by the light of the comet, three spectra (1) The spectrum of bright bands, (2.) The continuous spectrum of the nucleus; (3.) The continuous spectrum which accompanies the gaseous spectrum in the coma, and which represents almost entirely the light of the tail"

CHAPTER XVIII —*The Fixed Stars and Nebulæ*

The constellations. The great multitude of stars visible even to the naked eye renders it impossible to distinguish each by a particular name, astronomers, accordingly, for the sake of reference, have formed them into groups, known as *Constellations* or *Asterisms* To these the early astronomers gave the names of men and animals, and other objects, from fancied resemblances or analogies, for the most part not easily traced. These denominations are preserved in modern catalogues, and the practice of delineating the object itself on celestial globes and charts has been only recently, if it has yet been altogether abandoned. The ancients distinguished some of the brightest stars in the different constellations by particular names, but to include others less conspicuous, it became necessary to adopt a different mode of proceeding. According to the usual method, first introduced by Bayer in his *Uranometria*, each of the stars in every constellation is marked by a letter of the Greek alphabet, commencing with the most brilliant, which is designated by α, the next most conspicuous is called β, the third γ, and so on. When the Greek letters are exhausted, recourse is had to the Roman or Italic. The order of the letters was intended to indicate only the relative brilliancy of the stars in the same constellation, without any reference to those in other parts of the heavens. Thus α Aquarii is a star of the same order of brightness as γ Virginis. Moreover, whether owing to carelessness in the original lettering or to changes in the brightness of the stars, the order of the letters does not always correspond to the brightness, even in the same constellation. Thus, ϵ, ζ, and η Ursæ Majoris are far brighter than δ of that constellation. The stars of the first order of brightness are likewise denominated stars of the *first magnitude*, those of a degree inferior in brightness are said to be of the *second magnitude*, and so on with the third, fourth, &c. Below the sixth the same denominations are continued, but the stars of the seventh and inferior magnitudes are no longer visible to the naked eye, and are therefore called *telescopic stars*.

The number of constellations given by Ptolemy is 48, viz. —

North of the Zodiac.

1	Ursa Minor,	The Little Bear.
2	Ursa Major,	The Great Bear.
3	Draco,	The Dragon.
4	Cepheus,	Cepheus.
5	Bootes, or Arctophylax,	The Herdsman, or the Bearwarden
6.	Corona Borealis,	The Northern Crown.
7	Hercules ('Εν γόνασιν).	Hercules (kneeling).
8.	Lyra,	The Harp.
9	Cygnus,	The Swan
10.	Cassiopeia.	The Lady in her Chair.
11	Perseus,	Perseus.
12.	Auriga,	The Waggoner.
13.	Serpentarius, or Ophiuchus,	The Serpent-bearer
14	Serpens	The Serpent.
15.	Sagitta,	The Arrow
16	Aquila (or *Vultur*) et Antinous,	The Eagle and Antinous.
17	Delphinus.	The Dolphin.
18	Equuleus,	The Horse's Head.
19	Pegasus, or Equus,	The Flying Horse, or the Horse
20	Andromeda,	Andromeda.
21	Triangulum,	The Triangle.

In the Zodiac.

22.	Aries,	The Ram.
23	Taurus,	The Bull.
24	Gemini,	The Twins.
25	Cancer,	The Crab.
26	Leo,	The Lion, to which Ptolemy joined some stars of Berenice's hair
27	Virgo,	The Virgin.
28	Libra,	The Balence.
29	Scorpio,	The Scorpion
30	Sagittarius,	The Archer
31	Capricornus,	The Goat.
32	Aquarius,	The Water-Bearer
33	Pisces,	The Fishes.

Southern Constellations.

34	Cetus,	The Whale.
35	Orion,	Orion
36	Eridanus, or Fluvius.	Eridanus, or the River.
37	Lepus,	The Hare
38	Canis Major,	The Great Dog.
39	Canis Minor	The Little Dog.
40	Argo Navis,	The Ship Argo.
41	Hydra,	The Hydra.
42.	Crater,	The Cup.
43	Corvus,	The Crow.
44	Centaurus.	The Centaur.
45	Lupus,	The Wolf.
46	Ara,	The Altar
47	Corona Australis,	The Southern Crown
48.	Piscis Australis.	The Southern Fish.

The constellations added by Hevelius are the following (those marked * being now little used) —

*1. Antinous	Antinous
2. Mons Menelai,	Mount Menelaus
3. Canes Venatici,	The Greyhounds
4. Camelopardalis,	The Giraffe
5. Cerberus,	Cerberus
6. Coma Berenices,	Berenice's Hair
7. Lacerta,	The Lizard
8. Lynx,	The Lynx
9. Scutum Sobieskii,	Sobieski's Shield
10. Sextans,	The Sextant
11. Triangulum Australe,	The Southern Triangle
12. Leo Minor,	The Little Lion

The constellations added by Halley in the southern hemisphere are,—

1. Columba Noachi,	Noah's Dove
2. Robur Carolinum,	The Royal Oak.
3. Grus,	The Crane
4. Phœnix,	The Phœnix
5. Pavo,	The Peacock.
6. Apus,	The Bird of Paradise
7. Musca,	The Fly
8. Chamæleon,	The Chameleon.

Distance of the stars.

In considering the fixed stars, the first point to which our attention is naturally directed is the determination of their real dimensions, and a necessary, though not sufficient, preliminary is the determination of their distances from us. An obvious consequence of the annual motion of the earth is the existence of an annual parallax of the stars, but on account of the enormous distances of these bodies, this effect of the earth's motion is so small, that it cannot be easily measured, and there are even now very few cases in which, with the utmost refinements of methods and instruments, a measurable parallax has been detected. We find that, compared with the distances of the fixed stars, the diameter of the earth's orbit is merely a point; for in most cases, the most careful observation of the same star, at intervals of six months, indicates no variation whatever in the star's position, after the proper corrections have been made for the small effects produced by different known causes. The limits of the errors of modern observations cannot well be supposed to exceed 1″ It follows, therefore, that, seen from the distance of the fixed stars, the diameter of the ecliptic, which exceeds 180 millions of miles, subtends an angle of less than 1″ Had the annual parallax exceeded this small quantity, it could scarcely have escaped the multiplied efforts that have been made to detect it; yet the distance of a star having a parallax of 1″ is $\frac{1}{\sin. 1''}$ × radius of earth's orbit, that is, about 19 billions of miles.

The first star actually shown to have an annual parallax was the star 61 Cygni, a binary system of two sixth-magnitude stars, having a large proper motion. The parallax was detected and measured by Bessel, using the Königsberg heliometer. He compared the position of the point midway between the pair with that of two very small and presumably more distant stars. From the observations made between October 1837 and March 1840, Bessel deduced as the parallax 0″·3483, corresponding to a distance of about 600,000 radii of the earth's orbit. This result was confirmed shortly after by Peters at Poulkowa, who, from observations of the zenith distances, deduced the parallax 0″·349. It will presently be seen that more recent measures do not accord well with these results. In the meantime, though the result was published later, Mr Henderson, at the Cape Town Observatory, had been observing α Centauri, one of the brightest of the southern stars, with the object of determining if it has a sensible parallax. Notwithstanding the inferiority of the instrument he employed (a mural circle imperfectly graduated), Mr Henderson succeeded in recognising a parallax, which he estimated at 1″·16. Maclear, who was his successor as astronomer royal at the Cape, determined the parallax to be 0″·9128, and subsequent observations assign to the parallax the value 0″·9187. Doubtless 0″·9 fairly represents the most probable value. It is less than a tenth of the solar parallax; in other words, the orbit of the earth as seen from α Centauri subtends less than a tenth of the arc which the earth's disk subtends as seen from the sun. The distance corresponding to this parallax is in round numbers about 20 billions of miles, a distance which light traverses in about 3½ years.

Other stars have since so far yielded to the attacks made upon them by astronomers as to show signs of having measurable parallax. But it must be admitted that many of the results hitherto obtained are open to considerable doubt, as the following table serves sufficiently to indicate:—

	Magn.	Parallax formerly given by Sir J Herschel.	Latest Measurements of Parallax.
α Centauri.........	1	″0·976 (Henderson, corrected by Maclear)	″0·91
61 Cygni..........	6	0·348 (Bessel)	0·55
Lalande, 21,258 .	8	0·260 (Krüger)........	No new determination
Oeltzen, 17,415-6	9	0·247 (Kruger)	,,
α Lyræ.......... ..	1	0·155 (W Struve, corrected by O. Struve)	,,
Sirius..............	1	0·150 (Henderson, corrected by Peters)	0·27
70 Ophiuchi.......	5	0·160 (Krüger)........	No new determination.
ι Ursæ Majoris ...	3	0·133 (Peters)...........	,,
Arcturus...........	1	0·127 (Peters)......	,,
Polaris...............	2	0·067 (Peters)...........	″0·11
Capella	1	0·046 (Peters)..	No new determination.
Procyon	1	...	0·12

If we consider that, with the exception of α Centauri, no star has been observed with accordant results, we may question whether the instruments employed by astronomers are as yet competent to measure accurately small parts of a second of arc. As for the parallax assigned to the five last stars of the above list, it would be absurd to place any reliance on the estimated value, save as indicating that those stars lie at so enormous a distance that their parallax cannot be measured.

As the most powerful telescope does not show the real disk of a star, it is not possible to determine by actual measurement the size of even the largest or the nearest. The amount of light received from a star whose distance is known can, however, be compared with that which our sun would give if removed to the star's distance, and if we then assume equal intrinsic surface-lustre, we may infer (though not very safely) the surface, and therefore the size, of the star. Thus the distance of α Centauri exceeds the sun's 230,000 times, so that the sun, removed to the star's distance, would shine with only the 52,900,000,000th part of his observed lustre. But α Centauri shines with about the 16,950,000,000th part of the sun's brightness. Hence the star emits three times as much light as the sun, or (on our assumption) has a surface three times, a diameter $\sqrt{3}$ times, and a volume $3\sqrt{3}$ times (or more than 5 times) as great as his. Sirius dealt with in like manner would appear to have a volume exceeding the sun's about 2700 times But it is probable that the larger stars shine also with a greater intrinsic lustre, mile for mile of surface, and therefore are not so much larger as we should infer from the above method of reasoning.

Analysis of stellar spectra.

That the stars resemble the sun in general constitution and condition has been proved by spectroscopic analysis, the spectra of stars being in general respects like the spectrum of the sun. Nevertheless, characteristic differences exist, insomuch that the stars have been divided into four orders, distinguished by their spectra. These are thus presented by Secchi, after examination of the spectra of more than 500 stars :—

The first type is represented by α Lyræ, Sirius, &c., and includes most of the stars shining with a white light, as Altair, Regulus, Rigel, the stars β, γ, ε, ζ, and η of Ursa Major, &c. These give a spectrum showing all the seven colours, and crossed usually by multitudes of dark lines, but always by the four lines of hydrogen, very dark and strong. The breadth of these lines indicates a very deep absorptive stratum at a high temperature and at great pressure. Nearly half the observed stars showed this spectrum.

The second includes most of the yellow stars, as Capella, Pollux, Arcturus, Aldebaran, α Ursæ Majoris, Procyon, &c. The Fraunhofer lines are well seen in the red and blue, but not so well in the yellow. The resemblance of this spectrum to the sun's suggests that stars of this type resemble the sun closely in physical constitution and condition. About one-third of the observed stars showed this spectrum.

The third type includes Antares, α Orionis, α Herculis, β Pegasi, Mira, and most of the stars shining with a red light. The spectra show bands of lines (Secchi's instrument showed shaded bands, but with superior spectroscopes multitudes of fine lines appear). The spectra resemble somewhat the spectrum of a sun spot, and Secchi infers that these stars are covered in great part by spots like those of the sun. About 100 of the observed stars belong to this type.

The fourth type differs only from the last in the arrangement and appearance of the bands, and includes only faint stars. A few stars, as γ Cassiopeiæ, η Argus, β Lyræ, &c., show the lines of hydrogen bright instead of dark, as though surrounded by hydrogen glowing with a heat more intense than that of the central orb itself.

The exact spectroscopic observation of many stars by Huggins and Miller has shown (what Secchi's comparatively rough observations could not effect) that many elements known to us exist in these stars. Thus, in the spectrum of Aldebaran are lines coinciding with the lines of the elements hydrogen, sodium, magnesium, iron, tellurium, antimony, calcium, bismuth, and mercury. In the spectrum of Betelgeuse these physicists recognised in like manner the lines of sodium, magnesium, iron, bismuth, and calcium, but found the lines of hydrogen wanting. Sirius, Pollux, Castor, the stars of Ursa Major, and many others, were examined with similar results.

Coloured stars. Many stars are coloured. Thus Antares, Aldebaran, and Betelgeuse are ruddy; Arcturus, Procyon, and Pollux yellow; Vega and Altair slightly bluish; while Capella, Sirius, and many other stars are brilliantly white. Among telescopic stars, some are of a deep, almost blood, red, while others are ruddy, orange, yellow, garnet-coloured, and so on. Few single stars show a well-marked blue colour. But among the binary and multiple star-systems, blue, green, indigo, violet, and lilac stars are common, especially as smaller companion stars; such colours as olive, russet, grey, ash-colour, fawn, and so on, are also observed, though this is probably due to the combined lustre of several very small stars closely set. Complementary colours are not uncommon among double stars, the brighter of a pair (in such cases) usually having a red, orange, or yellow colour, and the smaller showing the respective complementary, green, blue, or purple. Nor are these instances to be explained as due to contrast (though contrast doubtless strengthens the apparent hue of the smaller star); for when the brighter is concealed from view, the fainter is still found to shine with its colour unchanged. Spectroscopic analysis shows that usually the colour of a star is due to the presence of absorptive vapours in the star's atmosphere cutting off certain portions of the light. Thus the orange component of the double star Albireo has a spectrum crossed by several bands in the blue and violet portion, while the blue component has a spectrum showing many strong lines in the red and orange portion,—hence the former star looks orange because of the deficiency of blue and violet in its light, and the latter looks blue because its light is deficient in red and orange.

Double and multiple stars. On examining the stars with telescopes of considerable power, many of them are found to be composed of two or more stars placed contiguous to each other, or at distances subtending a very minute angle. This appearance is probably in many cases owing solely to the optical effect of their position relatively to the spectator; for it is evident that two stars will appear contiguous if they are placed nearly in the same line of vision, although their real distance may be immeasurably great. There are, however, many instances in which the angle of position of the two stars varies in such a manner as to indicate a motion of revolution about a common centre; and in this case the two stars form a binary system, performing to each other the office of sun and planet, and connected together by gravity or some equivalent principle. The observations of Herschel, Dawes, South, and Struve have placed this fact beyond doubt. Motions have been detected which are so rapid as to be measurable within very short periods of time; and in certain cases the smaller star has been observed to disappear, either on passing behind or before its primary, or by approaching so near to it that its light has been absorbed by that of the other. The most remarkable instance of a regular revolution of this sort is that of the double star ξ Ursæ Majoris, in which the angular velocity is 6°·4 annually, so that the two stars complete a revolution about one another in the space of 60 years, and about a circuit and a half have been already described since its discovery in 1781. The double star 70 Ophiuchi presents a similar phenomenon, a revolution being completed in a period of about 80 years. α Castoris, γ Virginis, ζ Cancri, ξ Bootis, δ Serpentis, and that remarkable double star 61 Cygni, together with several others, exhibit similar variations in their respective angles of position. Sir W. Herschel observed in all 2400 double stars. The catalogue of Struve of Dorpat contains 3063 of the most remarkable. The object of these catalogues is not merely to fix the place of the star within such limits as will enable it to be easily discovered at any future time, but also to record a description of the appearance, position, and mutual distances of the individual stars composing the system, in order that subsequent observers may have the means of detecting their connected motions, or any changes by which they may be affected. There are many triple, quadruple, and quintuple stars. Every region of the heavens furnishes examples of these curious phenomena; but it is remarked that some parts of the heavens contain very few, while others present them in great abundance.

Star groups. The milky way. Aggregations of stars more and more complex appear as we extend our survey, and wider and wider regions of the heavens are occupied by groups of associated stars. The most complex and extensive of all such gatherings is the galaxy or milky-way, a zone-shaped region surrounding the whole sphere of the heavens, in which stars innumerable so combine their lustre as to present a milky luminosity. We speak of a zone-shaped region, be it noticed, not of a zone, for the milky-way does not form a complete zone, but simply occupies a zone within which appear streams, and nodules, and irregular clusterings of stars. Along part of the region there is but one well-marked stream; elsewhere two streams are seen, and in other places several

But parts of the circuit are incomplete, while in some cases dark regions in the very midst of a bright stream attest the irregular conformation of this strange star region.

Variations of stellar lustre.

Some of the fixed stars are subject to periodical variations of brilliancy. Several, formerly distinguished by their splendour, have entirely disappeared; others are now conspicuous which do not seem to have been visible to the ancient observers, and some alternately appear and disappear, or at least undergo great periodic variations in brightness. Some seem to become gradually more obscure, as δ Ursæ Majoris, others, like β in the Whale, to be increasing in brilliancy. Some stars have all at once blazed forth with great splendour, and, after a gradual diminution of their light, have again become extinct. The most remarkable instance of this sort is that of the star which appeared in 1572, in the time of Tycho. It suddenly shone forth in the constellation Cassiopeia with a splendour exceeding that of stars of the first magnitude, or even Jupiter and Venus at their least distances from the earth, and could be seen with the naked eye on the meridian in full day. Its brilliancy gradually diminished from the time of its first appearance, and at the end of sixteen months it entirely disappeared, and has never been seen since. During the whole time of its apparition, its place in the heavens remained unaltered, and it had no annual parallax, its distance was consequently of the same order as that of the fixed stars. Its colour, however, underwent considerable variations. Tycho describes it as having been at first of a bright white, afterwards of a reddish yellow, like Mars or Aldebaran, and lastly, of a leaden white, like Saturn. Another instance of the same kind was observed in 1604, when a star of the first magnitude suddenly appeared in the right foot of Ophiuchus. It presented phenomena analogous to the former, and disappeared in like manner after some months.

Temporary stars.

Variable stars.

Many stars have been observed whose light seems to undergo a regular periodic increase and diminution, and these are properly called *variable* stars. The star o Ceti (called also Mira) has a period of 334 days, and is remarkable for the magnitude of its variations. From being a star of the second magnitude, it becomes so dim as to be seen with difficulty through powerful telescopes. But its maxima and minima of brightness are variable. Thus between October 1672 and December 1676 Mira was never visible to the naked eye, while on October 5, 1839, it was half a magnitude brighter than its usual maximum.

Some are remarkable for the shortness of the period of their variation.

Algol (β Persei) shines ordinarily as a second magnitude star, but during about 7 hours in each successive period of 69 hours undergoes the following changes:—It decreases gradually to the fourth magnitude, remaining so for 20 minutes, and then increases as gradually to the second magnitude. Thus it remains a second magnitude star for about 62 hours in each period of 69 hours. The star β Lyræ in successive periods of 12 days 22 hours undergoes a double change, each occupying 6 days 11 hours (formerly assigned as the star's true period). In each period the star has a maximum brightness of about the 3·5 magnitude, but the minima of brightness are appreciably unequal, the star's magnitude in one being 4·3, in the other 4·5. The star δ Cephei varies in a period of 5 days 8 hours 48 min. from the fifth to the 3·5 magnitude, occupying 1 day 14 hours in passing from minimum to maximum, but 3 days 19 hours in passing from maximum to mininum. Two or three hundred stars are now recognised as variable. The most probable explanation of the variation in long periods is that stars so affected have periodical maxima and minima of disturbance, resembling that which causes the sun spots, only more marked. Some of the variables of short period are probably covered unequally in different parts of their surface by spots. But the variation of such stars as Algol, which shine with a constant lustre for the greater part of each period, and are reduced in lustre for a short interval, cannot be thus explained, and we must suppose that a large opaque orb circling around them transits the central luminary at regular intervals. Most of the stars which have appeared suddenly, and shone for a short time, probably resemble in character the only star of this kind hitherto examined—the star T in Corona Borealis, which, blazing out suddenly as a second magnitude star (usually of the tenth magnitude only), was found by Huggins and Miller to have a spectrum crossed by fine black lines, on which was superposed the spectrum of glowing hydrogen. As the star waned, the hydrogen spectrum faded, and finally disappeared. Presumably there had been an outburst of glowing hydrogen, or a conflagration in which hydrogen was the principal agent. The maximum brightness of the star exceeded the normal lustre almost 800-fold. The star η Argus can hardly as yet be classed either among periodically variable stars or among stars undergoing irregular changes. In 1677 Halley catalogued it as of the fourth magnitude, Lacaille, in 1751, observed it as of the second magnitude. Between 1811 and 1815 it was of the fourth magnitude, from 1822 to 1826 of the second, in 1827 of the first magnitude, thereafter, till 1837, of the second, in 1838 of the first; in 1843 the star was brighter than any except Sirius. At present it is barely visible to the naked eye.

Irregularly variable stars.

Stellar proper motions.

Passing over the speculations of Bruno, Hooke, and others, we find that Halley was the first to suspect from observation the proper motion of the stars. From comparisons between the observed places of Arcturus, Aldebaran, and Sirius, and the places assigned to these stars by the Alexandrian astronomers, he was led to the opinion that all three are moving towards the south. (*Phil. Trans.*, 1718.) The elder Cassini adopted the same view respecting Arcturus, proving, in fact, that even since the time of Tycho Brahe this star had shifted 5′ in latitude; for he showed that η Bootis, which should have shared in the change if the ecliptic itself had shifted in position, had not changed appreciably in position. Bradley and Wright theorised respecting the causes of stellar motion, and suggested that the sun and his fellow-suns, the stars, are moving in space. Tobias Mayer, in 1771, comparing Roemer's observations in 1706 with his own and Lacaille's in 1750–56, was led to the opinion that the stellar motions afford no sufficient evidence of the translation of the solar system through space. But in 1783 Sir W. Herschel, from the proper motions of seven principal stars, as determined by Maskelyne, deduced as the point towards which the sun is moving (or, as it is now commonly termed, "the apex of the solar way") a point in Hercules in right ascension 257°. After carefully examining Mayer's list of proper motions, he indicated a point close to the star λ Herculis (♅_1, fig. 52). In 1805 Sir W. Herschel published a paper based on Maskelyne's catalogue of the proper motions of 36 stars published in 1790, and presenting a result considerably different from that which he had before announced. He now set the apex in R.A. 245° 52′ 30″ and north declination 49° 38′ (♅_2 in fig. 52). Bessel in 1818 (*Fundamenta Astronomiæ*) expressed the opinion that Mayer had been right in denying the existence of sufficient evidence for determining the proper motion of the solar system. Later, however, the subject has been dealt with by Mädler, Argelander, and O Struve, whose various determinations of the solar apex are shown in fig. 52, marked M, Ar., and Σ_0 respectively. Sir G. Airy re-examined the subject by a new method, assigning to the sun (by an application of the method of least squares) such a direction

Proper motion of the sun

and rate of motion as accounts for the greatest proportion of the observed stellar motions. The plan was carried out

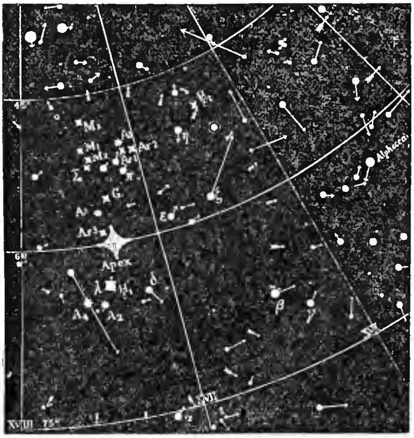


Fig. 52.—Various Determinations of the Apex of the Sun's Way.

according to two different hypotheses respecting errors of observation, and was first applied to about 300 stars, afterwards to about 1500, by Mr Dunkin. The results of the first pair of solutions are indicated by the points A_1 and A_2 in fig. 52, the results of the others by the point A_3 and A_4. A_3 lies in R.A. 261° 14′ and N.P.D. 57° 51′, A_4 in R.A. 263° 44′ and N.P.D. 65°. Lastly, Mr Galloway, by considering the motion of southern stars, has deduced the result indicated at G. Giving to these various results their due weight, we find for the probable position of the apex that shown in fig. 52.

The analysis of the proper motions of the stars by Mr Proctor has led to the recognition of local star-drifts. This is illustrated in fig. 53 Here arrows are drawn from

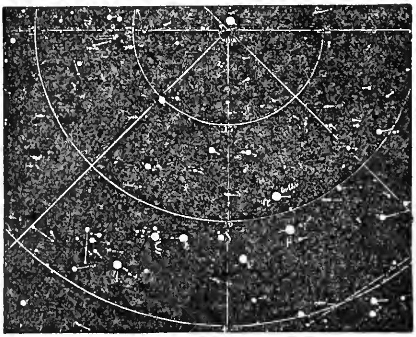


Fig. 53.—Illustrating Star-drift.

the several stars, indicating their direction and rate of motion, the rate being such that 36,000 years would be required to carry any star from its present position to the position marked by the extremity of the arrow-point. It will be seen that the stars β, γ, δ, ε, and ζ Ursæ Majoris, with the companions of ζ are travelling in the same direction and at the same apparent rate. Similar drifting motions can be recognised in other parts of the heavens.

Proper motions of approach and recession. Spectroscopic analysis affords a means of determining the motions of stars in the direction of the line of sight. For if a star is receding, the wave length of any definite portion of its light must be apparently lengthened; while if the star is approaching, such wave-length must be shortened. Thus, if the position of some known line in a star's spectrum can be compared with the position of the same line in the spectrum of a terrestrial element, any shift of position indicates whether the star is receding or approaching. In this way several of the brighter stars have been dealt with by Mr Huggins, and motions of recession and approach, amounting in some cases to 30 or 40 miles per second, have been recognised. This method has afforded an interesting confirmation of Mr Proctor's views about star-drift, seeing that Mr Huggins assigns to the five stars β, γ, δ, ε, and ζ Ursæ Majoris, equal motions of recession (about 17 miles per second). He also finds that their spectra are alike, indicating a resemblance in constitution and structure, such as we should expect to find in the members of a drifting system.

The nebulæ. The *Nebulæ* are celestial objects which present a cloudy appearance. When examined with a telescope of moderate power, the greater part of the nebulæ are distinctly perceived to be composed of clusters of little stars, imperceptible to the naked eye, because, on account of their apparent proximity, the rays of light proceeding from each are blended together, through the effects of irradiation, in such a manner as to produce only a confused luminous appearance. In others, however, no individual stars can be perceived, even through the best telescopes, and the nebula exhibits only the appearance of a self-luminous or phosphorescent patch of matter in a highly dilated or gaseous state. In some instances the nebula presents the appearance of a faint luminous atmosphere, of a circular form and of large extent, surrounding a star of considerable brilliancy. **Orion nebulæ.** One of the most remarkable nebulæ is that which is situated in the sword-handle of Orion. It was discovered by Huyghens in 1656, and described and figured by him in his *Systema Saturnium.* Since that time it has been examined and described by various observers, particularly Fouchy, Mairan, Le Gentil, and Messier, who have given engravings of it; and if any trust can be placed in their descriptions of so indistinct and difficult an object, it must have undergone great changes in its form and physical appearance. Unfortunately, however, no satisfactory inference can be drawn from the comparison of the different descriptions, for it is found that the same nebula, viewed on the same night with different telescopes, presents appearances so different as to be scarcely recognisable as the same object. The effects of atmospherical variations also cause great differences in its appearance, even when it is viewed through the same telescope at different times, so that it is scarcely possible that any two observers will be found to agree in their delineation of its outline. Sir J. Herschel, in the second volume of the *Memoirs of the Astronomical Society*, has given a detailed description of this nebula as it appeared in his twenty-feet reflector in 1824, together with a drawing, which, on account of the superiority of his telescope, is probably a much more correct representation of the object than any which previously existed. Plate XXX. is copied from that drawing. Of that portion of the nebula which he calls the Huyghenian region Sir J. Herschel gives the following account: "I know not how to describe it better than by comparing it to a curdling liquid, or a surface strewed over with flocks of wool, or to the breaking up of a "mackerel" sky when the clouds of which it consists begin to assume a cirrous appearance. It is not very unlike the mottling of the sun's disk, only (if

I may so express myself) the grain is much coarser, and the intervals darker; and the flocculi, instead of being generally round, are drawn into little wisps. They present, however, no appearance of being composed of small stars, and their aspect is altogether different from *resolvable nebulæ*. In the latter we fancy that we see stars, or that could we strain our sight a little more, we should see them, but the former suggest no idea of stars, but rather of something quite distinct from them."

Nebula in Andromeda.

Another very remarkable nebula is that in the girdle of Andromeda, which, being visible to the naked eye, was known in the earliest ages of astronomy. It was rediscovered in 1612 by Simon Marius, who describes it as having the appearance of a candle seen through horn, that is, a diluted light, increasing in density towards a centre. Le Gentil mentions that its figure had appeared to him for many years round, but that in 1757 it had become oval. He also remarks that its light was perfectly uniform in all parts,—a fact which is quite at variance with its present appearance, and which, if true, argues that the nebulous matter is in a rapid state of condensation. "At present," says Sir J. Herschel in the volume above referred to, "it has not, indeed, a star or any well-defined disk in its centre, but the brightness, which increases by regular gradations from the circumference, suddenly acquires a great accession, so as to offer the appearance of a nipple, as it were, in the middle, of very small diameter (10" or 12"), but totally devoid of any distinct outline, so that it is impossible to say precisely where the nucleus ends and the nebula begins. Its nebulosity is of the most perfect milky, absolutely irresolvable kind, without the slightest tendency to that separation into flocculi above described in the nebula of Orion; nor is there any sort of appearance of the smallest star in the centre of the nipple." This nebula has, however, been resolved into stars, at least partially, by the Harvard reflector.

Messier formed a list of 103 nebulæ. But Sir W. Herschel, by means of his large telescopes, discovered no less than 2500, and Sir John Herschel added 500 northern and 1700 southern nebulæ (staying seven years at the Cape to catalogue these last). In all, about 3700 nebulæ are known. They have been thus classified:—

Orders of nebulæ.

(1.) Clusters of stars (globular or irregular) in which the stars are clearly distinguishable.

(2.) Resolvable nebulæ, and such as, from their appearance, probably require only increased power to be resolved into separate stars.

(3.) Nebulæ properly so called, showing no appearance of stars.

(4.) Planetary nebulæ.

(5.) Stellar nebulæ.

(6.) Nebulous stars.

Among the varieties of form may be noted *spiral*, *elliptic* and *ring* nebulæ, *double* nebulæ, and *irregular* nebulæ.

Sir W. Herschel classified the nebulæ according to his conception of the probable stage of their development from purely nebulous matter into stars, single or multiple, as follows:—

(1.) Widely-spread nebulosity.
(2.) Irregular nebulæ.
(3.) Planetary nebulæ.
(4.) Nebulous stars.
(5.) Diffused clusters.
(6.) Stellar nebulæ.
(7.) Rich star-clusters.

Spectra of nebulæ.

Examined with the spectroscope by Mr Huggins, the stellar and resolvable nebulæ are found to give a spectrum resembling the stellar spectrum in general characteristics. But the irregular nebulæ, planetary nebulæ, and a considerable proportion of the irresolvable nebulæ, give a spectrum of three bright lines, indicating that they consist of glowing gas. One of these lines is the F line of the hydrogen spectrum, another is a line of nitrogen, and the third is undetermined. A few of the gaseous nebulæ show a fourth line.

Variable nebulæ.

Some nebulæ are variable. A large irregular nebula surrounding the singular variable star η Argus appears to undergo extensive variations, and we have seen that the great nebula in Orion is strongly suspected of variability. Some nebulæ have vanished, others have appeared where formerly no nebulosity had been recognised.

Groups of nebulæ.

As there are double and variable nebulæ as well as double and variable stars, so also are there groupings and aggregations of nebulæ as of stars. It is noteworthy that the zone region occupied by the milky-way shows very few nebulæ, and those mostly of the resolvable order. The regions farthest from the milky way, that is, the regions around the poles of the galactic circle, are those richest in nebulæ, speaking generally; but the distribution of the nebulæ is in reality too irregular to be sufficiently described in such terms. Streams and branches and clustering aggregations of nebulæ are found in both of the two hemispheres into which the galaxy divides the heavens. Most remarkable among these aggregations are the *Nubeculæ* or *Magellanic Clouds*, in the southern heavens. These resemble the milky-way in aspect, but on telescopic examination are found to consist, not of stars alone, like the milky-way, but of stars mixed with nebulæ. Within the Nubecula Major, Sir J. Herschel counted 278 nebulæ, besides more than 50 outlying nebulæ. The Nubecula Minor is not so rich in nebulæ but still deserves to be regarded as an aggregation of these objects.

Theories of the sidereal universe.

Space will not permit us to consider fully here the various theories of the constitution of the sidereal heavens advanced by Wright, Kant, Lambert, the Herschels, Struve, Mädler, Herbert Spencer, Proctor, and others. But so far as discussion of this subject depends on observation, it may be thus presented:—The zone of the milky-way being rich in stars, we must either infer great extension of the sidereal system in the direction of that zone, or a real aggregation of stars within a ring-shaped or spirally shaped region around the earth. If we adopt the former view, we shall naturally be led to regard the nebulæ, except only those known to be gaseous, as other sidereal systems outside our own, and so distant as to appear like small cloudlets of stars. But if we adopt the latter view, we may regard many of the nebulæ, if not all, as clustering aggregations of stars belonging to the same system. Sir W. Herschel adopted the former hypothesis at the beginning of his career as an observer; but later (though nearly all writers on astronomy overlook the fact), his opinion turned towards the latter. It was while he still supposed the stars spread with tolerable uniformity throughout the sidereal system that he trusted to a method of star gauging depending on the number of stars seen in equal telescopic fields in different directions. It is manifest that, if the telescope reaches to the limits of a system of stars scattered uniformly, the greater the distance at which the limit lies in any direction the greater will be the number of stars in that direction. Gauging the sidereal system on this principle, Sir W. Herschel deduced the inference that it is shaped like a cloven flat disk. But later, perceiving that the rich regions are often seemingly circular in shape, he inferred that such groups are really globular in form. It was natural to extend this principle, and, seeing that parts of the milky way are stream-shaped to infer that this appearance indicates the existence of real streams of stars. Also, since the clustering aggregations are various in size and constitution, it might be assumed that the nebulæ themselves are only clustering aggregations more remote than the rest, and belong, therefore, to the sidereal system. The fact that nebulæ are rich in regions remote from the milky-way would confirm this supposition, if not of itself sufficient (as Herbert Spencer thinks) to establish it beyond question. If the nature of the Magellanic clouds had been known to Sir W Herschel, this inference would have appeared to him irresistible. However, the results towards which his later views seemed tending were not definitely indicated or adopted by him, probably because he had already attained an extreme old age when he first enunciated his later and juster views of the sidereal universe. Sir J Herschel does not appear to have recognised his father's change of views, though conscious of serious difficulties in the older theory, and even definitely indicating the fact that the constitution of the Nubeculæ cannot possibly be reconciled with that theory The elder Struve, probably the only astronomer of his time who had thoroughly *studied* Sir W Herschel's remarkable papers, recognised clearly the change in Herschel's opinions. Following a suggestion thrown out by Piazzi, Struve compared the number of stars down to the eighth magnitude in different directions round the equator, and justly regarded the greater richness of such stars on and near the galaxy as a disproof of Herschel's earlier theory of generally uniform distribution. Strangely enough, however, while thus recognising a variation in the richness of stellar distribution in one direction, *i.e.*, in approaching the medial plane of the galaxy, Struve was unable to divest himself of a belief in uniformity of distribution in directions parallel to that plane. In an investigation claiming to be free from all hypothesis, but in reality (as Encke, Forbes, Proctor, and others have shown) based on several hypotheses, some of which are not even probable, Struve advanced the theory that the sidereal system is infinite in extension along the direction of the medial plane of the galaxy

But in reality the evidence we possess indicates laws of stellar aggregation which by their very nature preclude the possibility of applying such methods of gauging as either Sir W. Herschel or W Struve endeavoured to use. The gathering of stars of the leading orders of *apparent* magnitude in the galactic zone shows that stars of many orders of *real* size and brightness are there gathered together. The analysis of a rich star-region with higher and higher powers is shown to be, not *necessarily*, as was supposed, the penetrating farther and farther into space, but the more and more searching scrutiny of one and the same region of space. The two processes, indeed, may be combined, an increase of telescopic power bringing into view at the same time smaller stars in a particular region and remoter stars lying towards the same direction. In fact, it would be as great a mistake to assume, without definite evidence, that new stars so revealed are smaller in real magnitude, as to assume that they are more remote. The only kind of evidence available to discriminate between the two explanations, or to show to what extent either may operate, is that derived from statistical enumeration, but so complex are the relations involved, that such enumeration can only be interpreted when graphically illustrated. In other words, the secrets of the stellar universe can only be revealed by presenting in well-devised maps the results of widely extended scrutiny of the star depths. This process has already been applied by Mr Proctor to stars down to the eleventh order of magnitude (in the northern heavens), the resulting view of the stellar universe differing widely from that which would have been presented if any of the theories heretofore advanced had been just. It is probable that an extension of the system of uniform star-gauging and charting to the remoter star-depths will still further illustrate the complexity and diversity of structure existing within the universe. Already these general conclusions may be regarded as established:—"The sidereal system is altogether more complicated and more varied in structure than has hitherto been supposed: in the same region of the stellar depths co-exist stars of many orders of real magnitude; all the nebulæ, gaseous or stellar, planetary, ring-formed, elliptical, and spiral, exist within the limits of the sidereal system; and lastly, the whole system is *alive* with movements, the laws of which may one day be recognised, though at present they are too complex to be understood"

Bibliography

Among the most important treatises relating to the history of astronomy may be mentioned Delambre's *Histoire d'Astronomie* (Paris, 1817-21), Narrien's *Origin and Progress of Astronomy*, Lalande's *Bibliographie Astronomique*, Grant's *History of Physical Astronomy* (London, 1852), Bailly's *Histoires de l'Astronomie Ancienne* (Paris, 1781) *et Moderne* (Paris, 1785), Loomis's *History of Astronomy* (New York, 1855), and the *History of Astronomy* in the Library of Useful Knowledge. But the reader desirous of becoming well acquainted with the modern developments of the science will find it necessary to study the papers published by societies specially devoted to astronomy, as well as the astronomical papers published by other scientific bodies. Amongst the proceedings, journals, &c., to be particularly examined are the following:—In Britain—the *Memoirs* and *Monthly Notices* of the Astronomical Society, the *Transactions* and *Proceedings* of the Royal Societies of London, Edinburgh, and Dublin, and the *Reports of the British Association*, in France—the *Comptes Rendus* of the Paris Academy of Sciences; in Germany—the *Abhandlungen* and *Monatsbericht* of the Berlin Academy of Sciences, the *Sitzungsberichte* of the Imperial Academy of Vienna, the *Vierteljahrsschrift* of the *Astronomischen Gesellschaft* (Leipsic), and the *Astronomische Nachrichten* (Kiel); in Russia—the *Bulletins* of the Imperial Academy of Sciences; the proceedings published by learned bodies in Italy, Belgium, Portugal, and Denmark; in America—the *Reports* and *Proceedings* of the Smithsonian Institution (Washington), the *Journal of the Franklin Institute*, *Silliman's Journal*, and the *Proceedings of the American Association*, &c., besides transactions published by various societies in Australia, Canada, and other colonies. The following are among the principal treatises on theoretical and physical astronomy:—The *Principia* of Newton, Laplace's *Exposition du Système du Monde* and *Traité de Mécanique Celeste*, Delambre's *Astronomie Théoretique*, Brunnow's *Spherical Astronomy*, and the fine American works by Watson (of Ann Arbor), Chauvenet, and Loomis. The best works on practical astronomy are Pearson's *Introduction to Practical Astronomy*, the second volume of Chauvenet's work just mentioned (entitled *Spherical and Practical Astronomy*), and Loomis's *Practical Astronomy*. But, with the improvements continually being made in instruments and methods, the best work on practical astronomy soon becomes obsolete unless supplemented by the careful examination of the journals and proceedings mentioned above. For this reason a section on Practical Astronomy has not been added here, as in former editions of this work. Among popular treatises on general astronomy the most trustworthy are Airy's *Ipswich Lectures*, Arago's *Astronomie Populaire* (and the English version by Grant and Smyth), Herschel's *Outlines of Astronomy*, Chambers's *Descriptive Astronomy*, and Guillemin's *The Heavens* (later editions) Among works in special departments of astronomy may be mentioned Nasmyth's treatise *On the Moon*, Secchi's *Le Soleil*, Herschel's *Southern Observations*, Pingré's *Cométographie*, Coulvier-Gravier's *Recherches sur les Etoiles Filantes*, and W Struve's *Etudes d'Astronomie Stellaire*. The principal star atlases are Harding's *Atlas Novus Cœlestis*, Heis's *Atlas* and accompanying *Catalogue*, Bode's *Uranographia*, Argelander's *Uranometria*, and Lubbock's six maps on the Gnomonic Projection, published for the S.D U.K. For many departments of stellar research, however, celestial atlases are insufficient, and star catalogues have to be employed. Among the most important catalogues of isolated stars are Flamsteed's, Bradley's, Piazzi's, Lalande's, Groombridge's *Circumpolar Stars*, the *Catalogue* of the British Association, Argelander's Bonn series (containing 320,000 stars), Bessel's, Weisse's, Main's, &c. Among catalogues of double stars may be mentioned Sir W Herschel's in the *Phil. Transactions*, those by Sir J Herschel and South, and by Sir J. Herschel alone, the lists in the *Monthly Notices of the Astr Society*, and the catalogues of Dembowski, Burnham, P Secchi, Brothers, and others. Schellen's *Spectral Analyse*, or Roscoe's work on *Spectroscopic Analysis*, will be sufficient introduction to the subject of astronomical spectroscopy. In all the departments, however, there are many works besides those named which the student who desires to deal thoroughly with astronomy will do well to examine.

For the construction and use of astronomical instruments see the articles OBSERVATORY SPECTROSCOPE, TELESCOPE, &c. (R. A. P.)

Alphabetical Index

The figures refer to the pages.

ASTRUC, JEAN, a celebrated physician, was born in 1684 at Sauves, in Languedoc. His father, a Protestant clergyman, bestowed great pains upon his early education, after which he studied at the university of Montpellier, where, having commenced the study of medicine, he took his degree as doctor of physic in 1703 In 1706 he lectured at Montpellier as substitute for Professor Chirac. He studied most diligently all medical authors, both ancient and modern, and in 1710 published a treatise on muscular motion, which greatly increased his reputation In that year he was appointed to the chair of anatomy at Toulouse In 1717 he was appointed to teach medicine at Montpellier Subsequently he was appointed successively superintendent of the mineral waters of Languedoc, first physician to the king of Poland, and, in 1731, regius professor of medicine at Paris. Here his lectures on the practice of physic attracted students from other universities, as well as from foreign countries. He prosecuted his studies with unwearied assiduity to an advanced age, and was thus enabled to write many valuable works on medical subjects. He died on the 5th of May 1766, in the 82d year of his age. Of his numerous works, that on which his fame principally rests is the treatise entitled *De Morbis Venereis libri sex*, 1736, 4to. This was afterwards enlarged to 2 vols. 4to, it was translated into French by Jault, 4 vols 12mo, and has been frequently translated into English. In addition to many other works, principally on midwifery and cognate subjects, he published some treatises not connected with medicine, one with the title of *Conjectures sur les Mémoires originaux qui ont servi à Moise pour écrire la Genèse*, Bruxelles (Paris), 1753, 12mo; and two dissertations on the Immateriality, Immortality, and Liberty of the Soul, Paris, 1755. A long analysis of the *Conjectures* is given in the supplement to Herzog's *Real-Encyk d Prot. Theol.*

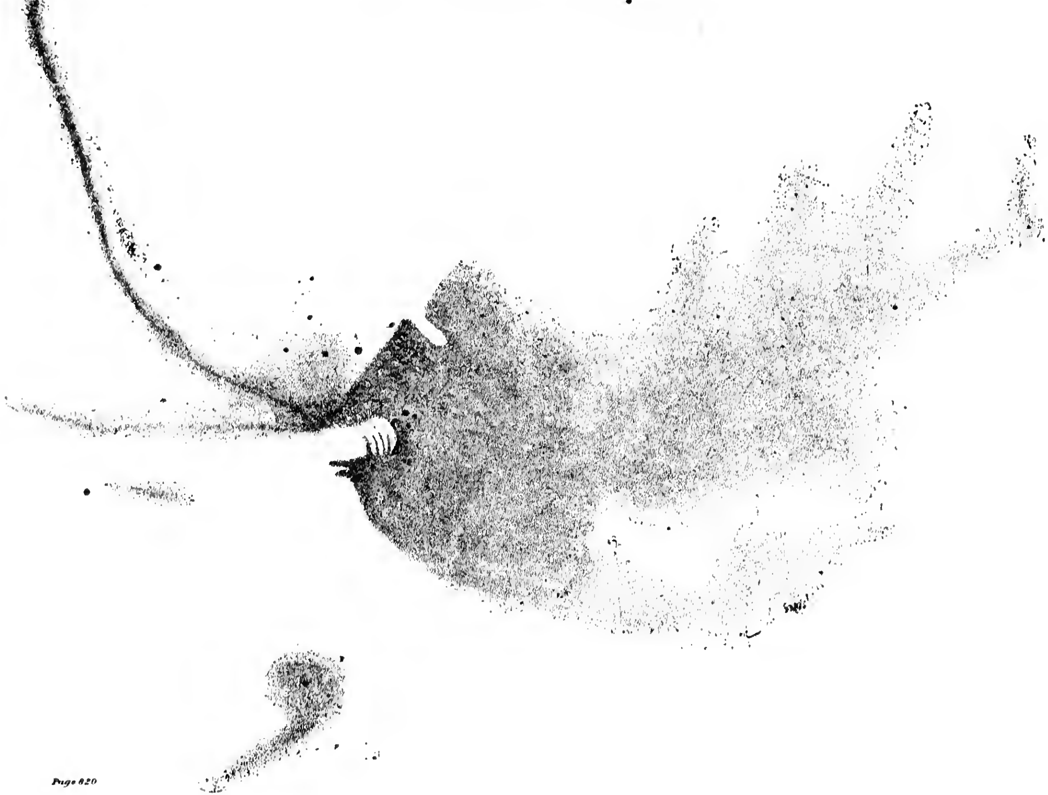
ASTURIAS, one of the ancient provinces of Spain, formerly (from 1388 downwards) conferred as a principality on the heir-apparent to the throne. By the new division of Spain in 1833, the province took the name of Oviedo, though not to the exclusion, in ordinary usage, of the older designation. It is bounded on the N. by the Bay of Biscay, on the S. by Leon, on the W. by Galicia, and on the E. by Santander, which is now incorporated with Old Castile. It consists of a portion of the northern slope of what is properly a part of the Pyrenean system, and is covered in all directions with offshoots from the main chain, by which it is almost completely shut in on all sides. Only a few of the passes across the mountains are practicable for carriages, and most of them are difficult even for horses. Along the coast there is a narrow strip of level ground, which consists largely of bare and moor-like reaches, covered with furze. The province, as might be supposed, is watered by numerous streams and rivers, which have hollowed out beautiful and picturesque valleys, but owing to the narrowness of the level tract, their courses are short, rapid, and subject to floods. The most important is the Nalon or Pravia, which receives the waters of the Caudal, the Trubia, and the Narcea, and has a course of 62 miles, after it rank the Navia and the Sella. Along the whole extent of the coast, a distance of 130 miles, there is not one good port. In that of Riba de Sella a large frigate may anchor, and Gijon will admit a vessel drawing 16 or 17 feet of water; but the entrance is in both cases difficult and dangerous. The climate of the district is generally mild, but overcharged with humidity, and in the higher regions the winters are protracted and severe. The broken character of the surface prevents anything like extensive agricultural industry, but abundant pasturage is found in the valleys. The wheat crop frequently fails. Rye succeeds better, and is often mixed with the maize which forms the principal food of all but the higher classes. Chestnuts—here, as elsewhere in Spain, an important article of diet—are very abundant on the hills, and the tree supplies valuable timber. Other timber-trees, such as oak and beech, are found in the mountains, along with various medicinal plants, such as hellebore, angelica, and valerian. Apples are abundant, and cider forms the common drink of the people, but little attention is paid to vines. The horses of Asturias are specially gentle and sure-footed, ranking among the best in Spain, and excelling those of Andalusia in strength, though surpassed by them in beauty. Wild deer, boars, and bears are not uncommon among the mountains; and the sea-coasts, as well as the streams, abound with fish of various kinds, including salmon and lampreys, which are sent to the markets of Madrid.

With regard to mineral wealth, Asturias can no longer boast, as it did in the days of the Romans, of satisfying the quest of the "pale seeker after gold," but it possesses valuable coal-measures, which are worked at Langres, Mieres, Santo Firme, &c., and furnish a supply to Cadiz, Carthagena, and other ports in the Mediterranean. The yield in 1868 was 2,720,000-met. quintals, or upwards of 267,000 tons. Beneath the coal-beds there is frequently a large development of hematite or iron ore; copper mines are worked in the neighbourhood of the river Aviles; and lead, magnesia, arsenic, cobalt, lapis lazuli, alum, antimony, jet, marble, and rock-crystal are found in various parts of the province, while amber and coral are gathered along the coast. Fuel of various kinds being plentiful, several manufactories of copper utensils are maintained, which supply some parts of Leon and Castile with kettles, pots, and similar articles. There used, besides, to be a large royal cannon-foundry near Oviedo. Coarse cloth is manufactured in the province, but not in sufficient quantity to supply the inhabitants. The roads in Asturias are not of a very satisfactory description, with the exception of the *Camino real*, or royal highway, leading from Gijon to Leon and Madrid, which was projected by Jovellanos,—himself a native of Gijon,—and cost so much that Charles V. inquired if it were paved with silver. It is carried by means of bridges and embankments over every impediment of a rugged and mountainous territory. A railway has been formed from Gijon to Langres, about twenty-five miles inland, where there are mines; and a more important line uniting Gijon to Leon has for long been "in course of construction."

The capital of the province is Oviedo, and the other towns of importance are Gijon, Aviles, Llanes, and Luarca. Ten miles E.S.E. of Oviedo is the collegial church and sanctuary of Covadonga, famous for its connection with the struggle of Pelayo against the Moors. The people of Asturias have been called the Swiss of Spain: they are robust, patient, and hardy; unenterprising, but laborious, hospitable to strangers, and enthusiastic lovers of their country. Like the Swiss, they leave their homes in large numbers, and make a living in the southern cities as servants and water-carriers, the married women even often hiring themselves as nurses in Madrid and elsewhere. The native dialect is called Bable, and among other distinctive marks employs *f* for the usual Spanish *h* in many words, thus approaching nearer to the original Latin. There is a special clan among the Asturians called the Baqueros, who lead a nomadic life, tending their cattle in winter on the coast, and in summer on the mountains of Leytariegos. They never marry beyond the bounds of the tribe. The ancient Asturians or Astures—so called, it is supposed, from the old Spanish root *ast*, a hill-fortress—were in possession, not only of the present province, but also of what is now the northern part of Leon, where they have left their name to the city of Astorga. The district south of the Cantabrian mountains was subjugated by the Romans

Fig. 108.

Nebula in the Sword Handle of Orion as seen on the 1st Feby 1824.



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about 25 B.C., but the warlike natives maintained their independence in the north. And long after, when the rest of Spain was in the hands of the Moors, this rugged region was a refuge to the otherwise vanquished race, which at length acquired strength to break forth from its fastnesses and beat back the invader.

ASUNCION, or ASSUMPTION, the capital of the Republic of Paraguay in South America. It is situated in the midst of a fertile territory on the eastern bank of the River Paraguay (here upwards of 600 yards in width), about 18 miles above the most northerly mouth of the Pilcomayo. It was one of the earlier Spanish settlements in this part of America, being founded in 1535 by Gonzalo de Mendoza and Juan de Salazar y Espinosa, and receiving its name of *Nuestra Señora de la Asuncion*, in honour of the festival of the Assumption. Originally a small fort, it soon became, from the convenience of its situation, a town of considerable importance, and in 1547 was erected into a bishopric. Formerly, while the Jesuits were masters of the country, it consisted of a rather irregular assemblage of one story, houses, relieved by ecclesiastical buildings of varying pretension, from the cathedral downwards; but under the dictatorship of Francia, the streets were more symmetrically arranged, and a number of secular buildings erected. These were greatly increased under the rule of his successors, and Asuncion was brought into similarity with a European city of corresponding rank, having its government house, its president's palace, its arsenal, custom-house, barracks, military hospital, theatre, and railway station. During the recent war between Paraguay and the neighbouring states, Asuncion suffered greatly, being taken and plundered in 1869 by the Brazilian forces, who had already bombarded it from the river. The population, Spanish for the most part in language, but of various races, was estimated, before the war, at 48,000, and carried on a somewhat extensive trade in Paraguay tea, or *Yerba Maté*, hides, tobacco, fruits, molasses, and rum.

ASYLUM (ἄσυλον), in *Greek Antiquities*, a temple enclosure, within which protection from bodily harm was afforded to all who sought it and could prove their danger. In a general sense, all Greek temples and altars were ἄσυλα, that is, it was a religious crime to remove by force any person or thing once under the protection of a deity. But it was only in the case of a small number of temples that this protecting right of a deity was recognised with common consent, and, apparently, these were among the oldest temples of Greece. Such, for example, was the temple of Athena Alea at Tegea in Arcadia, where King Pausanias II. spent the remainder of his days after the battle of Haliartus; or the temple of Ganymeda (Hebe) at Phlius, where, it is said, persons who had escaped from prison hung up their chains in the sacred grove. Other instances are the sanctuaries of Poseidon at Calauria and Tænarum, of Athena Chalciœcus at Sparta, and of Amphiaraus at Oropus; though it is possible, also, with regard to the three last-named sanctuaries, to explain the facts as proving only the ordinary religious *asyla* (Schömann, *Griech. Alterthümer*, ii. p. 202). In Asia Minor these asylums were more numerous and, in Roman times at least, more extensive, so that in the reign of Tiberius the Roman senate considered the question of reducing their limits (Tacitus, *Annal.*, iii. 60, iv. 14). Of these the chief seems to have been that of the temple of Diana at Ephesus, which exercised its right of protection beyond its boundary wall, at one time so far as to include part of the city. But Augustus, finding this an encouragement to crime, reduced the limits (Strabo, p. 641). Even debtors obtained sanctuary at Ephesus. Generally, however, the classes of persons who claimed the rights of asylum were slaves who had been maltreated by their masters, soldiers defeated in battle and pursued by the enemy, and criminals who feared a trial, or who had taken advantage of the opportunity allowed for escape before sentence was passed. A slave was required to show the justice of his complaint, and, if he failed, was restored to his master; if not, a new master was found. In all cases, it seems that the refugee was retained under protection only so long as his means of subsistence lasted, and it may have often happened that pursuit was given up less out of respect for the rights of a temple than from a conviction that want would soon drive the fugitive out of the asylum again. Asylums in this sense were an institution peculiar to the Greeks.—Livy, xxxv. 51, *Templum est Apollonis Delium—ubi et in fano lucoque ea religione et eo jure sancto quo sunt templa quæ asyla Græci appellant.*

ATACAMA, a district of South America, extending along the W. coast from 21° to 25° S. lat., partly belonging to Chili, and partly to Bolivia,—the 24th parallel, according to the treaty of 1866, being recognised as the line of demarcation. (1.) The Chilian province has an area of about 38,000 square miles, with a population of 82,300. It is bounded S. by the province of Coquimbo, W. by the Pacific, and E. by the Argentine Republic. It is one of the richest copper and silver districts in the world, nearly 1000 mines being worked for the former metal, and about 250 for the latter. The silver ore was first discovered in 1832, by a shepherd, Juan Godoy, at a place which has since been occupied by a village that bears his name. The ores of lead and zinc are frequently found, and sulphur, alum, and salt are all of them abundant, the deposit of the last article alone covering about 50 square miles at the Laguna Salada. Gold likewise occurs in sufficient quantity to be mentioned in the list of exports. The capital of the province is Copiapo, with 13,380 inhabitants, and the population is principally clustered in the valleys of Copiapo and Huasco, and in the neighbourhood of the various mines. Caldera is the principal port, and is connected with the capital and the eastern districts by the first railway constructed in South America. The value of the mineral exports through this and the adjacent ports was in 1871 estimated at 6,218,275 dollars. (2.) The Bolivian department has an area of about 70,000 square miles, with a population of about 8000, which is rapidly increasing. It also owes its prosperity almost solely to its wealth in copper and silver. The mines of Caracoles, recently discovered, are said to be the most productive silver mines in the world. In other products it coincides with the Chilian province, with the addition, however, of meteoric iron, which has been found in remarkable masses. A large part of what is more especially designated the Desert of Atacama is included in the department. It is not, as the name might suggest, a sandy, but for the most part a rocky and rugged, tract, with the merest patches and strips of vegetation. The capital of the department is Cobija, or, as it is officially called, Puerto de la Mar; but its prosperity is in some degree threatened by the rise of Mejillones, a seaport which has recently been connected by railway with the principal mining districts. See Philippi, *Reise durch die Wüste Atacama*, Halle, 1860; Tchudi, *Reise durch die Andes*, a supplement to Petermann's *Mittheil.*, 1860; *Journ. Roy. Geog. Soc.* 1851, 1855.

ATAHUALLPA (*atahu*, Latin *virtus*, and *allpa*, sweet), called the last of the Incas, was the son of Huayna Capac, eleventh Inca of Peru, by the daughter of the conquered sovereign of Quito. His brother Huascar succeeded Huayna Capac; for as Atahuallpa was not descended on both sides from the line of Incas, Peruvian law considered him illegitimate. He obtained, however, the kingdom of Quito, whether by stratagem or not is uncertain. A jealous feeling soon sprang up between him and Huascar, who insisted that Quito should be held as a dependent province of his empire. A civil war broke out between the brothers, and, though the details of it are not accurately known, it appears that just about the time when Pizarro was beginning to move inland from the town of San Miguel, Huascar had been defeated and thrown into prison, and Atahuallpa had become Inca. Pizarro set out in September 1532, and made for Cassamarca, where the Inca was. Messengers passed frequently between them, and the Spaniards on their march were hospitably received by the inhabitants. On the 15th November, Pizarro entered Cassamarca, and sent his brother and Fernando de Soto to request an interview with the Inca. On the evening of the next day, Atahuallpa entered the great square of Cassamarca, accompanied by some five or six thousand men, who were either unarmed, or armed only with short clubs and slings concealed under their dresses. Pizarro's artillery and soldiers were planted in readiness in the streets opening off the square. The interview was carried on by the priest Vicente de Valverde, who addressed the Inca through an interpreter. He stated briefly and dogmatically the principal points of the Christian faith and the Roman Catholic policy, and concluded by calling upon Atahuallpa to become a Christian, obey the commands of the Pope, give up the administration of his kingdom, and pay tribute to Charles V., to whom had been granted the conquest of these lands. To this extraordinary harangue, which from its own nature and the faults of the interpreter must have been completely unintelligible, the Inca at first returned a very temperate answer. He pointed out what seemed to him certain difficulties in the Christian religion, and declined to accept as monarch of his dominions this Charles, of whom he knew nothing. He then took a Bible from the priest's hands, and, after looking at it, threw it violently from him, and began a more impassioned speech, in which he exposed the designs of the Spaniards, and upbraided them with the cruelties they had perpetrated. The priest retired, and Pizarro at once gave the signal for attack. The Spaniards rushed out suddenly, and the Peruvians, astonished and defenceless, were cut down in hundreds. Pizarro himself seized the Inca, and in endeavouring to preserve him alive, received, accidentally, on his hand the only wound inflicted that day on a Spaniard. Atahuallpa, thus treacherously captured, offered an enormous sum of money as a ransom, and fulfilled his engagement; but Pizarro still detained him, until the Spaniards should have arrived in sufficient numbers to secure the country. While in captivity, Atahuallpa gave secret orders for the assassination of his brother Huascar, and also endeavoured to raise an army to expel the invaders. His plans were betrayed, and Pizarro at once brought him to trial. He was condemned to death, and, as being an idolater, to death by fire. Atahuallpa, however, professed himself a Christian, received baptism, and his sentence was then altered into death by strangulation. His body was afterwards burned, and the ashes conveyed to Quito. From the reports of the Spanish historians, it is impossible to gain an accurate idea of the character and abilities of the Peruvian monarch, and we have no other notices by which to test their account. (See Prescott's *Conquest of Peru*, and Helps's *Spanish Conquest of America.*)

ATALANTA, in *Greek Legend*, (1) was connected with Arcadia, where, at her birth, she had been exposed on a hill, her father Jasion having expected a son. At first she was suckled by a she-bear, and then saved by huntsmen, among whom she grew up to be skilled with the bow, swift, and fond of the chase, like the virgin goddess Artemis. At the hunt of the Calydonian boar her arrows were the first to hit the monster, for which its head and hide were given her by Meleager. At the funeral games of Pelias, she wrestled with Peleus, and won. Melanion, with intense love, followed, fought, and toiled in her service, she despising love, and remaining true to Artemis long, but yielding at last. She was the mother of Parthenopæus. But there was (2) another Atalanta in Bœotian legends, who was to be obtained in marriage only by him who could outstrip her in a race, the consequence of failure being death. Hippomenes, before starting, had obtained from Aphrodite three golden apples, which at intervals in the race he dropped, and Atalanta, stopping to pick them up, fell behind. Both were happy at the result; but forgetting to thank the goddess for the apples, they were led by her to a religious crime, and for this were transformed into lions (Ovid, *Met.*, x. 560–704). Latterly the adventures of these two separate heroines were united and told as of one.

ATAXY, LOCOMOTOR (*a* priv., τάξις, order—Synonyms, *Progressive locomotor ataxy, Tabes dorsalis, Posterior spinal sclerosis*), a disease of the nervous system, manifesting itself principally by disordered movements of the limbs in locomotion. This disorder is not, as was once supposed, a form of paralysis (there being no diminution of muscular strength), but is dependent on the loss of the power of co-ordinating the muscles into harmonious action, which is essential to the proper performance of the voluntary movements of the body, and the maintenance of its equilibrium. Although the disease had been previously noticed both by Professor Romberg and Dr R. B. Todd, it was first fully described and named by Dr Duchenne in 1858. Its pathology has subsequently been investigated by Mr Lockhart Clarke. Locomotor ataxy usually begins insidiously, and advances slowly. Among the earlier symptoms observed are disorders of vision, with occasionally temporary or permanent paralysis of some of the cranial nerves, a feeling of uneasiness in the back, accompanied with violent shooting pains down the limbs, increased or perverted sensibility in various parts of the body, and disturbance of the genito-urinary functions. These initial symptoms may continue without much change for a long period, but generally in the course of time others are superadded, which give more definite intimation of the existence of the disease, and render its diagnosis a matter of little difficulty. The sufferer begins to be aware that he cannot walk with the same freedom as before, and he feels as if some soft substance were interposed between his feet and the ground. His gait assumes a peculiar and characteristic appearance. He begins the act of walking with evident difficulty, and his steps are short and hurried. Each leg is lifted well from the ground; but as he moves forward it is thrown out from him, and his heel descends forcibly, and is followed at a longer than the normal interval by the sole. In walking he requires the aid of his vision to preserve his equilibrium, and he therefore looks at his feet, or rather at the ground a little in front of them, as he advances. He cannot turn about suddenly without the risk of falling. If asked to stand erect with his feet approximated, and then directed to close his eyes or to look upwards, he immediately begins to sway and totter, and would fall if not supported. These various phenomena are the result, not of any weakness of motor power, but simply of defective muscular co-ordination. Along with this there usually exists markedly diminished tactile and cutaneous sensibility, particularly in the feet and legs. Sometimes the disorder implicates the upper extremities, and then the hands and fingers cease to perform their functions with precision, so that the patient is unable to pick up any small object from the ground, to button or unbutton his clothing, and even sometimes to feed himself, although at the same time there is no weakness in the muscular power of the hand, which is capable of grasping as firmly as before. With the advance of the disease the disorder of movements increases. The patient's efforts to walk become more and more difficult and distressing, for his limbs are jerked about wildly without restraint, while even the aid of his vision and the support of a stick are insufficient to prevent him from falling. Ultimately, all efforts of this kind have to be abandoned, and he is compelled to lie in bed. In the later stages of the disease all the symptoms become aggravated. The shooting pains and violent jerkings of the limbs increase, motor power becomes impaired, and the patient sinks under the prolonged and exhausting course of suffering, or dies from some intercurrent disease. Although usually progressive to a fatal termination, locomotor ataxy is sometimes arrested, and even appears occasionally to be recovered from, particularly in its earlier stages. In most instances its duration extends over a number of years.

The pathological condition giving rise to locomotor ataxy is disease of a certain portion of the spinal cord, viz., the posterior columns and the posterior nerve roots. These undergo various transformations, which result in their ultimately becoming atrophied and indurated. When affecting, as this lesion most commonly does, the lower dorsal and lumbar regions of the cord, the ataxic symptoms are chiefly confined to the legs; but when it affects the cervical portion, the arms are involved. Occasionally the whole posterior columns of the cord are found diseased. The exciting causes of this malady are but ill understood. Exposure to cold and privation, intemperance, over exertion, and mental anxiety have been supposed to give rise to it. In some instances the disease appears to be hereditary. Locomotor ataxy is much more common among men than among women. It is a disease of middle life, being most frequently observed to occur between the ages of 30 and 50. From the nature of the structural changes affecting the spinal cord in locomotor ataxy, it is evident that, beyond the employment of means to alleviate the various painful symptoms, little can be done towards its cure. Numerous medicines have from time to time been brought forward as supposed to possess special efficacy in the treatment of this disease, but none of them have proved to be of much value. The employment of electricity in the form of the continuous current has been recommended by many high authorities. Probably most good will be found to result from careful efforts to maintain the general health by a well-appointed diet and regimen. (J. O. A.)

ATBARA (Bahr-el-Aswad, or Black River), an important river of Eastern Africa. It rises in the mountains of Abyssinia to the N.W. of Lake Tâna, unites its waters with a number of rivers, such as the Settite, the Salaam, the Angarep, and the Tacazze, several of which more than equal it in volume, and continues its northward course till its junction with the Nile at El-Damer. It flows in many parts through a very fertile and beautiful country, tenanted only by the beasts of the field, or sparsely peopled with a few Arab tribes. In the dry season its waters are considerably lessened, but during the rains it has an average depth of 35 or 40 feet, and measures 400 or 500 yards across at its embouchure. See Hassenstein and Petermann's *Karte und Mémoire von Ost-Afrika* (supplement of Petermann's *Mittheil.*, 1861); and Baker's *Journey to Abyssinia* in Jour. Roy. Geog. Soc. 1863.

ATCHAFALAYA (the Lost Water), a river of Louisiana, in North America, or more properly a secondary channel of the Mississippi, by which a portion of its water flows off from the main trunk into the Mexican Gulf. Its mouth is 120 miles W. of the principal embouchure of the Mississippi.

ATE, in *Greek Mythology*, a personification of criminal folly (*Iliad*, xix. 91). She had misled even Zeus to take a hasty oath, when Heracles was born, for which, seeing his folly, he cast her by the hair out of Olympus, whither she did not again return. She fell, it was in later times said, on the hill where Troy was built. Ate, however, remained always a mere allegory, and never assumed the individuality of a goddess, though described (*Iliad*, ix. 502) as a swift-footed being, who leads to crimes which the old and crippled Litæ obtain redrsss for.

ATELLA, an ancient city of Campania, about 9 miles from Naples. In the second Punic war it sided with Hannibal, and, in consequence, its inhabitants were dispersed by the Romans and their place supplied by the people of Nuceria. In the time of Cicero it was a flourishing town, and under Augustus it received a military colony. In the early Christian centuries it was an episcopal see; but in 1030 A.D. its inhabitants were removed to Aversa, the newly founded city of Count Rainulph, and since then it has sunk into ruins. The *Fabulæ Atellanæ* (named after this city) was a species of satirical comedy exhibited at Rome after the subjugation of Campania. The principal characters were Maccus, a fool with ass's ears; Bucco, a loquacious glutton; Pappus, an old simpleton; and Dossenus, a sharper. The comedy was originally in high repute, but was eventually suppressed by order of the senate for indecencies introduced into it.

ATH, or AETH, a city of Belgium, in the province of Hainaut, situated on the river Dender, a navigable confluent of the Schelde, rather more than 30 miles by rail from Brussels. It is well built, and possesses a parish church (St Julian's), dating originally from 1393, and remarkable for the height of its spire; a college, founded in 1416; a town-house, erected about 1600; an orphan asylum, a theatre, &c. The oldest building in the city is the *Tour du Barbant*, which dates from 1150. The population, numbering about 8300, is variously employed in the manufacture of linen, lace, cotton, soap, sugar, salt, beer, gin, dyes, trinkets, &c. Ath was a place of importance in the 13th and 14th centuries, and was afterwards fortified by the Spaniards. It was besieged and captured by Louis XIV. in 1666, restored to the Spaniards in 1679, recaptured by the French under Catinat in 1697, and fortified by Vauban, but again given up by the treaty of Ryswick in the same year. In 1706 it fell into the hands of the allies, but was restored to the empire in 1716. It was captured by the French under Banderon in 1745, and dismantled and restored by Maria Theresa in 1748. Its fortifications were again destroyed in 1781, rebuilt in 1815, and finally demolished in 1830.

ATHABASCA, or ATHAPESCOW, a river in the north-western territory of British North America, which flows into a lake of the same name. It rises in the Rocky Mountains, and has a long and tortuous course in a north-eastern direction, during which it receives the Lesser Slave River, the Red Deer, and several others. The lake is about 230 miles in length, with a breadth varying from 30 to 14 miles, lying in a direction almost E. and W., in lat. 59° N., long. 110° W. It communicates with Hudson's Bay on the one hand, and with the Polar Sea on the other.

ATHALIAH, the daughter of Ahab and wife of Jehoram, king of Judah, who, after the death of King Ahaziah, her son, caused all the male members of the royal house of Judah to be massacred, in order that she might usurp the throne. Among the victims were her own grandchildren, except the youngest, Joash, who was concealed in the temple by his aunt, Jehoshebs, wife of the high priest, Jehoiada. After six years Jehoiada organised a successful revolution in favour of Joash, and caused Athaliah to be put to death by the Levitical guards (2 Kings xi.; 2 Chron. xxii. 10–12, xxiii.) The story of Athaliah forms the subject of one of Racine's best tragedies. It has been musically treated by Handel and Mendelssohn.

ATHANASIUS, St, Bishop of Alexandria, and one of the most illustrious defenders of the Christian faith, was born at Alexandria about the year 297. Of his family, circumstances, or early education nothing can be said to be known, although a legendary story has been preserved by Rufinus of Aquileia as to the manner in which he came, while yet a boy, under the notice of his predecessor, Alexander. It seems certain that Alexander became his patron, took him as a youth into his house, and employed him as his secretary. This was probably about 313, and from this time Athanasius may be said to have been devoted to the Christian ministry. He was, no doubt, a student in the "Didascaleion," or famous "catechetical school" of Alexandria, which included amongst its already illustrious teachers the names of Clement and Origen. In the museum, the ancient seat of the Alexandrian university, he may have learned grammar, logic, and rhetoric. His mind was certainly well disciplined, and accustomed to discuss from an early period the chief questions both in philosophy and religion. The persecution under which the Alexandrian Church suffered at this time, and his intimacy with the great hermit Antony, of which he himself has told us, had all their effect upon his character, and served to nurture in him that undaunted fortitude and high spirit of faith by which he became distinguished.

Before the outbreak of the Arian controversy, which began in 319, Athanasius had made himself known as the author of two essays addressed to a convert from heathenism, one of them entitled *Against the Gentiles,* and the other *On the Incarnation of the Word.* Both are of the nature of apologetical treatises, arguing such questions as monotheism, and the necessity of divine interposition for the salvation of the world , and already in the second may be traced that tone of thought respecting the essential divinity of Christ as the "God-man" for which he afterwards became conspicuous. The origin of the Arian controversy has been already described under the heading Arius. There is no distinct evidence of the connection of Athanasius with the first contentions of Arius and his bishop, which ended in the exile of the former, and his entrance into Palestine under the protection of Eusebius the historian, who was bishop of Cæsarea, and subsequently of his namesake the bishop of Nicomedia. It can hardly be doubted, however, that Athanasius would be a cordial assistant of his friend and patron Alexander, and that the latter was strengthened in his theological position by the young enthusiastic student who had already expounded the nature of the divine Incarnation, and who seems about this time to have become archdeacon of Alexandria. At the Council of Nicæa, in the year 325, he appears prominently in connection with the dispute. He attended the council, not as one of its members (who were properly only bishops or delegates of bishops), but merely as the attendant of Alexander. In this capacity, however, he was apparently allowed to take part in its discussions, for Theodoret (i. 26) states that "he contended earnestly for the apostolic doctrines, and was applauded by their champions, while he earned the hostility of their opponents. Within 'five months' after the return of Alexander to the scene of his episcopal labours he expired, and his friend and archdeacon was chosen to succeed him. He was elected 'in the sight and amidst the acclamations of the people.' He was now about 30 years of age, and is spoken of as remarkable both for his physical and mental characteristics. He was small in stature, but his face was radiant with intelligence, as 'the face of an angel.' This is the expression of Gregory of Nazianzus (*Orat.*, xxii. 9), who has written an elaborate panegyric upon his friend, describing him as fit 'to keep on a level with common-place views, yet also to soar high above the more aspiring,' as accessible to all, slow to anger, quick in sympathy, pleasant in conversation, and still more pleasant in temper, effective alike in discourse and in action, assiduous in devotions, helpful to Christians of every class and age, a theologian with the speculative, a comforter of the afflicted, a staff to the aged, a guide of the young."

The first few years of the episcopate of Athanasius were tranquil , but the storms in which the remainder of his life was passed soon began to gather around him. The Council of Nicæa had settled the creed of Christendom, but had by no means composed the divisions in the church which the Arian controversy had provoked. Arius himself still lived, and his friend Eusebius of Nicomedia rapidly regained influence over the Emperor Constantine. The result of this was a demand made by the emperor that Arius should be re-admitted to communion. Athanasius stood firm, and refused to have any communion with the advocates of a "heresy that was fighting against Christ." Constantine was baffled for the moment ; but many accusers soon rose up against one who was known to be under the frown of imperial displeasure. The archbishop of Alexandria was charged with cruelty, even with sorcery and murder. It was reported that a Meletian bishop in the Thebaid, of the name of Arsenius, had been unlawfully put to death by him. He was easily able to clear himself of such charges, but the hatred of his enemies was not relaxed, and in the summer of 335 he was peremptorily ordered to appear at Tyre, where a council had been summoned to sit in judgment upon his conduct. He did not venture to disobey the imperial order, and a commission was appointed to inquire into an alleged instance of cruelty urged against him, notwithstanding the explanations which he had made. There appeared plainly a predetermination to condemn him, and he fled from Tyre to Constantinople to appeal to the emperor himself. "He resolved," says Gibbon, "to make a bold and dangerous experiment, whether the throne was inaccessible to the voice of truth." He presented himself suddenly with five of his suffragans before the emperor, while riding into his new capital. Refused at first a hearing, his perseverance was at length rewarded by the emperor's consent to his reasonable request—that his accusers should be brought face to face with him in the imperial presence. The leaders of the Tyrian council, amongst the most conspicuous of whom were the two Eusebii, were accordingly summoned to Constantinople, just after they had celebrated, at a great dedication festival at Jerusalem, the condemnation of Athanasius and the restoration of Arius to church communion. In confronting the former before Constantine they did not attempt to repeat the charge of cruelty, but found a more ready and effective weapon to their hands in a new charge of a political kind—that Athanasius had threatened to stop the Alexandrian corn-ships bound for Constantinople. Here, as in other matters, it is very difficult to understand how far there was any truth in the persistent accusations made against the prince-bishop of Alexandria. Probably there was in the very greatness of his character and the extent of his popular influence a certain species of dominance which lent a colour of truth to some of the things said against him. On the present occasion his accusers succeeded in at once arousing the imperial jealousy ; and the consequence was, that, notwithstanding his earnest denial of the act attributed to him, he was banished to Trier, or Treves, the capital of Gaul.

This was the first banishment of Athanasius, which lasted about two years and a half. It was only brought to a close by the death of Constantine, and the accession of Constantine II. as emperor of the West. It is recorded by himself (*Apol.* 7) that, on his return to Alexandria, "the people ran in crowds to see his face, the churches were full of rejoicing; thanksgivings were offered up everywhere; the ministers and clergy thought the day the happiest in their lives." But this period of happiness was destined to be short-lived. His position as patriarch of Alexandria placed him, not under his friend Constantine II., but under Constantius, another son of the elder Constantine, who had succeeded to the throne of the East. He in his turn fell, as his father had done, more and more under the influence of the Nicomedian Eusebius, now transferred to the see of Constantinople. A second expulsion of Athanasius was accordingly resolved upon. The old charges against him were revived, with the addition of his having set at naught the decision of a council. It was further resolved on this occasion to put another bishop in his place. Accordingly, in the beginning of the year 340, a Cappadocian named Gregory, said to be an Arian, was installed by military force on the throne of the great defender of the faith, who, to save his followers from outrage, withdrew to a place of concealment. As soon as it was possible he repaired to Rome, to "lay his case before the church." He was declared innocent at a council held there in 342, and in another held at Sardica some years later. Julius, the bishop of Rome, warmly espoused his cause, and, generally, it may be said that the Western Church was Athanasian in its sympathies and its creed, while the majority of the Eastern bishops sided with the Eusebian party. This severance was clearly shown at the Council of Sardica, where the Orientals refused to meet with the representation of the Western Church, because the latter insisted on recognising the right of Athanasius and his friends to attend the council as regular bishops. The commonly received date of this council is 347, but the rediscovered *Festal Letters* of Athanasius have had the effect of throwing back this date for some years. It has been placed by some as early as the end of 343, by Mansi and others in the end of 344. The decision of the Council of Sardica, however, had no immediate effect in favour of Athanasius. Constantius continued for some time implacable, and the bold action of the Western bishops only incited the Arian party in Alexandria to fresh severities. Gradually, however, the excesses of the Arian party brought their own revenge, while the death of the intruded bishop Gregory, in the beginning of 345, opened up the way for a reconciliation betwixt the Eastern emperor and the banished prelate. The result was the restoration of Athanasius for the second time, amidst the enthusiastic demonstrations of the Alexandrian populace, which is represented by his panegyrist, Gregory Nazianzen, as streaming forth "like another Nile" to meet him in the distance as he approached the city. His restoration is supposed to have taken place, according to the more accurate chronology based upon the *Festal Letters*, in October 346.

For ten years at this time Athanasius held his ground in Alexandria. But the intrigues of the Arian or court party were soon renewed against him, and the feeble emperor, who had protested that he would never again listen to their accusations, was gradually stimulated to new hostilities. A large council was held at Milan in the spring of the year 355, and here, notwithstanding the vigorous opposition of a few faithful men amongst the Western bishops, a renewed condemnation of Athanasius was procured. This was followed up by the banishment of the faithful prelates, even of Hosius of Cordova, whose conciliatory character and intimate connection with the imperial family had not prevented him from addressing to Constantius a pathetic remonstrance against the tyranny of the Arian party. When his friends were thus scattered in exile, their great leader could not long escape, and on the night of the 8th of February 356, while he was engaged in service in the church of St Thomas, a band of armed men burst into the sacred building. He has himself described the scene (*Apol. de fuga*, 24). Here for a time he maintained his composure, and desired the deacon to read the psalm, and the people to respond—"*For His mercy endureth for ever*," and how, as the soldiers rushed forward with fierce shouts towards the altar, he at length made his escape in the crowd, and sought once more a place of safe retirement. The solitudes of Upper Egypt, where numerous monasteries and hermitages had been planted, appear to have been his chief shelter at this time. Here, protected from pursuit, he spent his time in literary labours in behalf of his cause, and to this period, accordingly, belong some of his most important writings, above all the great *Orations, or Discourses against the Arians*, which furnish the best exposition of his theological position and principles.

For six years at this time Athanasius continued in exile, till the death of Constantius in November 361 opened once more the way for his return to his episcopate. Julian, the successor to the imperial throne, professed indifference to the contentions of the church, and granted permission to the bishops exiled in the late reign to return home. Amongst others, Athanasius took advantage of this permission, and seated himself once more upon his throne, amidst the jubilations of the people. He had begun his episcopal labours with renewed ardour, and summoned a council to Alexandria to decide various important questions, when an imperial mandate yet again drove him from his place of power. The faithful gathered around him weeping. "Be of good heart," he said, "it is but a cloud: it will soon pass." His forecast proved true, for within a few months Julian had closed his brief career of Pagan revival, and Athanasius "returned by night to Alexandria." He received a letter from the new emperor, Jovian, praising his Christian fidelity, and encouraging him to resume his work. With the emperor he continued to maintain friendly relations, and even drew out for him a synodal letter embodying the Nicene Creed, which was graciously received. During the brief reign of this bluff soldier-prince, comparative quiet prevailed in the church. But the repose was of short duration. In the spring of 365, after the accession of Valens, troubles reappeared. An order was issued for the expulsion of all bishops who had been expelled by Constantius, and Athanasius was once more forced to take refuge in concealment from his persecutors. His concealment, however, only lasted for four months, when an order came for his return; and from this time (Feb. 366) he was left undisturbed to pursue his episcopal labours. Those labours were unceasing in refuting heretics, in building churches, in rebuking rapacious governors, in comforting faithful bishops, and in strengthening the orthodox everywhere, till at length, in the spring of 373, "in a good old age," he ceased from all his work. Having consecrated one of his presbyters his successor, he died quietly in his own house. His "many struggles," according to his panegyrists, won him "many a crown." He was gathered to his fathers, patriarchs, prophets, apostles, and martyrs, who had contended for the truth. Even those who fail to sympathise with the cause which Athanasius steadfastly maintained, cannot refuse their tribute of admiration to his magnanimous and heroic character. The cynic eloquence of Gibbon grows warm in recounting his adventurous career, and the language of Hooker breaks into stately fervour in celebrating his faith and fortitude. "The whole world against Athanasius, and Athanasius against it, half a hundred of years spent in doubtful trial which of the two in the end should prevail—the side which had all, or else the part which had no friends but God and death—the one a defender of his innocency, the other a finisher of all his troubles." If imperious in temper and inflexible in dogmatic determination, Athanasius had yet a great heart and intellect, enthusiastic in their devotion to Christ, and in work for the good of the church and of mankind.

His chief distinction as a theologian was his zealous advocacy of the essential divinity of Christ as co-equal in substance with the Father. This was the doctrine of the Homoöusion, proclaimed by the Nicene Creed, and elaborately defended by his life and writings. Whether or not Athanasius first suggested the use of this expression, he was its greatest defender; and the catholic doctrine of the Trinity has ever since been more identified with his "immortal" name than with any other in the history of the church and of Christian theology. (For an exposition of the Athanasian Creed, see the article CREEDS.) (J. T.)

ATHELSTAN, or ÆTHELSTAN, son of King Edward the elder, and grandson of Alfred the Great, was born in 895. There has been much doubt with regard to his legitimacy, as his mother, Ecgwyn, is said to have been of humble origin; but these suspicions appear to rest on slight foundations. On the death of Edward in 925, Athelstan, who had been named by him as his successor, was elected king by the Mercians and West Saxons, and crowned at Kingston in Surrey. Considerable opposition was made to his election, and several of the leading nobles entered into a conspiracy to put out his eyes and deprive him of the kingdom. Alfred the Atheling, who himself aimed at the royal power, was suspected of being concerned in this plot, and was obliged to proceed to Rome and there take an oath of innocence. While in the act of swearing at the altar, he is said to have dropped down in a fit, and to have died three days afterwards. In 925 Athelstan gave one of his sisters in marriage to Sihtric, the Danish ruler of Northumbria, on whose death, in the following year, he invaded the Danish dominions, drove out Sihtric's son, Guthfrith, and took possession of his territory. Guthfrith, after an unsuccessful attempt to stir up Constantine, king of Scotland, to whom he had fled and after a fruitless invasion of England, made submission to Athelstan, and was kindly treated by him. During the next few years, the Welsh, both of Wales and of Cornwall, appear to have been subdued, and to have done homage to the king of England, who levied tribute on them, and fixed the Wye and the Tamar as the boundaries of Wales and Cornwall respectively. He was thus virtually king of all England. In 933 or 934 he also invaded Scotland, ravaged all the south country, and compelled Constantine to pay a yearly tribute. Four years later, in 937, a powerful combination was made against him. Anlaf, a Danish chief, or, according to some accounts, a son of Sihtric, with the king of Scotland, the Welsh, and the Danes of the north, invaded England. Athelstan, with his half brother Edmund, met and signally defeated the invaders in the battle of Brunanburh, celebrated in the "Brunanburh War-Song." In 940 or 941 Athelstan died at Gloucester, and was buried at Malmesbury. England had prospered under his reign; for he devoted much attention to commerce, and exercised a fostering care over the civil and religious interests of his people. His power made him respected and esteemed on the Continent, and several foreign princes and nobles were sent to be educated at his court.

ATHENA (Ἀθηνᾶ, Ἀθήνη, Ἀθηναία), in *Greek Mythology*, a goddess who, from being originally a personification of the clear, bright upper region of the sky, had, as early as the time of the epic poets, changed, or advanced, so as to embody under a divine form a conception of the clear insight of the human mind in its various functions. This upper air or ether seemed to be a distinct element in the universe. From it came the light of morning before sunrise and of evening after sunset, reminding us of the light which, in the Mosaic account of the Creation, existed before the sun and moon were placed in the sky. In the first stage of her character, in which, like the other deities of Olympus, she was directly identified with an element of nature and supposed to act as it acted, Athena bore the name of Pallas, and was thought of more in connection with the storms than with the serenity or light of the heavens. The obvious counterpart of a storm was a raging battle, and, accordingly, she became a goddess of war, armed with spear and helmet, and with the *ægis*, or storm-shield, of her father, resistless among men, hurling to the ground the giant Enceladus, and even superior in might to Ares himself, the god of war. The storm sweeps sorest round high citadels, where also the storms of war rage fiercest; and on such places was her favourite abode. But a storm is followed by serenity brighter than before, more enjoyable, and more exciting to activity of every kind; and then the goddess lays aside her armour to encourage and foster skill and industry. Her title is then Ergane. To her was ascribed the invention of spinning and weaving; of taming horses, bridling and yoking them to the war-chariot; of the flute, and in some way of the healing art. This is the second stage of her character, which the myth, agreeably to its principle, explains in a different fashion, when it says that she sprang into existence from the brain of the all-wise ruler of the world, Zeus, and that he had before swallowed his wife, Metis (intelligence). She must therefore have been in a measure a complement of him, created for the purpose of carrying out among men what was in his mind, but what yet he could not himself, as the supreme and impartial ruler, execute. As his substitute, she lent her aid to Heracles in all his hardships and adventures; to Theseus under similar circumstances; to the Greeks in their war against Troy; to Perseus in slaying the Gorgon Medusa, whose head she afterwards bore upon her *ægis*, from which she obtained the name of Gorgophone; and to the Argonauts on their expedition to Colchis. She maintained always her character of a virgin, and, to express this, bore, at Athens in particular, the name of Parthenos. Her birth took place in Olympus, in presence of the other deities, Hephæstus aiding it, as it is coarsely said, by splitting open with his hatchet the skull of Zeus, a subject often represented on the ancient painted vases. This was also the subject of the sculptures in the front pediment of her greatest temple, the Parthenon at Athens. From the fact that in the other pediment the sculptures represented her contest with Poseidon for divine supremacy over Attica, it might perhaps seem that the first act of her existence was to claim this sovereignty. Foremost in her character always is her protection of high citadels, like that of Athens. Yet it was not for this, but for her causing an olive to grow on the bare rock of the Acropolis, that she was chosen rather than Poseidon, whose claim was that he had raised on the same rock a spring of brackish water. The olives of Attica were a source of great wealth, and the light supplied by their oil may have seemed not unlike the light of the ether. As the defender of citadels her title was Polias.

There is, however, a different account of her origin hinging on her name of Tritogenea or Tritonis, and describing her as a daughter of Poseidon and the Triton lake in Libya. But this is obviously a late invention, founded, apparently, on traditions handed down in Libya from the early Minyæ colonists, in whose original seat at Orchomenos and Alalcomenæ in Bœotia was a very early form of the worship of Pallas as a goddess in some way connected with lakes and streams. In this district, in Arcadia, and in Crete also, were found rivers bearing the name of Triton, and associated in very early traditions with the birth of Athena.

At one time, therefore, her relation to or control of the watery element must have formed a considerable part of her worship. To this also is traced her ancient name of Ὄγγα or Ὄγκα at Thebes. How she came by the name of Glaucopis, *i.e.*, "owl-eyed," by which she is so frequently addressed in the *Iliad*, is not satisfactorily explained, least of all by the recent theory, which, interpreting it as "owl-headed," maintains that the goddess had originally the head of an owl, and appeals to certain rude clay vases and figures found on the supposed site of Troy, with faces intended to be human, but yet not much unlike the face of an owl. As the goddess of victory she was called Nike, and it was to her in this capacity that the edifice known as the Temple of the Wingless Victory was erected on the Acropolis of Athens. Hippia was her title as the tamer of horses. Erichthonius, at Athens, was the first mortal whom she taught to yoke horses. For Bellerophon, on the Acropolis of Corinth, she bridled the winged horse Pegasus. Besides Corinth, the chief seats of her worship outside of Attica were Argos, Sicyon, Trœzen (in Arcadia, where, with the title of Alea, warm, fostering, she had a celebrated temple), Laconia, Elis, and in Asia Minor, at Ilium, where it survived after her image, the Palladion, which had fallen from heaven, had been removed to Athens or Argos, both of which claimed to have received it. At Athens an ancient image of her existed in the Erechtheum, and was regarded with peculiar sanctity, even in the times when men were familiar with the splendid statue of her by Phidias in the Parthenon. Except at Athens, little is known of the ceremonies or festivals which attended her worship There we have—(1.) The ceremony of the *Three Sacred Ploughs*, by which the signal for seed-time was given, and, apparently, dating from a period when agriculture was one of the chief occupations of her worshippers; (2.) The *Procharisteria*, at the end of winter, at which all the magistrates offered sacrifice; (3) The *Skirophoria*, with a procession from the Acropolis to the village of Skiron, in the height of summer, the priests who were to offer sacrifice to Athene walking under the shade of parasols held over them, (4.) The *Oschophoria*, at the vintage season, with races among boys, and a procession, with songs in praise of Dionysus and Ariadne, (5) The *Chalkeia*, with rites referring to her as a goddess presiding jointly with Hephæstus over industrial arts, (6.) The *Plynteria* and *Callynteria*, at which the ancient image in the Erechtheum was cleaned, with a procession in which bunches of figs were carried, (7) The *Arrhephoria*, at which four girls, between seven and eleven years of age, selected from noble families, brought during the night certain sacred objects from the temple of Aphrodite by an underground passage to the Acropolis, (8.) The *Panathenæa*, at which the new robes for the image of the goddess were, before being placed on it, carried through the city, spread like a sail on a mast. The last festival was attended by athletic games, open to all who traced their nationality to Athens As to artistic representations of Athena, we have first the rude figure which seems to be a copy of the Palladion, secondly, the still rude, but otherwise more interesting, figures of her, as, *e.g.*, when accompanying heroes, on the early painted vases; and thirdly, the type of her as produced by Phidias, from which little variation appears to have been made. (A. S. M.)

ATHENÆUM, a name originally applied to buildings dedicated to Athena (Minerva), was specially used as the designation of a temple in Athens, where poets and men of learning were accustomed to meet and read their productions. The academy for the promotion of learning which the Emperor Hadrian built at Rome, near the Forum, was also called the Athenæum. Poets and orators still met and discussed there, but regular courses of instruction were given by a staff of professors in rhetoric, jurisprudence, grammar, and philosophy This species of university continued in high repute till the 5th century. The same name was afterwards applied to similar institutions in Lyons and Marseilles; and it has become a very general designation for literary clubs or academies. It has also been used as the title of literary periodicals, particularly of the journal of art criticism edited by the brothers Schlegel, and the two well-known modern papers published in London and Paris.

ATHENÆUS, a Greek rhetorician and grammarian, or man of letters, was a native of Naucratis, a town in Egypt, near the mouth of the Nile. Exceedingly little is known of his life, but from one or two references to known events which occur in his works it may be gathered that he flourished about the end of the 2d and the beginning of the 3d century A.D. Besides a history of the Syrian kings, and a small tract on the identification of the *thratta*, a peculiar kind of fish, mentioned by the comic poet Archippus, both of which are lost, he wrote the extensive work, in fifteen books, called the *Deipnosophistæ*, *i.e.*, the Feast of the Learned, or, as it may be translated, the Skilled in Feasting. The first two books, and parts of the third, eleventh, and fifteenth, are only extant in epitome, but otherwise we seem to possess the work entire. It is an immense store-house of miscellaneous information, largely but not exclusively on matters connected with the table, and full of quotations from writers whose works have not come down to us. It has been calculated that nearly 800 writers and 2500 separate writings are referred to by Athenæus, and he boasts of having read 800 plays of the Middle Comedy alone. Of many writers we have no remains, save the excerpts given by him, and a glance at any collection of Greek fragments will show how large is the proportion drawn solely from this source. The plan of the *Deipnosophistæ* is exceedingly cumbrous, and is badly carried out. It professes to be an account given by the author to his friend Timocrates of a banquet held at the house of Laurentius, a wealthy patron of art. It is thus a dialogue within a dialogue, after the manner of Plato, but a conversation of sufficient length to occupy several days (though represented as taking place in one) could not be conveyed in a style similar to the short conversations of Socrates. Among the twenty-nine guests whose remarks Athenæus reports are Galen and Ulpian, a lawyer, supposed to be the famous jurist. Their conversation ranges from the dishes before them to literary matters of every description, including points of grammar and criticism, and the guests are expected to bring with them extracts from the poets, which are read aloud and discussed at table. The whole is but a clumsy apparatus for displaying the varied and extensive reading of the author. As a work of art it can take but a low rank, but as a repertory of fragments and morsels of information it is invaluable. The text, particularly in the quotations from the minor comic poets, is still in a very corrupt state.

Editions —Casaubon's, 1597, Schweighauser's, 14 vols., with translation and copious commentary, 1801–1807, the best recent editions are Dindorf's, 3 vols., 1827, and Meineke's, 4 vols., 1858–66.

ATHENAGORAS, a Christian apologist, was a native of Athens, and lived during the 2d century A.D. The only sources of information regarding him are a short notice by Philip of Sida, and the inscription on his principal work. Philip says that he was at the head of an Alexandrian school (the catechetical), that he lived in the time of Hadrian and Antoninus, to whom he addressed his *Apology*, and that Clement of Alexandria was his pupil, while Pantænus was the pupil of Clement. This statement is thoroughly inaccurate and worthless. The inscription on the work describes it as the "Embassy of Athenagoras, the Athenian, a philosopher and a Christian, concerning the Christians, to the Emperors Marcus Aurelius Antoninus and Lucius Aurelius Commodus, &c." This statement has given rise to considerable discussion, but from it and internal evidence the date of the *Apology* may be fixed at about 176 or 177 A.D. Athenagoras is also the author of a discourse on the resurrection of the dead, which is not authenticated otherwise than by the titles on the various manuscripts. In the *Apology*, he refutes the accusations brought against the Christians of atheism, eating human flesh, and licentiousness, and in doing so takes occasion to make a vigorous and skilful attack on Pagan polytheism and mythology. The discourse on the resurrection answers objections to the doctrine, and attempts to prove its truth from considerations of God's purpose in the creation of man, His justice, and the nature of man himself Athenagoras is a powerful and clear writer, but his theology is strongly tinged with Platonism. His discussion of the Trinity has some points of speculative interest, but it is not sufficiently worked out; he regards the Son as the Reason or Wisdom of the Father, and the Spirit as a divine effluence. On some other points, as the nature of matter, the immortality of the soul, and the principle of sin, his views are interesting. There are many editions of Athenagoras; the best are those of the Benedictine Maranus, and of Otto, Jena, 1857. The works have been translated into English by Humphreys, London, 1714, and by the Rev. B. P. Pratten, Edinburgh, 1867 (*Ante-Nicene Christian Library*). In 1599 and 1612 appeared in French a work on *True and Perfect Love*, purporting to be a translation from the Greek of Athenagoras; it is a palpable forgery.

ATHENODORUS, surnamed CANANITES or SANDONUS, a Stoic philosopher, was born at Tarsus. He probably gave instruction to Augustus when he was at Apollonia; and on proceeding to the Roman courts, he was made tutor to Tiberius. The emperor esteemed him greatly for his proved virtue and probity. He was in the habit of giving his opinion very freely, and warned Augustus, whenever he found himself giving way to anger, to rehearse the twenty-four letters of the alphabet before saying or doing anything. Retiring late in life to his native town, he died there at the age of 82. None of his works have survived. Another Stoic of this name, surnamed CORDYLION, also of Tarsus, was keeper of the library at Pergamus, and died at Rome in the house of Cato the Younger. There were likewise two sculptors named Athenodorus, one of whom assisted Agesander in the group of the Laocoon.

ATHENRY, a decayed town of Ireland, county of Galway, and province of Connaught, 14 miles E. of Galway. It is a place of antiquity, and traces of its walls and castle, and of an old Dominican monastery, are still visible. It gave the title of baron to the family of De Bermingham, and from the time of Richard II. till the Union it returned two members to parliament. Population of the parish in 1871, 3639.

END OF VOLUME SECOND